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Vol. 187 No. 4154

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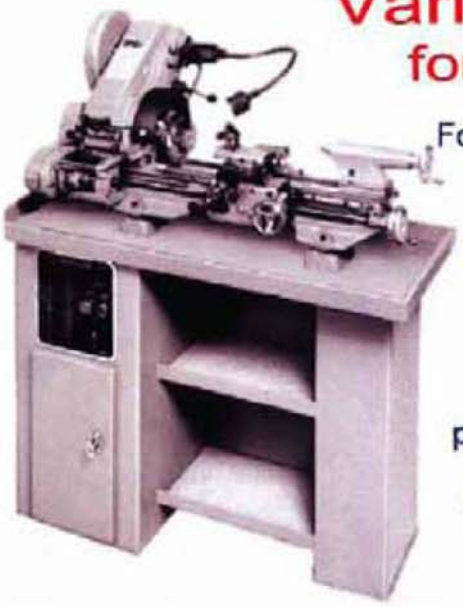

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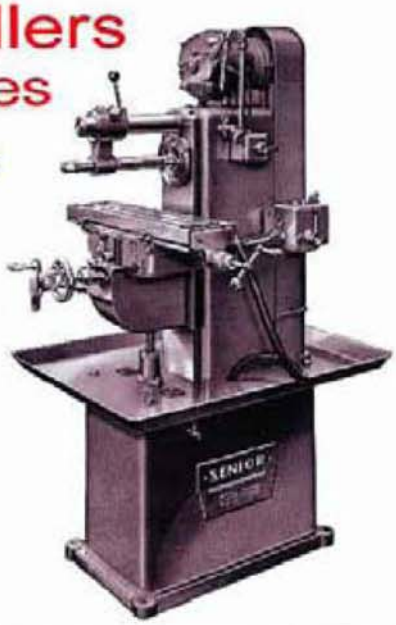

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Published by
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Tel: 01322 660070; Fax: 01322 616319
www.nexusonline.com
Nexus Special Interest
is a wholly owned subsidiary of
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Printed by
Polestar Colchester Ltd.
Origination by
Atelier Data Set, St Austell, Cornwall

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Rates for 26 issues (annual), 13 issues (six months):
UK: £52.00 (annual) £26.00 (six months);
Europe: £66.50 (annual), £33.25 (six months);
Sterling Overseas: £72.50 (annual), £36.25 (six months);
US dollars Overseas: $94 (annual), $47 (six months).
Cheques payable to Nexus Special Interests Ltd.
Airmail rates on request. Second class postage paid at Rahway NJ USA. Postmaster, Send address corrections to Model Engineer c/o Mercury Airfreight International Inc, 2323 Randolph Avenue, Avenue 1, NJ 07001. Usps 0011099.
US Subscription Agent: Wise Owl Worldwide Services, 1926 S. Pacific Coast Highway, Suite 204, Redondo Beach, CA90277-6145, USA.
Phone: 310 944-5033; Fax 310 944-9963.
Visa/MC/Discover accepted.
Model Engineer is published fortnightly.

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ISSN 0026-7325

IN THIS ISSUE

● 7 September 2001 Vol. 187 No. 4154 ●

On the cover ...

A 2in. scale Harvest Diorama by Brian Wardman of York DSME was awarded Best in Show at Harrogate 2001. Featuring a Ransomes Thrasher and Baler, the diorama was powered by the working model 1938 Type M Marshall Diesel Tractor shown on the cover and photographed in action at this year's Pickering Steam Rally. By traversing the rally field at a brisk walking pace, the model demonstrated that it not only looks the part but is also a good runner!

(Photograph by Barry Jordan)

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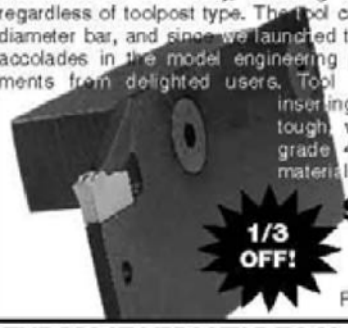

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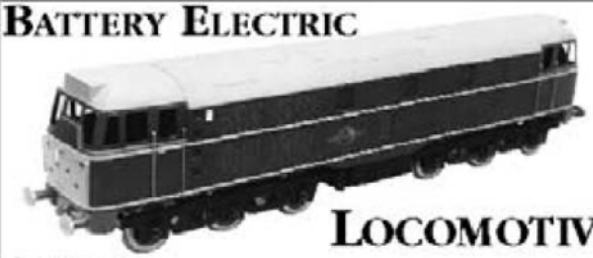

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SMOKE RINGS
With the Editor

For the benefit of others

As an antidote to the dreadful events of Tuesday 11 September 2000, it is good to be able to cheer ourselves up with a reminder of all the positive and caring activities in which model engineers are involved. Readers of Stan Bray's *Club Chat* columns will be well aware that many clubs and societies run for charity, either by entertaining visitors with special needs or by organising events from which the income is donated to local, national or international charities.

Many clubs also make their track sites available for birthday parties and other such celebrations. It so happens that I was able to join with other members of North London SME a few days ago to help with a gathering from Mencap. It has been a joy to note that with the passing years, this regular event seems to have become more and more popular. The consensus among club members was that this was the best yet with more visitors than ever before, matched by an excellent turnout of members with locomotives, traction engines and music. Our visitors were accompanied by their families and everyone seemed to enjoy riding on the railway and being trundled about the well-kept grassy site in trailers drawn by miniature traction engines. Smiles were very much in evidence throughout the event and everyone went home happy following a splendid afternoon.

Entertaining MENCAP at North London. Brian Apthorpe at the regulator of his much modified* Maid of Kent *chats with Controller Peter Davies (right) and Ian Murray whose flying fingers coaxed popular melodies from his accordion which suited the afternoon's activities perfectly. Standing up for my photograph is Jack, a young visitor who said he'd had a brilliant time! Behind Jack are Jamie and Matthew with dad John while NLSME member Bill Mason ridies as guard at the rear of the train.

Model engineering courses

We have received information about six more centres at which courses for model engineers are currently running, as follows:

Model Engineering at St Helens College, Technology Centre, Waterside, Pocket Nook Street, St Helens, Merseyside WA9 1TT. Contact Dave Pye or Bob Langton, tel: 01744-623580 or 01744-623542. Courses run on Wednesday and Thursday evenings 6-8.30pm and Saturdays 9.30am-12.30pm. The courses will run for 36 weeks and commenced on 12 September 2001.

Model engineering students at St Helens College enjoy the benefits of a well-equipped machine shop which includes a spark-erosion unit and a versatile Sykes gear-cutting machine. Access to welding and sheet metal facilities during the evening sessions is an added bonus. Visitors are welcome but should please first report to Reception.

Model Engineering at Doncaster College, Waterdale Site. Contact John Moore, tel: 01302-553553. The classes, for which there is no charge, are held on Monday, Wednesday and Thursday evenings 6-9pm and started on 17 September 2001. It is possible to attend any or all of the evenings.

The college is fortunate in having an excellent workshop with lathes, milling machines, grinding machines and welding equipment, etc. Excellent advice is available from the course leader and others on the course, some of whom once worked at the Plant in the town. Tea making facilities are also available and the evenings provide an excellent night out. Photographs of the workshop can be found on **malcolmhigh.com**

Model Engineering at Dudley College, Broadway, Dudley. Call 01384-455433 or contact Alan Jones tel: 01902-893557. The course runs on Wednesday evenings 6.30-9pm.

Model Engineering (Code GE40B) at Coleg Menai, Bangor, North Wales. Call 01248-370125. The course runs on Wednesday evenings for 10 weeks and started on 29 September 2001.

Model Engineering at Isle College, Ramnoth Road, Wisbech, Cambridgeshire PE13 0HY. Contact Chris Rabicano tel: 01945-582561 Ext. 250; email: **chris.rabianco@aisle.co.uk** The course runs on Fridays 10am-12midday for 10 weeks and commenced on 28 September 2001.

Model Engineering at Leicester College, Abbey Park Campus, Leicester. Contact Mick Rodgers tel: 0116-224-4100. The classes run for three 10 week sessions on Mondays 9.30am-12.30pm beginning on 5 October 2001. The Course Tutor is Norman Smedley, Technical Editor of *Engineering in Miniature* magazine. Evening classes would also be available if there is sufficient demand.

If you are responsible for a similar course or have the necessary information and care to let us know about it, we will be happy to bring it to readers' attention in this column. There is no charge for this service; we are pleased to have the opportunity to support and promote those prepared to give of their time for the benefit of fellow enthusiasts.

SM&EE trip to Sinsheim

Following last year's successful tour, the Society of Model & Experimental Engineers is once again arranging a coach trip to this major exhibition in Germany where more than 6000 metres of 5 and 7¼in. track are to be found together with smaller gauges, a boat pool, road vehicles, stationary engines and the usual supporting trade stands and demonstrations in five halls with a total of 30,000m² of exhibition space. While some will doubtless prefer to remain at the exhibition, during the weekend it is also planned to offer participants preferring a more varied itinerary, a daylight sightseeing tour along the splendid Rhine Valley from Mainz to Koblenz and to visit the famous Automobile (Schlumpf) Collection with over 120 Bugatti cars, or the Railway Museum at Mulhouse, and to visit the sister Technik Museum at Speyer.

Travel will be by executive coach with toilet and drinks facilities. Passengers will be collected from various pick-up points (to be arranged) on Thursday 10 January 2002, and taken to Dover for the lunchtime crossing to Calais. Pick up points *en route* and from other locations in the UK can be arranged to suit numbers. Passengers who prefer to do so can meet the tour in Brussels where arrangements can be made to travel by Eurostar. The first night will be spent in Köln, arriving at Sinsheim early on Friday morning. The next two nights will be spent in or near Heidelberg. Most of Friday, Saturday and Sunday until late afternoon may be spent at the exhibition in Sinsheim or participating in any or all of the excursions. The journey home will begin on Sunday afternoon with an overnight stop in Köln, arriving in the UK late on Monday evening, 14 January 2002.

The cost of the tour is £295 per person (sharing a twin room) including bed and breakfast in hotels, evening meals, excursions and entrance fees. This price is subject to confirmation on full itinerary. A booking deposit of £90 per person will be required.

Details of the full itinerary and a tour booking form can be obtained from Glajd UK, PO Box 1829, Shrewton, Salisbury, Wiltshire SP3 4PN; tel: 01980-621900, fax: 01980-621418, email **linda.hardiman@glajd.co.uk**

POST BAG

Making springs

SIRS, - Although I have always admired Keith Wilson's work on 7¼in. gauge locomotives and rolling stock, and I have often wondered at his knowledge of Swindon practice, but when it comes to springing, whether locomotive tenders or goods rolling stock, I am afraid he has run badly off the rails.

In *M.E.* 4150, 13 July 2001, Keith shows the main spring leaves for his Toad brake van. Even bearing in mind the great weight which might be imposed on the vehicle, the No. 10 hole is far too large, and in any case it must be an oval slot otherwise when the weight is applied it would jam. A suitable slot would be about 0.25 x 0.130 inch.

Furthermore, it will be found very difficult for the average model engineer to make a hole in such thick spring steel. I know because I have tried many times. Even the central hole cannot easily be made. If you don't mind spoiling a few HSS drills it is just possible to drill it. No, the way to produce that central hole is to make a simple but very strong press tool. Make a slot a very good fit for the spring-steel and make a proper hardened and tempered silver-steel punch. The job is then very quick and easy. (Yes, I have such a press tool.)

I do not think that annealed flat spring-steel can be obtained in 'our' quantities, though it is probably easy enough if you can order a hundredweight! I have written to more than one company who can supply only in large quantities and who then referred me to the smaller firms such as the well-known Reeves who now, I am glad to say, are back in business once more. I have always found their spring-steel of excellent quality.

Keith suggests that this spring-steel can be obtained in either annealed or tempered state. I don't think so. In any case if it was annealed it would no longer be springy! No. Leave it as it comes, then all that has to be done is to partly soften the ends to obtain the slots mentioned earlier; an easy job as one has a long length to hold it by.

Incidentally, if any 7¼in. gauge builder does not fancy working on such hefty spring-steel, there is no objection to using two leaves of half the thickness. Keith says *"... bend the leaves to the desired radius."* You can't. The still hard spring-steel will simply return to its original shape. How do I know? I know because I have tried! If you must have the leaves radiused you will have to first soften the steel and then use bending-rolls, but is it really necessary? Keith's rather flat shape is so flat that it is really quite unnecessary. Just leave the leaves to take up their natural position as the weight of the Toad or whatever, is applied.

Keith recommends Titanium nitride drills which he says will make the job easy. They may if you can both obtain them and afford to pay for them. I would not advise the use of carbide drills, I have several of these but they are only suitable for drilling brick walls, and their range of diameters is very limited. I don't think they have a place in a precision engineering shop.

Regarding coil springs, how many of our readers, I wonder, have successfully made coil springs heavy enough for hefty 7¼in. gauge tenders or rolling stock? Take it from me, this is very difficult and you will never make a spring as good as a commercial one. These hefty coil springs are manufactured by such companies as Salters of West Bromwich or Sandvik of Birmingham, but they are not for us. I have had some very good commercial springs from Reeves, and being the lucky owner of three very fine Salter balances, have no trouble in deciding the weight of the spring required.

Martin Evans
West Sussex.

Keith Wilson replies:

In response to Martin's interesting letter, I would only mention that I have purchased my spring steel from Fearnehough & Sons, last known address and number: Fernite Works, Coleford Road, Darnell, Sheffield; tel: 01742-448517. This company has always been most helpful and, although I have actually had it done locally, they will undertake heat treatment too.

There is, of course, no trouble in machining, drilling, or rolling the annealed material to the required shape. To date I have made a total of 7 Toads and have also used the annealed/subsequent heat treated method for some 20-30 locomotives.

It is actually possible to roll the hardened material, but it takes far more distortion to finish up with the correct radius which is one of the reasons why I chose to use annealed material, quite apart from drilling and suchlike. Having made a toggle press to handle it (it worked!) many years ago I used a punch to pop holes into the hardened stuff.

The 24V motor as used by Derby SMEE for point operation.

With the greatest possible respect to friend Martin, I write only of what I have actually done. I am now on locomotives Nos. 57, 58, 59 and 60, and am getting to learn something about them.

Actuator motors

SIRS, - The accompanying photographs are of an ex-WD 24 volt actuator used by Derby SMEE to operate points on their ground level track. Having added another point to their layout they are left with only one spare motor.

Does anyone happen to have any of these motors with which they would be prepared to part? If so, would they please contact the undersigned on 01332-556686?

Dennis Monk
Derby.

Critique

SIRS, - While I write in respect of D. A. G. Brown's excellent feature *Metric Screwcutting on the Myford,* having seen the prototype and discussed it at length with him at the Model Engineer Exhibition, my first point has general application.

It appears to me to be most desirable with any such construction article that in Part I a materials list should be provided so that those of us who wish to make the same (or are merely contemplating doing so) are able to raid the junk box and also to put in hand the acquisition of the required materials, since this can occasionally take some time. It is also galling to discover that an item could have been purchased at an exhibition or otherwise, had one known of its need early enough.

On page 540 in Part II of his series (*M.E.* 4147, 1 June 2001), Mr Brown refers to the modified 24T wheel. The 24T wheel which is normally on the tumbler stud is both high tensile and apparently heat treated thus rendering it, as one might say, rather hard. I have seen off two centre drills and find it untouchable by a file so will need to acquire a soft version!

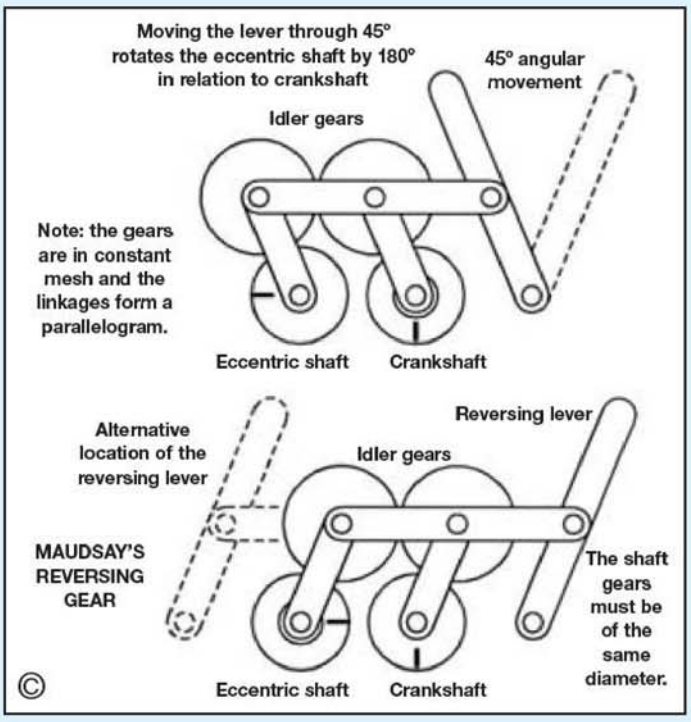
Regarding the reference in *Smoke Rings* (also *M.E.* 4147) to Reeves 2000, we must continue to support Geoff Stait's gallant efforts on our behalf to re-establish Reeves as a premier and reliable supplier. Bill Barton highlights the work load quite succinctly.

The article *A Moving Experience* (*M.E.* 4148, 15 June 2001) seems less than safe in two respects, both connected with the brazing hearth/ forge. The photograph quite clearly shows the firebricks apparently directly on what seems to be a wooden bench top and provision is not made to take away the fumes of such operations. Similarly the wall lining, again which appear to be wooden, are too close and unprotected by fireproof material other than a few bricks stood close by.

K. A. Willson
Hampshire.

Norman Barber replies:

Mr. Willson's observation that the fire bricks forming the brazing hearth are on a wooden bench is correct. I have always found firebricks to be both incombustible and very good insulators. If the hearth were intended for heavy duty brazing operations such as boiler construction I feel that there might be some grounds for concern. It is not intended for and is quite inadequate for this type of work which I would expect to carry out in the open air.



I agree that fume extraction equipment is desirable and have been considering the installation of an extraction fan for this purpose. Rome was not built in a day, however, and in the meantime I adopt the practice which I suspect is common to the majority of model engineers: I open the door and window!

Finally, the wall lining is not wood, as supposed by Mr. Willson, but is foil backed Gyproc plaster board. This is a fire retardant material, recognised as such by the building industry.

I might add that after many years as manager of a mechanical engineering development laboratory and its associated workshops I am, contrary to Mr. Willsons implication, very safety conscious. I wonder how many model engineers realise just how potentially dangerous an environment our workshops represent, an environment in which we invariably work alone.

Maudsay's valve gear

SIRS, - With reference to Mr. Fred Graham's letter in *M.E.* 4149, 29 June 2001 regarding the 'Maudslay' or Maudsay's Reversing Gear, I may be able to help.

Some time ago I was intrigued by the Cheddar Models *Proteus* engine, and worked out how I thought the valve gear operated. I enclose a drawing which, together with this letter, I hope is self-explanatory, but note that the slide valve chambers, if they are on each end of the cylinder block, must be angled to align with the off-centre eccentric shaft as viewed from the end. However, if they are on the face of the cylinder block, they must be vertically above the eccentric shaft, again as viewed from the end.

Another valve design in which I am interested is the Marshall Gear, similar to the Hackworth Gear as fitted to the GAGE TVR I A engine, but with a swinging link instead of a swivelling die block, but I can see installation problems adapting a *Marcher* engine, which I am presently constructing, to take this.

Brian T. Armistead
Edinburgh.

My first lathe

SIRS, - I have always been interested in all things mechanical and, for Christmas 1928, my parents bought me a copy of *Every Boy's Hobby Annual*. This was not to be confused with the *Hobbies Annual* which was a fretwork publication and as such, only of passing interest to me. However, EBHA was the real thing and was full of things to make, primarily in metal; it was most definitely a man's book!

Most of the materials needed were what I would now call household throw-outs, Cocoa tins, knitting needles and similar junk no longer required by the adult branch of the family. With these materials I made most of the things in the book and learnt a lot about electric motors which I made from cocoa tin lids, knitting needle axles and cotton covered wire, all as instructed in the book, progressing through to toc-toc boats, model yachts, a harmonograph and various other devices.

I also constructed a telephone across the street to my friend's house; at this time a telephone was unheard of in a normal household and was the wonder of the district for some time.

But back to the lathe; among the articles in the book was a steam engine, a grand affair which used a set of castings. From what I can remember this appeared to be a Stuart Turner horizontal No. 10. But this required, so it said, the use of a lathe; I didn't even know what a lathe was and would not have recognised one had it dropped on my foot! I asked my father but his trade had been in the pottery business, which he had left, and at the time ran a sweet and tobacco shop, so no joy there.

Ever resourceful, I searched my mind for a solution and recalled that I had a relative who had a foundry. I didn't know what this was either, but it sounded to be in the right area. The next time I saw him, I asked if he knew what a lathe was, and if he knew of one for sale, which was rather pushing it a bit family-wise. He did know what it was and said he would enquire about one for sale.

A few weeks later I had my answer. He had found three for sale, two Patricks, and another which had no name but he said was certainly the best buy at 25/- (£1.25p), a definite bargain. This information, although pleasing to me, rather startled my father for this was the first he had heard of it.

Not liking to lose face, fortunately my fourteenth birthday was approaching, so I was sent to look at this machine to see if it would do, a rather pointless exercise as they could have shown me anything and I would not have known whether or not it was right!

I was taken to some allotments near my home to see the machine, and eventually we came to a hut. On entering I beheld a complete workshop, most of which was new to me, but I did recognise a drilling machine although I had only seen them in pictures, but I was soon to know the purpose of everything.

The machine I had come to see was in fact a set of castings, and it was explained to me that all would be made up and I could help in the making and thus learn how to use it and what it could do. This seemed to me an ideal arrangement and I could hardly wait to get started, but first I had to convince my father that it was okay and would not be a passing phase.

About half most men's weekly wages, twenty-five shillings was quite a sum in those days, but I was about to start work myself and would be bringing home the princely sum of 8/- (40p) a week and so my father finally gave in and said *"Yes!"*

So that solved the problem of where to go two or three nights a week and although there was only one pupil, this must have been one of the first model engineering night school classes.

The workshop itself consisted of a lathe of about 6in. centre height and 4ft. long, I have already mentioned the drilling machine which would take up to a 1in. drill, and a grindstone, all driven via shafting and belts by a gas engine. There was no electricity and all the lights were gas-mantles. A coke stove in a corner provided the heat and was also used as a heat source for hardening and tempering tools. There were also a fair number of hand tools, maybe not much compared to some model engineers' workshops which I have been in since (including my own) but, everything appeared to have been made by the owner who, I learned, was a turner by trade.

The machine we were making was 3in. centre height and about 14in. between centres with a back geared No. 1 Morse taper spindle with a 7/8in. Whitworth nose, for which I still have the tap which I got to make fittings for it. The bed was two steel bars about 1 1/4in. dia. with a centre leadscrew but no clasp nut, so the slide rest had to be wound all the way along the bed which was no hardship for an enthusiastic young lad.

I was shown how to use the big lathe to make small parts such as handles and similar bits, with a warning to keep my fingers out of the dangerous areas, no Health and Safety Executive in those days, it was up to you to take care of yourself!

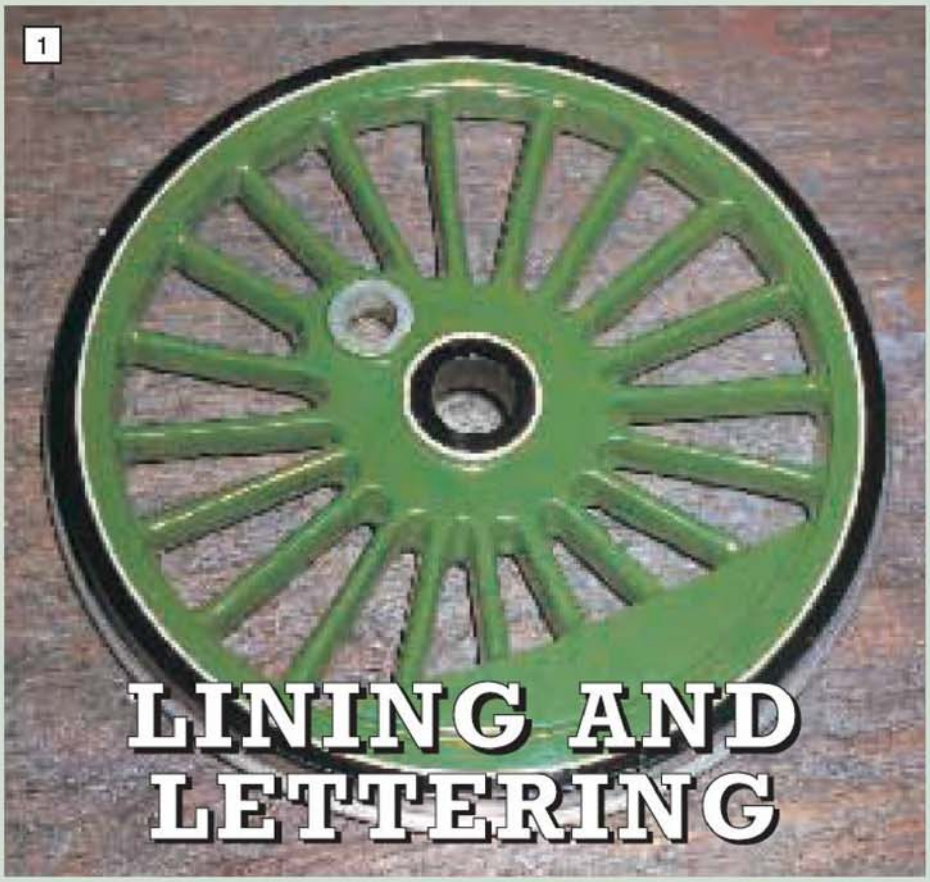
After about a month, the machine was finished but I can't recall how I got it home. I must have borrowed a pair of wheels as we did not have any other means; cars were few and far between in those days. It was possible to borrow handcarts, etc. for 6d a day, something which in later life I did frequently when I bought what are now known as basket-case motorcycles.

On arriving home, it was taken up into the attic which was my workroom and mounted on an old table. A visit to the foundry produced a flywheel to make a treadle, and I was in business. I found the treadle much harder work than using the large lathe driven by the gas-engine but it was good for my legs!

I kept the machine for a number of years but it was eventually sold to finance something else. I can't remember what, or to whom, but I hope it served them as well as it did me. I have had numerous machines since but the thrill of the first one with parts I had made myself, was never repeated.

I never did manage to make the Stuart engine which set it all in motion. Someday maybe!

Stan Wade
North Yorkshire.



Left: Close up of a finish painted and lined driving wheel

David Machin
offers some advice about this important finishing touch for your model
●*Part I*

Martin Wallis' excellent articles on lining and lettering prompted me to think about passing on some additional hints and tips on these most important, and for many model engineers, difficult processes. First, Martin mentioned the difficulty in tracing a drawn or computer-generated piece of lettering or lines to a *dark* painted surface with carbon paper. Here is a simple solution: simply rub a stick of white chalk over the back of the sheet of drawn letters/lines or computer print-out. Attach the sheet to the painted surface using masking tape, (so that on removal the paint isn't torn off as well) checking alignment. Draw over the letter/lines outlines with an HB pencil. The letters/lines will be transferred to the painted surface ready for applying colour. Inevitably there will be some areas where chalk has been transferred where it's not wanted. If these are an irritation, then simply flick a clean linen rag on the surface and these marks will be removed, without affecting the traced lines. Notice that I did not say *rub* the surface with the rag. This certainly will remove the transferred letters and lines as well.

Now to some lining techniques, the first of which, as far as I know, has not been seen in these pages before. When making models I prefer, as far as possible, to paint parts as they are made. Such was the case with the wheels of the current project, an A1/A3 LNER Pacific. **Photo 1** shows one of these wheels, while **photo 2** shows the set. The lining of these wheels may appear daunting, but it needn't.

First, paint the wheels to a good finish. This involves a number of gloss coats, all rubbed down with carbon silicate paper, *used wet.* The secret of good brush painting is to apply the paint evenly to avoid runs and also fairly rapidly to enable the paint to stay wet enough for it to flow out to eliminate brush marks. Also, use a liquid gloss paint, rather than a thixotropic (non-drip) one, as this does not flow out as well as liquid gloss. Primers and undercoats don't flow at all well, so I always get to the gloss stage as quickly as possible and remove the brush marks of the undercoat by rubbing down the gloss coat with the carbon silicate paper. A simple test of this is to rub down the gloss surface to a completely matt one. The brush marks will then have been removed. Subsequent coats of gloss should not show brush marks.

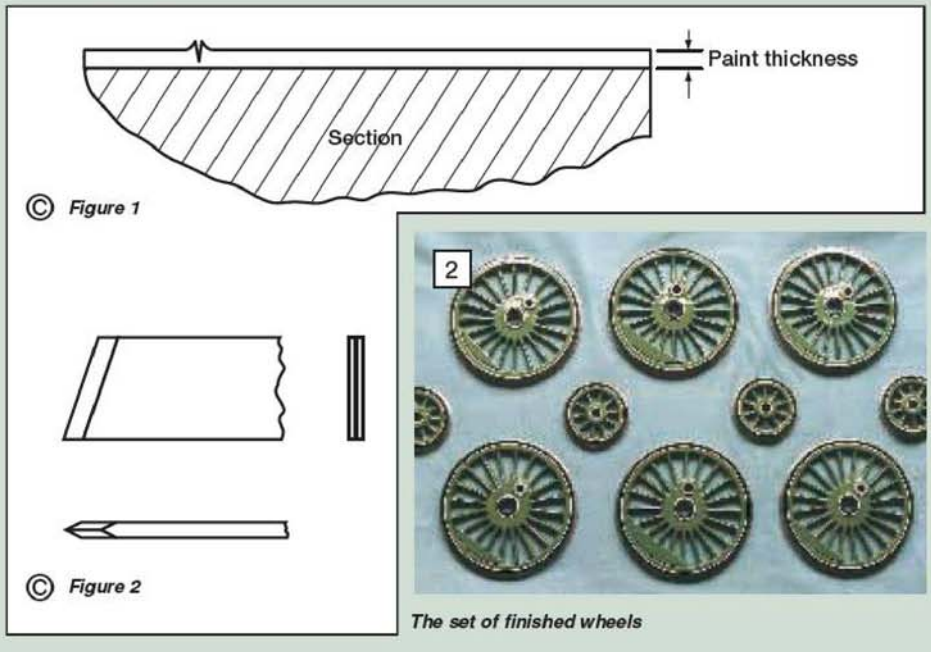
The final coat should be allowed to harden off for about a week before lining is attempted. For the lining style of the LNER A3 Pacific, lining has to be carried out in two stages. Stage one is to paint the whole width of the line white. The second stage is to paint the black line, and to leave the thin white line unpainted at the edge. Now this is precision stuff, and it's all done with a signwriters brush. So how can the brush be persuaded to be so precise?

Knifing

Simply put, the paint surface is knifed in the appropriate position for each stage. Referring to **fig 1**, the painted surface is literally cut with a knife. This throws up a burr, and it is this 'burr' which guides the brush. The object is not to cut back to bare metal, but to cut into the top two or three coats.

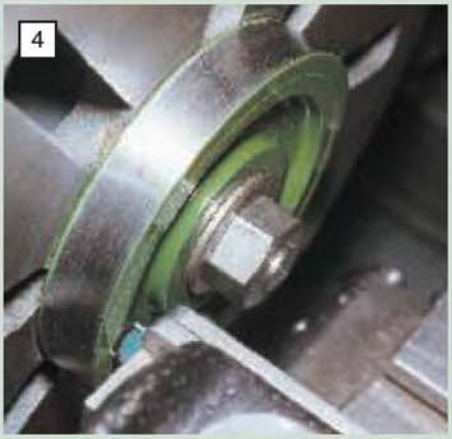
The wheels are mounted on the lathe to do this. I finish-turned these loco wheels using the faceplate and a No. 2 M/T taper arbor for this. A draw bar is used to prevent the arbor from being pulled out of the socket when tightening the nut. **Photo 3** shows the same set up as used for the knifing and lining.

Next, a tool is ground to a knife-like profile, **fig 2** gives the details. I use an old or broken hacksaw blade for this, and mount it in a special holder designed for very fine parting off, featured in an excellent book by L. C. Mason *(Using the Small Lathe* - MAP), which is now out of print. However, **photo 3** should show enough details to allow you



The set of finished wheels

The knifing tool in the special holder



Knifing the line on a test piece

Store lining brushes so the bristles are protected

to construct the simple holder, if you wish. Note that the tool is drawn as it is to be used—as a knife. Conventional tool angles don't apply!

The tool is set up with the point at centre height and square to the work. The tool can then be carefully positioned to the required diameter—the cross slide index will assist in this. With the lathe running at the lowest back geared speed, the tool is fed in for about 0.003 to 0.004 inch. **Photo 4** shows this being carried out on a test piece specially prepared for this article, since, unfortunately, no record was kept of the original lining of the wheels. Having completed the knifing, the painting can commence.

Brushes

These can be bought in an Art shop, but they may have to order them specially. Ask for signwriters brushes as the hairs are longer and this is very important The best brushes have sable hairs and are the most expensive, but with care, will last for years. A brush that has come to the end of its life loses its 'spring', i.e., the hairs will not bend into an arc *when pressure is applied in use.* **Photo 5** shows this 'spring' on a good brush. An old brush without this spring is very difficult to use, and should be scrapped. (Unfortunately I haven't such a brush to photograph). Martin Wallis showed some brushes which had ferrules made from a transparent material. These are called quills and the ferrules are made from the quill of a bird's feather. The size in this case is according to the bird from which the quill came, with the lark being the smallest, and the swan being the largest. The sable hairs are then set in these quills. I still have some of these and rather like using them. To my amazement they are still available, and recently I was able to obtain a replacement Lark Quill. This is shown in **photo 6**, but is larger than the original that I had. This is very handy for the odd free-hand bits of very fine lining. It cost £5, so may be too expensive for very occasional use. I have been looking at some brushes with synthetic hairs called Prolene Series 10 Signwriters brushes. (Usual disclaimer). They have a chisel edge and are available from size 0 to size 14. Unless you are making very large models, Sizes 0 to 3 should be all that are needed. **Photo 7** shows all but a No. 1, which is a sable haired brush, together with a quill, in this case a crow. Note the piece of cardboard, which acts as a protection to the brushes when being stored. The Nos. 0, 2 and 3 Prolene set cost me £6.66. The size of the brush is, of course, relative to the job in hand. I am using a size 2 on the test piece, which should be equally satisfactory for the 3½in. gauge 5in. dia. wheels of the A1/A3. (I rather think I used the crow quill originally).

To care for your brushes, treat them *gently* and wash first in white spirit or turps substitute. If using a can for the washing, take care not to allow the ferrule to scrape along the bottom. This can break off or bend hairs. Dry off on a cloth or kitchen paper towel and then wash in warm water and washing-up liquid. Work the liquid into the brush by gently stroking the brush into the palm of the hand. Rinse and dry again. A good check on thoroughness of brush washing is to smell the brush. All turps odour should have gone. Work a little grease or Vaseline into the hairs by gently pulling the brush through thumb and forefinger. Finally 'set' the brush to its normal 'as new' state by the same method. Make sure that any container can't crush the hairs in storage. As described earlier, it is a good plan to have a cardboard base for protection.

Paint

I am using Dulux white liquid gloss, but any good quality gloss paint will do, together with a little white spirit. A palette, similar to an artists mixing palette, is also needed to achieve the correct consistency of paint as well as the right amount of paint on the brush. A tin lid, piece of steel plate, plywood or hardboard is fine for this. If using wood, seal the surface with some form of paint, varnish or sanding sealer beforehand, or the liquid part of the paint will be absorbed and defeat the object! Take paint from the tin and brush it onto the palette. Take a little white spirit on the brush from a suitable 'dipper', and mix the two, **photo 8**. Getting the right consistency is a matter of trial and error. Too thin and the paint will run, and not cover (obliterate) the base coat. Too thick and it won't flow. A test/practice piece such as the one I'm using, might be a good idea. The brush should be

Mixing the paint on a palette

Applying the white line. Note the method of application

Finishing the white line. The heel of the brush is now well down

Applying the black line after the white line has dried and the position has again been knifed

The finish painted test piece before varnishing

loaded such, that when the brush is moved sharply up and down, none drips off. Now, mount the first wheel on the faceplate ready for lining.

Technique

With the wheel spinning in lowest back gear, and holding the brush in the way shown in **photo 9**, with the hand resting on a piece of bar, gently apply the brush between the knifing and the edge of the wheel. Note how the ferrule and handle of the brush is *tangential* to the wheel. This is very important. At first, the application will be hit and miss, but keep the brush steady. It will take quite a few revolutions to completely fill the knifed areas. It may also be necessary to move the brush laterally to complete the process. **Photo 10** shows the completion; note that the 'heel' of the brush is well down, and a lot of the hair length is in contact with the workpiece. This is important as the tip of the brush hasn't sufficient contact to apply a sufficient quantity of paint. This is why it's so important for the brush hairs to be flexible and long. The edge of the wheel will be painted where you don't want it, but a piece of lint free rag, moistened with white spirit can be applied to the revolving wheel to remove the surplus. Repeat for all wheels. Note that the greatest amount of opacity is achieved exactly where it's needed, so another application shouldn't be necessary. Allow to dry and harden for about a week.

Repeat the knifing, this time leaving a thin line, of course. Once again, the cross slide index will give a precise thickness, and this will be *consistent* for all wheels. Next set up as before, prepare the brush and paint, and apply the paint as previously described, but this time black! **Photos 11** and **12**. Usually black will cover white in one coat, but if not, a second coat is easy to do. Allow to dry and finally apply a coat of clear varnish. **Photo 13** shows the finished result, but with no varnish applied.

With the type of line such as the above, lining in the way described is fairly easy to do, as we have seen. The technique will have other applications, such as the flywheel of a showman's traction engine. It is also possible to apply paint between two knifed lines. With care, the lathe will guarantee correct spacing. I have also attempted this method on flat surfaces, with some success, but I think I have a better solution now.

At one time I used to do all lining with brushes, with a Lark Quill for the really thin lines, but with advancing years this isn't too easy and probably out of the question for most model engineers. This all came to light when I had a bit of refurbishment to do on my Allchin traction engine recently (the original lining was completed over 20 years ago!) What was needed was a suitable lining tool which was easy to use.

Making a lining tool

I use Rotring drawing pens for ink drawings and these consist of a very fine tube with a centre 'wire' to assist and control the flow of ink. The thickness of line is achieved by machining a short spigot to the required diameter at the business end, (more on this later). Pondering this, I thought of a needle from a hypodermic syringe. My friendly GP gave me some with which to experiment and, although I had asked for used ones, on health grounds he had to give me new ones. The sizes obtained were 0.8mm (0.031in.); 0.6mm (0.023in.); and 0.5mm (0.019in.). I found that I could poke a piece of 37swg (0.0068in. dia.) piano wire down them all. The idea here wasn't so much to control the flow, more to make sure that I could clean the tube and leave the wire in place between jobs so that there would be no chance of a blockage. This has proved to be sound.

I also tried a few of the very small sizes—obtained from the local chemist after an embarrassing few moments for me, explaining their intended use! One problem here is that a chemist may not be prepared to break open a box of a 100 to sell you just a couple. I found these very small sizes difficult to deal with, and decided to concentrate on the ones already obtained.

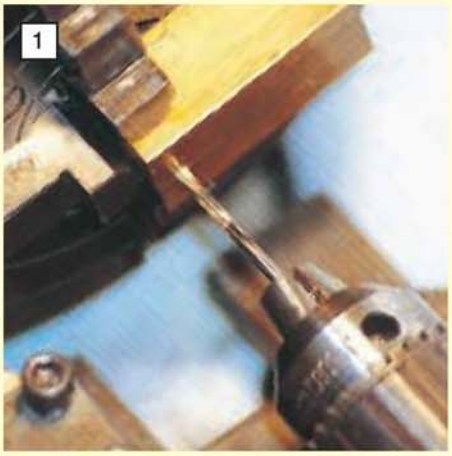
Some simple experiments were made to test the viability of using the needles obtained from my GP. After grinding off the tapered sharp end, this was then stoned to a rounded end with a smooth finish. The needle had a plastic mounting which normally fits into the syringe. This acted as a reservoir for paint for these tests. Trial lines encouraged me enough to make the lining tool shown in **photo 14**. The separate components are shown in **photo 15** while **photo 16** shows a nozzle with the needle fitted and finished as a stylus. **Photo 17** shows all three nozzles.

To be continued.

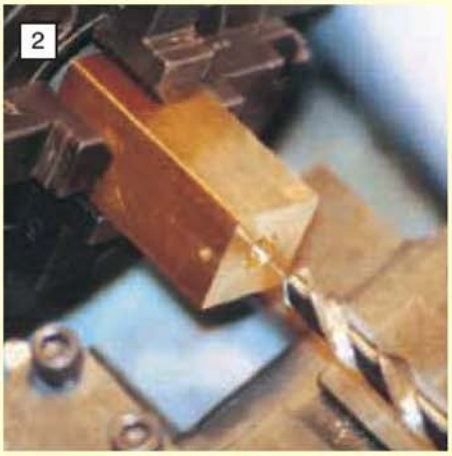
The lining tool made by the author

The dismantled lining tool

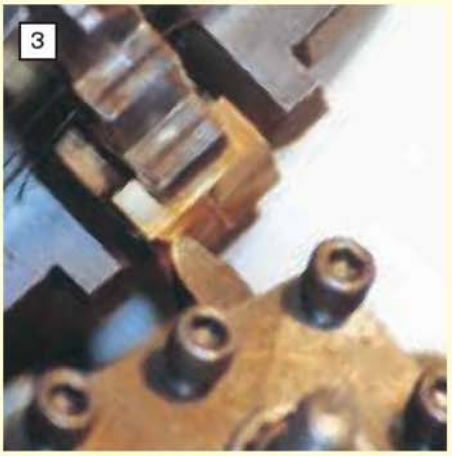
Lining nozzles made from hypodermic syringe needles



Reaming the valve spindle hole in the steam chest with workpiece mounted off centre in 4-jaw.



Opening up the valve recess 1/2in. blind hole in the steam chest.



Machining the front of the steam chest.

LITTLE BEN

Bruce Robertson

deals with the steam chest valve gear and chimney of this delightful little traction engine

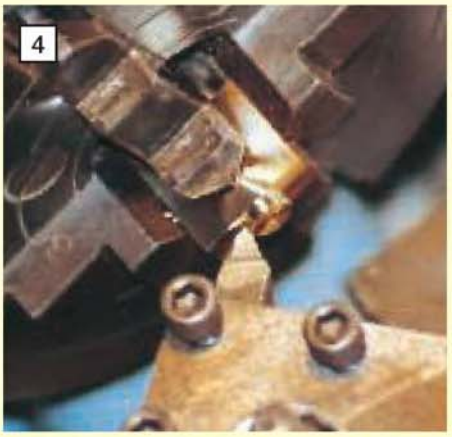
●*Part VII continued from page 124 (M.E. 4152, 10 August 2001)*

The steam chest is turned from a piece of 1in. square brass bar, preferably about 2in. long so that it is easy to handle and chuck in the lathe. Chuck this bar in the 4-jaw and face off one end square, then turn the bar around in the chuck and face off the other end. Remove the bar from the chuck and scribe a line along the centre of one of the sides. Centre punch a point on this line which is about 1/4" from one of the ends. Chuck the bar in the 4-jaw again so that the point you have just marked is on centre. Drill a hole right through using a No. 31 drill, and then ream the hole to 1/8in.—this is the hole for the valve spindle (**photo 1**).

Turn the piece around again so the end face nearest the 1/8in. hole is pointing outwards, and face off again so that the thickness between this face and the centre of the valve spindle hole is 3/16 inch. Make sure that the workpiece is turning on centre, and use a 1/2in. drill to cut the blind hole which will form the interior of the steam chest (**photo 2**). Be careful that the tip of the drill goes no deeper than 5/16in., otherwise you will have an unwanted hole in the front of the steam chest once you machine the other side of it! Part the steam chest off 1/2in. from the end of the bar, and turn it around in the chuck to machine the front of the steam chest to give a finished thickness of 3/8in. (**photo 3**).

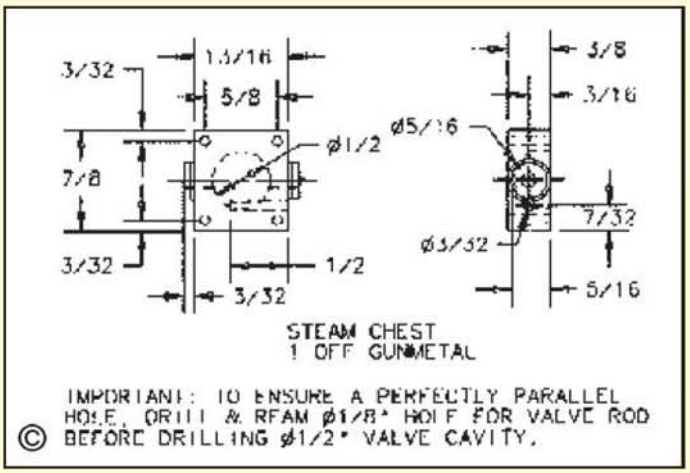
To machine the ends of the steam chest with the valve spindle bosses, mount the piece sideways in the 4-jaw so that the valve spindle hole is on centre. Machine both ends so that the finished width of the component is 13/16in., and each of the valve spindle bosses is 3/32in. long (**photo 4**). Similarly mount the piece again to in turn machine the top and bottom faces to give a finished height of 7/8in., which will give it the same height as the valve block.

Mark, centre, and drill the 3/32in. hole for the steam inlet pipe, which needs to be done fairly accurately as this hole comes quite close to one of the holes for the mounting screws. The steam supply pipe will later be soldered into this hole. Mark out the four holes for the mounting screws by lightly scribing four lines which are 3/32in. from the edges on the front of the steam chest. Centre punch at the four intersections of these lines and drill through using a No. 43 drill.

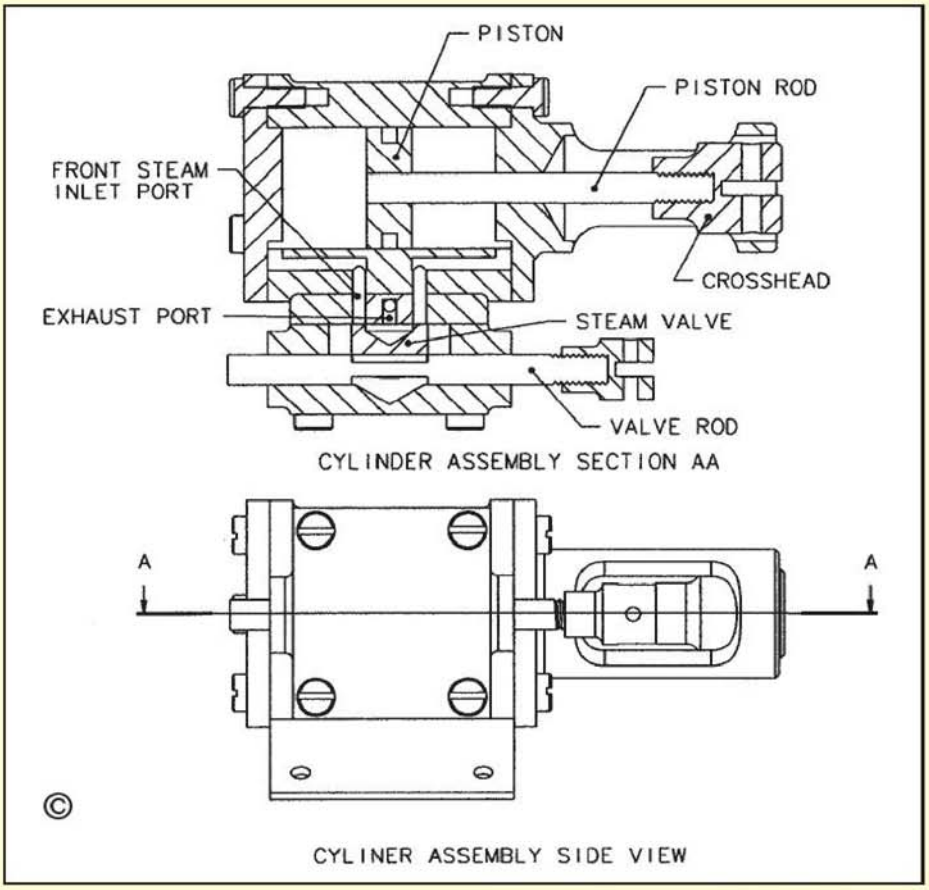


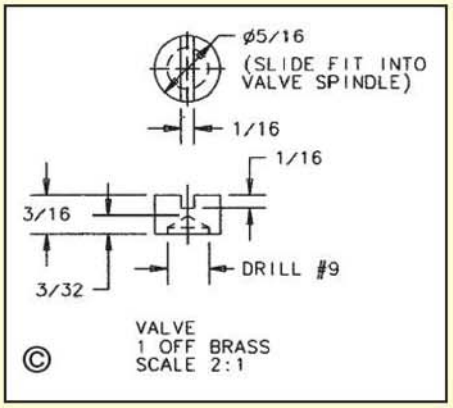
Machining the valve spindle bosses on the ends of the steam chest.

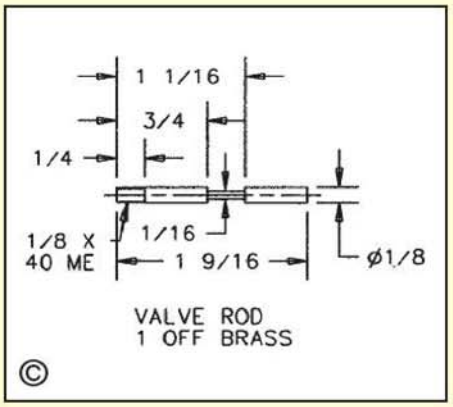
To fix the steam chest to the cylinder assembly, do as per for the front cover and crosshead guide by spotting through the holes with the components held together in the correct place. Start by doing one corner (spot through with No. 43, remove steam chest, drill 1/4in. deep with No. 50 into the cylinder, tap 8BA), and then assemble with that corner screwed tightly in position. Next do the corner which is diagonally opposite the one just done, and then once that is screwed firmly in position you can do the remaining two screw holes in one operation. It may seem a little drawn out doing it this way, but if you were to spot all four holes in one operation, and the two components moved against each other while you were doing it, the screw holes would not line up—which is annoying to say the least.

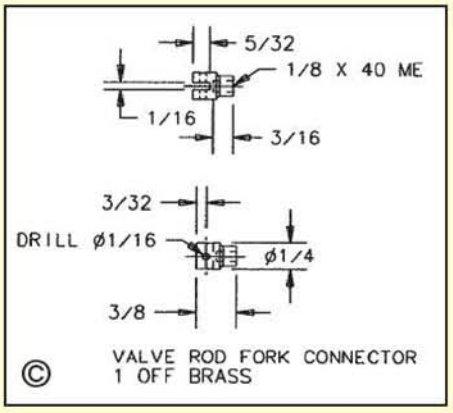


Turning the 1/16in. diameter on the valve spindle.









Valve

Chuck a piece of 1/2in. diameter brass rod in the 3-jaw, face off the end, and turn a 1/4in. length down to 5/16in. diameter. Centre and use a No. 9 drill to make a 3/32in. deep (to the tip of the drill) hole. Cut the end of the rod off to a length of 1/4in., turn it around, chuck in the lathe again, and face off to a finished width of 3/16 inch. With this piece held either in the lathe chuck, or in the vice soft jaws, whichever you find easier, use a hacksaw to make the 1/16 x 1/16in. slot in the top of it.

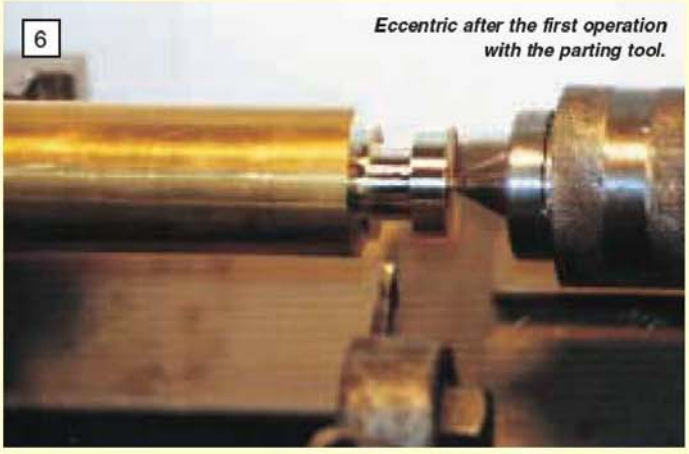
Valve rod and fork connector

Cut a 1 5/8in. length of 1/8in. diameter brass rod off and face the ends in the lathe to get a finished length of 1 9/16 inch. Cut a 1/4in. long 1/8in. x 40 ME thread on one end of it, and scribe a mark on the rod which is 3/4in. from the end which has the thread on it. Make a second mark which is 1 1/16in. from the threaded end. Turning the diameter between these marks down to 1/16in. is very difficult unless the workpiece is supported at both ends in the lathe, so I use the tailstock chuck for support, with a bit of grease smeared on the brass rod, and the chuck only done up enough to support the rod—not to grip it. With the piece set up like this, use a square end ground parting tool to turn down the diameter, taking it slowly so as not to put too much load on the rod (**photo 5**). The turning should be between the two marks you have previously made, but check the fit of the valve as you are doing the job. The width should be such that the valve will slide into it without binding at all, but also it should not be loose.

The valve rod connector is made in a similar way to the crosshead, although being smaller it is a little more fiddly. Start by facing off the end of a 1/4in. brass rod, and then centre punch it on its side 1/16in. from the faced end to allow you to cross drill the hole using a 1/16in. drill. With this hole complete, cut the 1/16in. slot in the end of the rod, which is perpendicular to the drilled hole. Cut the end of the rod off to a length of 7/16in., chuck it in the 3-jaw, face it off to a finished length of 3/8in., and cut a radius on the edge to make the piece look nice. Finally drill No. 40 to a depth of 3/16in., and tap 1/8in. x 40 ME.

Eccentric

Chuck a piece of 1in. diameter brass bar in the 4-jaw, face the end off, and turn down a 1/2in. length to 3/4in. diameter. Use a square end ground parting tool to cut a diameter of 1/2, 1/4in. wide, which starts 7/32in. from the end of the bar—i.e. the end of the bar will have 7/32in. at 3/4in. diameter, and then 1/4in. at 1/2in. diam-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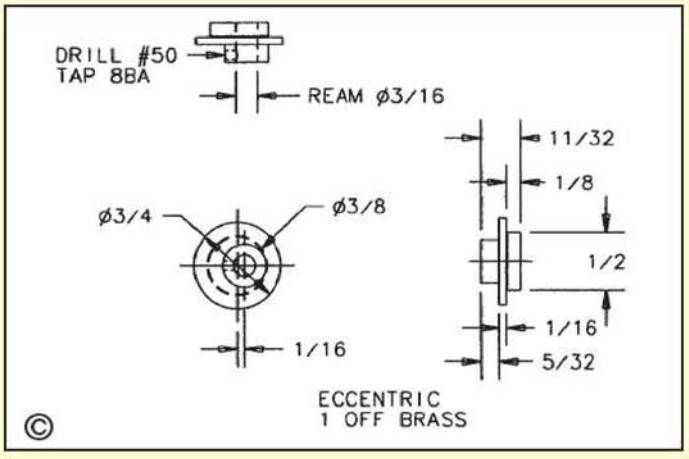
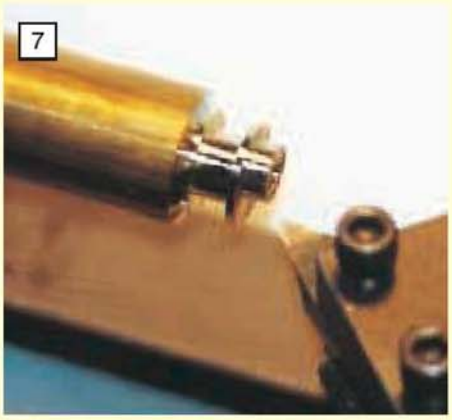
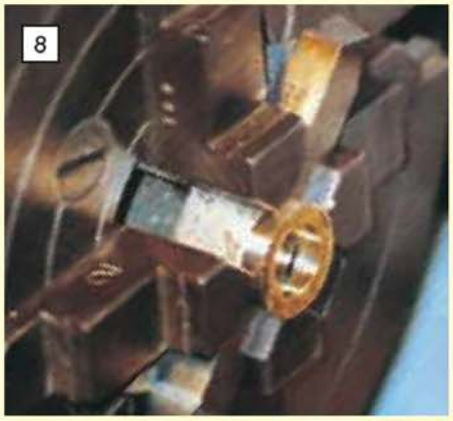
Eccentric after the first operation with the parting tool.

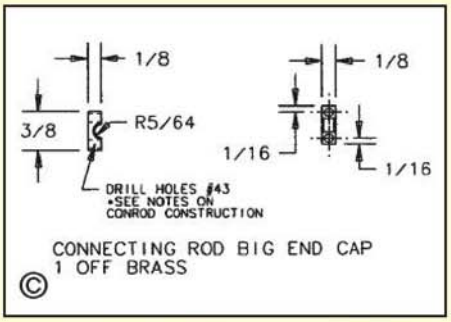


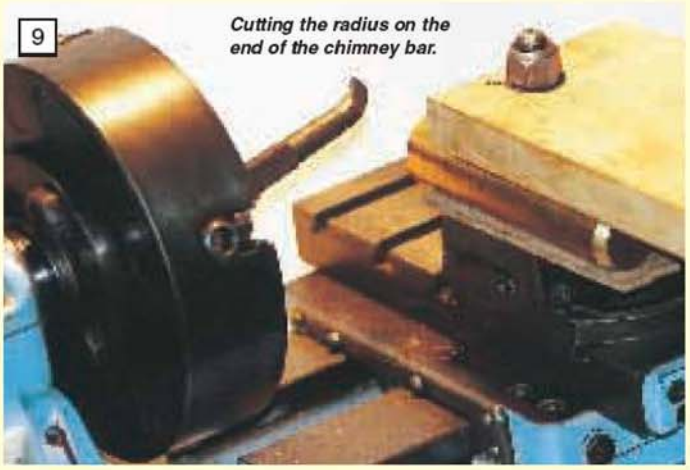


Eccentric after turning offset in chuck.

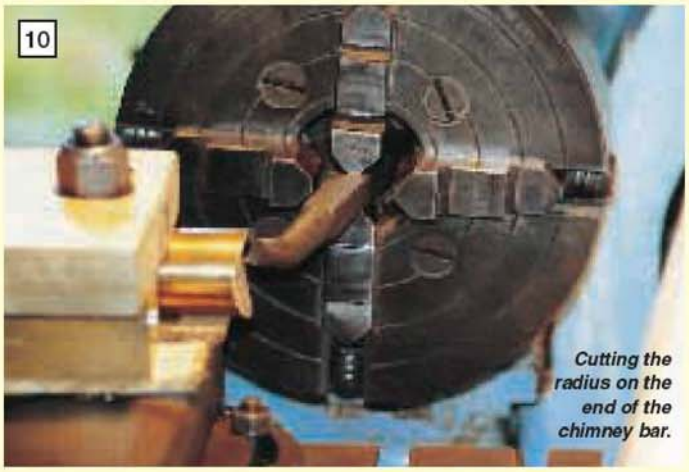


Turning eccentric strap with spacer behind it in the 4-jaw.

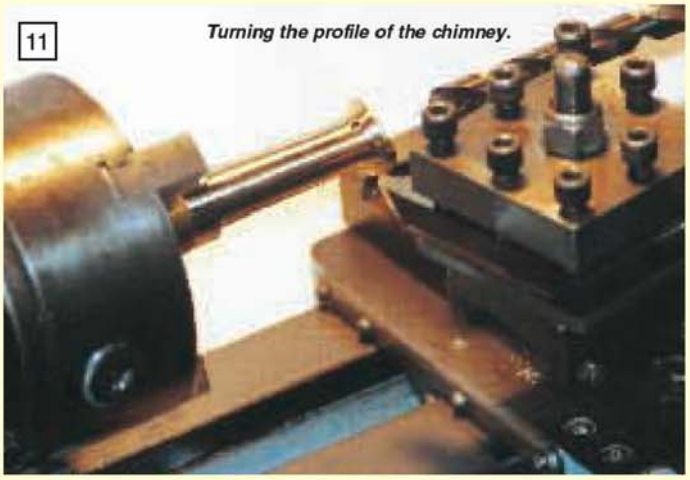




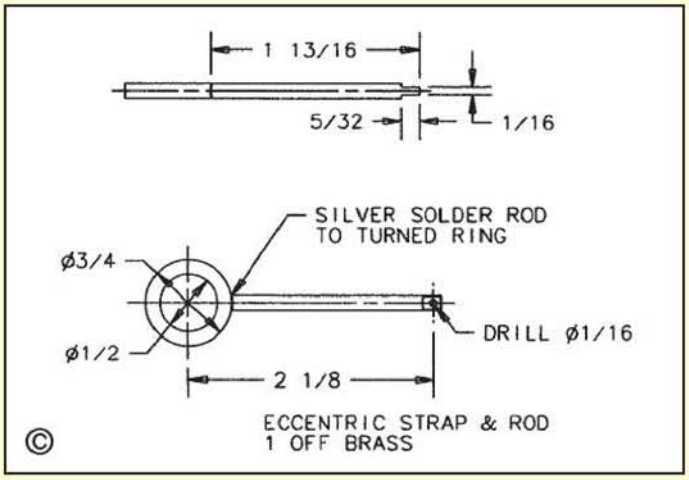
Cutting the radius on the end of the chimney bar.



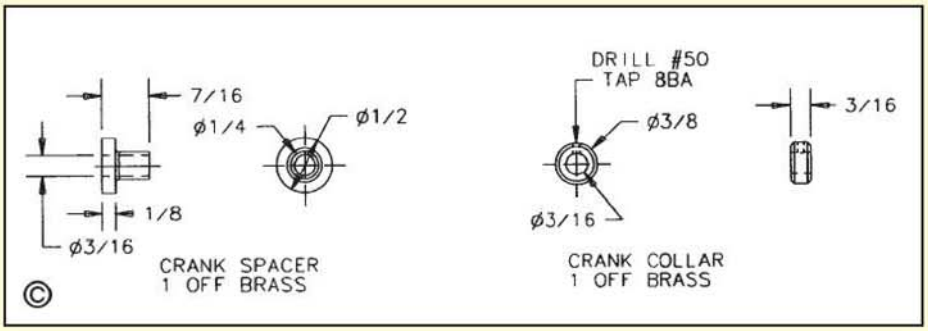
Cutting the radius on the end of the chimney bar.



Turning the profile of the chimney.

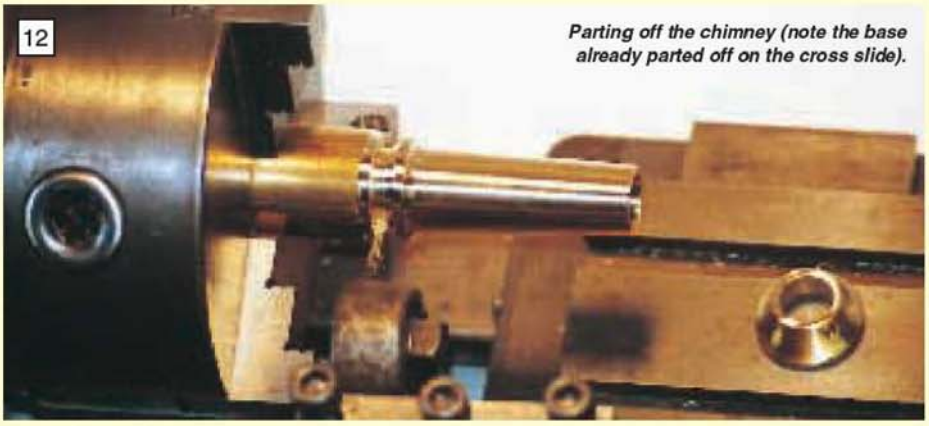


eter (**photo 6**). The bar is now offset in the chuck by 1/16in., which can be done in the same way as I described for offsetting the crankshaft. Set the cutting tool onto the surface of the 3/4in. diameter (with the cross slide backlash taken up for winding outward), move the cross slide out 1/16in. (0.0625in.), and then adjust the chuck until the workpiece just touches the tool again at the highest point of its eccentric movement. Centre and drill to a depth of 1/2in. at this new position with a No. 14 drill, followed by a 3/16in. ream. Turn down the end of the bar to 3/8in. for a length of 5/32in. (**photo 7**), and then part off the bar to a width of 3/8 inch. Mount this piece in the chuck with the parted face protruding (which should be 1/2in. diameter) and face off so that the finished 1/2in. diameter is 1/8in. wide. Lastly, drill No. 50 and tap 8BA for the eccentric setting screw.



Crank spacer and collar

The function of the crank spacer is to prevent the eccentric strap from working its way off from the eccentric, and also, in conjunction with the crank collar, prevent the crank from floating sideways. Both of these parts are a straightforward turning exercise, which really should not require further explanation other than that given by the drawings, so I will leave the reader to it!



Parting off the chimney (note the base already parted off on the cross slide).

Eccentric strap and rod

The eccentric strap is a simple turning job from a 1in. diameter brass bar. Chuck the bar in the 3-jaw, face the end, turn 1/4in. length down to 3/4in. diameter, drill 1/4in. deep with 3/8in. drill, and part off to 3/16in. width. Turn the piece around in the chuck, and use a suitable spacer behind it (**photo 8**), so that the second side can be faced off parallel to the first with a finished width of 1/8 inch.

Cut a length of 1 7/16in. for the eccentric rod from a piece of 1/8in. brass rod. Lay this on a flat soldering hearth along with the eccentric strap, and silver solder the two together, making sure that the centre line of the rod is lined up with the centre of the strap.

As was done for the conrod, file the flats on the end of the rod by holding the workpiece on a flat surface and drawing the file, making sure that the file stays parallel with the flat work surface at all times. Centre and drill the hole for the connector pin so that the finished distance between the pin centre and the strap centre is 2 1/8 inch.

Chimney

The chimney and chimney base are machined as one piece, and then parted at the end to form the two separate parts. Start with a piece of 1in. diameter brass bar, which is at least 4in. long, and mount it in your lathe as best you can to cut a 1in. radius in one end of it. I have done this in my ML7 by clamping it to the cross slide, which works very well (**photos 9 and 10**). Make sure that you set the bar up so that its centre height is the same as the lathe centre height, otherwise you will end up with a chimney that does not sit on your boiler shell properly.

The hole for the steam exhaust pipe to enter the chimney base is now drilled, as it will be far more difficult if left until later. Mark, centre, and drill this hole 3/16in. from the bottom of the boiler shell radius cut. Drill the hole 1/4in. deep with a 3/32in. drill, and remember to keep it parallel with the centre line of the boiler shell radius cut.

Chuck the bar in the 3-jaw with the radiused end protruding out, and drill up the centre of the bar with a 1/2in. diameter drill to a depth of 2 5/8 inch. Turn the outside of the chimney to the profile shown in the drawings (**photo 11**), and give it a final going over with some fine emery cloth to get a really good finish on it (a really bright chimney never fails to impress!)

Carefully part the chimney base off from the rest of the chimney so that the height of the base, when sitting on the boiler, will be 3/8in.—as measured from the top of the boiler—(**photo 12**). Finally, part the rest of the chimney off from the brass bar so that the top part of the chimney is 2 1/8in. long.

To be continued.

A GIESL EJECTOR for a FOWLER 4F LOCOMOTIVE

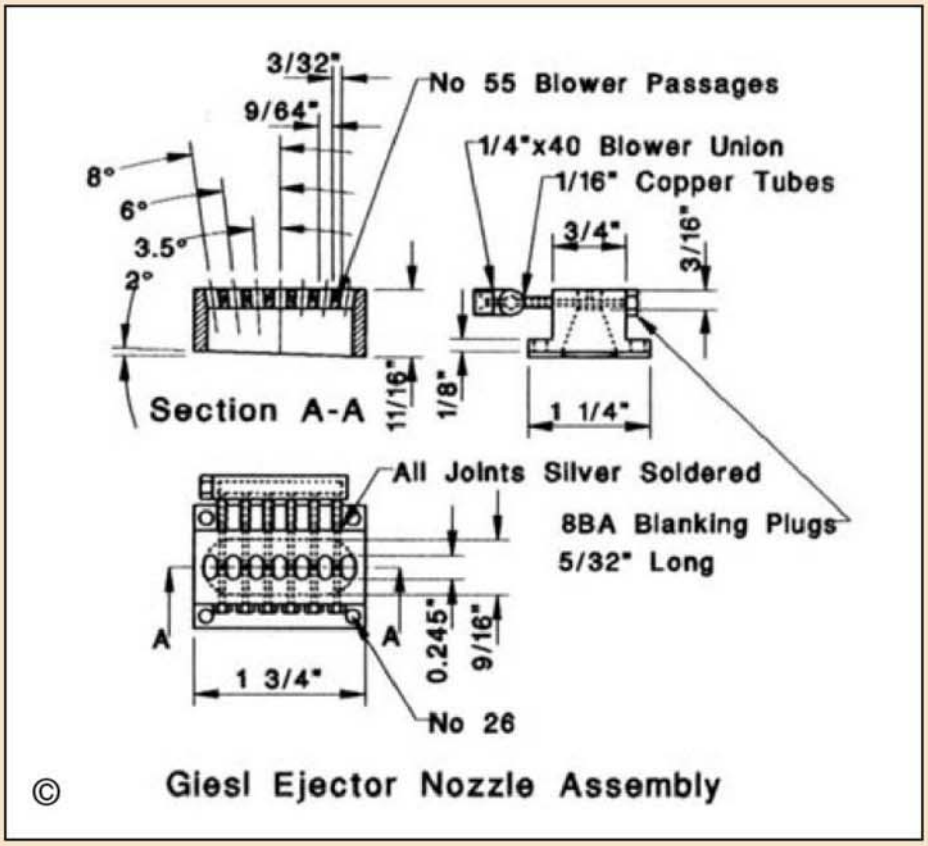
Richard Gomersall

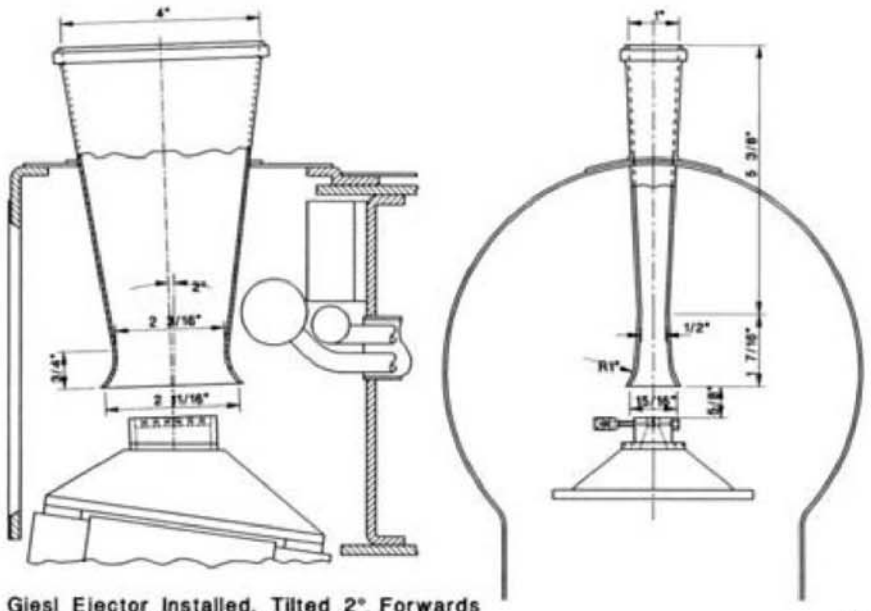
achieved improved efficiency from his locomotive and got a new pen holder for his desk.

I am a volunteer machinist on the Keighley and Worth Valley Railway and was involved with the fitting of Giesl Ejectors onto our locos 34092 City of Wells and earlier this year onto 78022 (a British Railways Standard class 2 2-6-0). I had the pleasure of correspondence with the inventor of the Ejector, Dr. Adolph Giesl-Gieslingen, who provided all the necessary drawings for both installations.

As well as my interest in full-size locomotives I have also been involved in model engineering and after several visits to Hemsby, in Norfolk, and other local 7 1/4in. gauge railways I was ready to put aside my 3 1/2in. gauge models and have a go at a model in 1/8 scale.

On the K&WVR we have a Fowler 4F 0-6-0 loco and I commenced work on a model of this engine, work started on the drawing board in 1989. I used actual measurements from 43924 with design details from Martin Evans published data. These 4F locos are not exactly at the cutting edge of steam engine technology so I incorporated Swindon type Stephenson link motion and modern piston valve cylinders with drafting in line with the latest British Railways Standard locos.





Giesl Ejector Installed, Tilted 2° Forwards

The model was ready for trial runs early 1994, before painting was completed, and although it steamed with no problems I decided to fit a Giesl Ejector when the model was stripped for painting.

Designing the Giesl Ejector

I arrived at the proportions of the Fowler pattern chimney by taking the figure of 4.5% of the grate area for the chimney choke. This gave a figure of 1 1/2in. for the choke dia., working from this the chimney liner diverges at 4deg. to nicely fit the scale chimney casting.

The model has the same 2 1/4in. diameter cylinders as the Highlander design and therefore the same blastpipe diameter of 15/32in. was used. This represents a figure of just over 20% of the cylinder diameter. The position of the blastpipe below the choke was arrived at with the 17deg. taper cone as shown on the accompanying drawing.

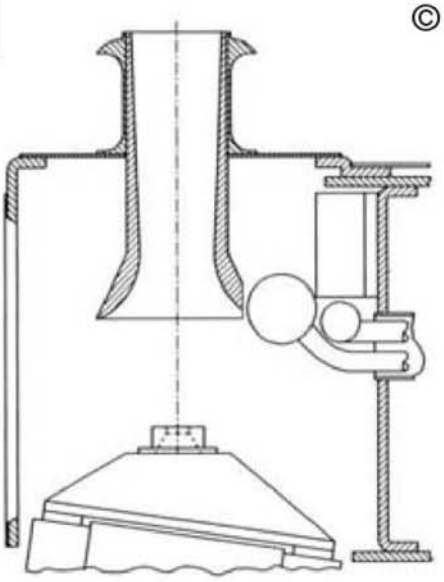
Using the data provided by Dr. Giesl I selected a blastpipe area of 0.2126 sq. in. for the Ejector, this is 23% greater than the Fowler blastpipe which is 0.1726 sq. inch. This area is divided by seven to arrive at a dimension for each of the exhaust nozzles which are oblong slots 9/32in. wide x 0.246in. long. These exhaust nozzle slots are milled at angles along the centre line of the nozzle block corresponding to the shape of the upper part of the chimney. The blower jets have also to be fitted between each of the exhaust nozzles; they are supplied with steam via a manifold on the side of the nozzle block, hopefully the drawing will make this clear.

The whole Ejector assembly is tilted forwards by 2deg. to clear the superheater hot header.

The alignment of the nozzle assembly to the chimney is of great importance on the Giesl Ejector, the full-size units are actually keyed together to prevent misalignment. I used a simple jig to help set up the Ejector on the model. All in all I would add that it was the single most challenging component to manufacture on the whole locomotive.

After making an adapter to fit onto my lighting up blower the loco was despatched again to Hemsby for a trial run in early May 1995. The first noticeable effect of the ejector was the improved blower performance, which can be attributed to it having six blower jets exhausting into the much smaller chimney choke. The exhaust note of the loco when pulling away with a substantial train is noticeably quieter.

One of the aims of the Giesl Ejector is to reduce exhaust back pressure in the cylinders, to assist in this area it is recommended that the exhaust from each cylinder end is kept separate right up to the actual blast nozzle. This has been achieved on the model by a divided manifold that sits on top of the steam chest liners.



Original Blast Pipe Arrangement

While I judged it not possible to measure and compare the differences in performance of both chimneys on the model, I set up a pressure gauge to measure the exhaust pressures and a U-tube manometer to measure the vacuum created in the smokebox on loco 78022. The results are plotted on the graph. E. S. Cox in his excellent book *British Railways Standard Steam Locomotives* states that a 1.5% reduction in steam per indicated horse power for each pound less of back pressure can be theoretically expected: this equates to a saving of approximately 4%. This figure has been confirmed by extensive testing of an Austrian Class 33 loco in the early 1950s. The graph shows that these savings become greater the harder the loco is worked and for each corresponding level of exhaust pressure the Giesl creates a higher level of smokebox vacuum.

I only intended to fit the Giesl Ejector to the model as an experiment but now favour retaining it for the forseeable future and have converted the Fowler chimney into a pen holder for my office desk.

Finished at last! Brian Nicholls' 20 year build of a 5in. gauge GWR King class locomotive King Edward VIII *was rewarded with First Place in Locomotive class (Section 39) together with the Myford Trophy.*

This 2in. scale Harvest Diorama featured a Ransomes Thrasher and Baler both powered by a Marshall Diesel Tractor model. Builder B. Wardman gained First Place in the Miscellaneous Section as well as Best in Show.

HARROGATE 2001

Barry Jordan
our out of town correspondent
presents highlights of the 8th National Model Engineering & Modelling Exhibition.
●*Part I*

Well what can one say! The Harrogate Exhibition has always been a show with a special atmosphere, going from strength to strength and this year was no exception. Regular visitors to this family run exhibition regard it as the premier exhibition in the UK and now there can be little doubt. With the massive extension to the Flower Hall available to the exhibition organisers this year the floor space was virtually doubled. The majority of the trade stands were housed in the new extension leaving the original hall for the models. Another excellent feature of the venue was the installation of a large roller shutter door, which, when lowered, isolated the new extension from the original hall. When the exhibition had closed on the final day it enabled the trade to leave the building without clashing with modellers who were all trying to remove their exhibits and property at the same time. The whole exercise went as smooth as clockwork. The models hall was virtually cleared by 6.30pm.

The new restaurant area separated the two halls and was very busy each day despite the high cost of the food and refreshments. This service is supplied as part of the package when hiring the venue, therefore the organisers of the exhibition have no control over the prices charged by the catering company. Even so, the food I sampled was excellent, but I did miss those delicious Italian Pancakes. Maybe they had commitments elsewhere this year.

Regarding the models, there was an increase in the overall numbers on show compared with last year, although exhibits in competition were down. However, the quality of exhibits remained impressive, with some fine locos entered. One loco stood out as the winner of the Locomotive Section. This was Brian Nicholls' 5in. gauge Great Western King Class *King Edward VIII*. Brian is a retired marine engineer from Northumberland and, due to his sea-going career, it has taken him some 20 years to build the loco, researching the authenticity of every detail. We saw the 'nearly finished' loco last year on one of the club stands, so it was nice to see it finished and in competition. Congratulations to Brian on a fine model.

Mr. B. Wardman, a member of the York City and District Society of Model Engineers, exhibited a fascinating working diorama in 2in. scale of a Ransomes Thrasher and Baler all powered from the working model of the famous Marshall Diesel Tractor. The tractor is exact in all its detail, and based on the Model 'M' of 1939 vintage. Fully working, it runs on high pressure injected diesel fuel. The engine has to be cranked over from the front to start it running. The gearbox and steering all work just like the real thing. This very authentic model of the Marshal Tractor was worthy of a First Award on its own merits. The models were displayed on a realistic custom built stand. Again the judges were in agreement and awarded Mr. Wardman the Trophy for Best in Show.

A new class this year, and arguably a first in any exhibition, was the competition for Kit Built Models. Many aspiring modellers use this excellent introduction to the hobby as a stepping stone

The Maxitrak Cup, awarded to the best Kit Built Model, went to Peter Thomas for his Great Western 0-4-2T 1466 Tank Loco built from a Winson kit.

Joint Third Place in the Miscellaneous Section went to J. Cartledge for this 1/8 scale Horse Drawn Malt Wagon.

Runner-up in Loco Section 39, this 7¼in. gauge class B50T Shay Logging loco by Robert Bowron also won the Phoenix Trophy for Best Paint Finish.

A general view of some of the trade stands in the new Hall taken on day one of the show from the balcony.

to scratch building. A large number of the more mature engineers among us no doubt started our careers with an Airfix or Meccano kit. Numbers in this class were disappointing but we did have a first class-winning model. This was a Winson 14xx kit Great Western 0-4-2T 1466 Tank Loco built, steamed and enjoyed by Dr. Peter Thomas. He was presented with the Maxitrak Trophy and a gift voucher by Bernard Fenton of Maxitrak. If you are in the process of building or have built a model from a kit of parts—either a locomotive or road vehicle—the organisers of the exhibition look forward to seeing you and your model next year. There is the fine Maxitrak Trophy to win.

Another new addition to the silverware this year was the Doug Hewson Cup for the best 5in. gauge Rolling Stock. Geoff Bird received this trophy for his United Dairies six wheel Milk Tanker exhibited on the Ground Level 5 Mainline Association stand.

Peter Dekker, who specialises in I.C. engines entered a nice little model of the Barr & Stroud Sleeve Valve 350cc Motor Cycle Engine of around 1920 vintage. The model is rated at 12cc. This gained Peter a First in the Stationary Engine Section and a Workshop Accessory Kit kindly donated by Hemingways.

Raymond McMahon travelled all the way from Northern Ireland again. This year he exhibited his 'Raymac' Cutter Grinder. This useful piece of workshop design was awarded First in the Workshop Equipment Section.

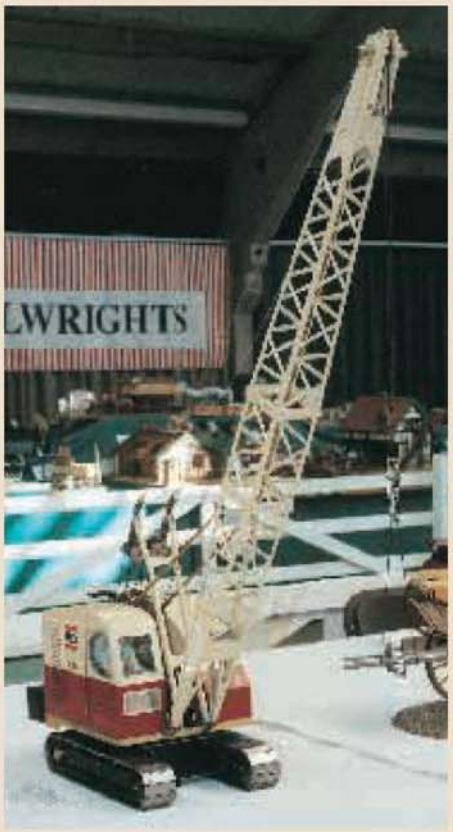
Second place in the Miscellaneous section was a 1/12 scale Ruston Bacyrus 22 RB Crane built by W. L. Auty. First impressions when looking at this model did not put it among the awards, but on closer examination and after reading the builder's notes I revised my opinion. The work involved in the model necessitated a closer examination. There was a mass of detail which was not at first obvious - for instance 35ft. of brass angle was used in the boom, 54 small ball races in the transmission and turntable, six electric control motors, 44 track links on each side (hinged on 1/16 diameter pins) and intricate electronics inside the cab. Both winch drums have approximately 18ft. of 9 strand cable. This is an example of how much help a few brief notes can give the judges (brief being the operative word).

In the Road Vehicles Section there was only five entries and no First Prize was awarded. Second place went to A. Langthorne for his 2in. Clayton Steam Wagon. Unfortunately, a minor dispute crept into the judging on the first day. This involved two matching 4in. Fowler BB1 Ploughing Engines together with their Two Wheeled Water Tanker and Plough Unit. All were entered in competition in the Road Vehicle Section. Both models and their supporting equipment were of the highest engineering standard, however, it was established that they had recently been purchased completely finished by their current owner. After lengthy discussion the eight judges agreed unanimously that this entry should be disqualified. This decision was made on the ground that it was unfair for a model such as this to be entered in competition against another which has taken a dedicated modeller many years to complete. We all admire fine examples of model engineering and any exhibition organiser would

The Doug Hewson Bowl for Best Rolling Stock went to Geoff Bird for his 5in. gauge United Dairies Milk Tanker.

Sporting a superb finish, this delightful 3in. Marshall Traction Engine is by E. Stowell.

First Place in the Stationary Engines Section went to P. P. Decker for his 4in. Barr & Stroud sleeve valve motorcycle engine.



Fine detail featured on this 1/12 scale Ruston Bucyrus 22 RB Crane built by W. L. Auty which took Second Place in the Miscellaneous Section.

Dave Wainwright's 5in. gauge LC&DR Europa class locomotive gained a Commended award.

Derrick Wild's London Transport Metrovic Loco, **Sherlock Holmes,** *was exhibited on the Keighley and District M.E.S. stand.*

be pleased to have these items in the loan section with the owner's name on display. However, such examples of 'Cheque Book Model Engineering' need to be discouraged and entry forms should make it clear that models which have not been built by their present owner should indicate this fact and be exempt from competition.

It was a very welcome sight to see a newcomer to the list of Clubs and Societies - The Guild of Model Wheelwrights attended for the first time displaying an excellent selection of work. They were justifiably awarded the trophy for the Best Club Stand. The 34 models on display were all the work of six guild members. I can imagine transporting these fragile masterpieces presented their creators with a bit of a nightmare. Another newcomer came from north of the border in Scotland. Edinburgh SME presented a fine and varied selection of models all well displayed. I hope they enjoyed the Exhibition as much as we all appreciated the efforts they had gone to, to make the journey south.

As in previous years the 7¼in. Gauge Society and the Ground Level 5in. Mainline Association both produced an impressive collection of Locos and Rolling Stock for us to admire.

The stalwart of the Stirling Engine Society, Roy Darlington, with his colleagues, spent the three days demonstrating his vast collection of Hot Air Engines to amazed visitors. A nice touch from Roy was a gift of a special engine for Mr Lou Rex, the Exhibition Organiser. Lou proudly displayed the engine on the reception desk throughout the exhibition.

The weather, as last year, was kind to the 'Harrogate Steamers', those intrepid men and their smoky machines keeping everybody amused trundling back and forth outside the venue over the three day period of the show. There were a total of 18 engines in action. They included Harry Clyne who travelled all the way down from Lockailort in the Highlands of Scotland with his 4in. Tasker Traction Engine and steamed it each day. Another steamer was Martin Young who ran his very nice 4in. Garrett Traction Engine. The smallest engine running outside was a plucky 2in. Fowlers Showman's Engine built and run by T. Backhouse of Cumbria.

A fine example of a Black Five class locomotive, built to 5in. gauge by M. K. Young.

Many familiar faces were present representing the 'Trade'. As in previous years it was nice to stock up on goodies that only ever seem to be available on these occasions. A new exhibitor this year in the Trade Section was Swann-Morton selling their range of precision scalpels. On the Saturday they featured what can only be described as 'mindboggling' micro-modelling. Mr. Willard Wigan has created a range of sculptures from such materials as granules of sugar and the lead in a pencil. Some of these minute works of art were mounted in the eye of a standard sewing needle and can only be seen through a powerful microscope. Willard holds the Guinness Book of Records Title for his micro-sculpture. There was a steady flow of visitors eager to view his work through the microscope. One needle's eye contained a galleon in full sail, carved from a granule of gold. Another contained a carving of the Statue of Liberty sculpted from a minute piece of ivory. Many sceptical onlookers were convinced of some form of trick display involving the microscope lens, but I was allowed to move the slide mount and adjust the focus while viewing one of the needles. This proved to me beyond doubt that no tricks or illusions had been used. All very clever, but not our kind of Model Engineering. Even so I am pleased that I did not miss meeting Willard and seeing the work of this uniquely skilled artist.

In conclusion, I would judge the whole exhibition a total success and congratulations should be given to the organisers and the team of stewards.

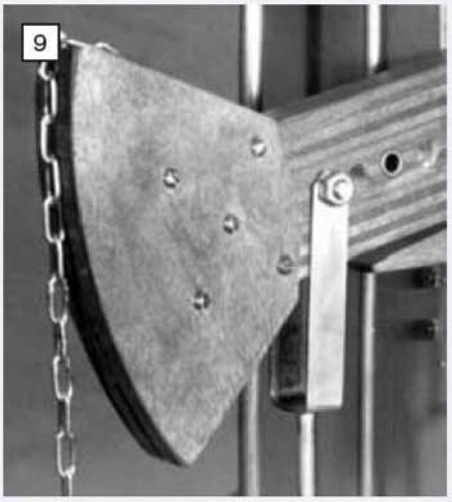
●*To be continued.*

Exhibiting for the first time at Harrogate was Maxitrak.

The Huddersfield Society of Model Engineers stand.

A Spam can makes a fine hot well. The snifting valve is mounted above the water level so that water discharge can be observed.

The piston has two 'rings' and 0.015in. clearance. The spring and nut provide for delicate adjustment of friction versus sealing.



The motion of the laminated plywood beam is limited by the to 'spring beam' beneath it. Multiple holes allow for changing the pump output.

A GIANT STEP BACKWARD

Chris Leggo

continues his description of how he got his model of a Newcomen engine to work reliably.

●*Part II continued from page 115 (M.E. 4152, 10 August 2001)*

The model is equipped with only one valve, there being no available drop to pull the water from the cylinder. The valve, **photo 7**, can be either above or below the water level in the hot well. When working properly, it will discharge water and then a slight amount of air and steam as the piston is rising. When injection water is admitted to the cylinder and condensation takes place, the check valve closes.

The piston is made in three pieces, **photo 8**. The lower 'ring' is compressed between a bottom flange and a loose fitting brass ring. The top 'ring' is compressed between that brass ring and a cup at the top. A spring and nut adjusts the compression. The 'rings' are soft string, just the way Newcomen did it except that he used weights to compress a rope packing. The water seal is vital. Without it, air will seep into the cylinder and the engine will stall for lack of vacuum.

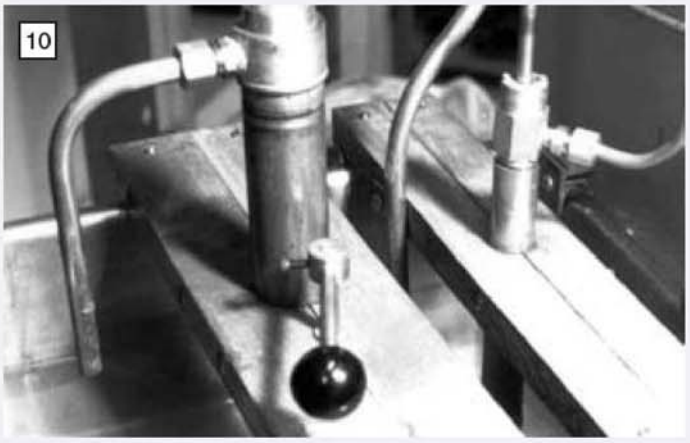
The frame is almost 36in. high which brings the scale of the engine and house to about 1in. to the foot. The model was made for demo purposes no attempt was made to simulate a proper house. The beam, **photo 9**, is made of laminated plywood to simulate the built up beam of the period. It pivots on a 1/4in. steel axle in oilite bearings. Care was taken throughout the building of the engine to minimise friction which turned out to be very necessary. It became apparent that the reason models of Newcomen engines are so delicate in their running is that friction does not scale. The cylinder is capable of a 5in. stroke but is limited to 4in. by the setting of the valves and the 'spring beam'. Not so necessary in the model, the spring beam was vital in the original to keep the piston from going through the top of the cylinder, or the bottom.

There are two pumps, **photo 10**. The pit pump is 1 1/4in. diameter and was one of those treasures from the scrap box. It had a very nice cup-ring bucket with a built in valve. The foot valve has six each 1/8in. holes in a circular pattern and the valve is a loose fitting disc of rubber from an inner-tube. The foot is fitted with a cock on the inlet in order to load the pump and slow down the action. The smaller pump is the cistern pump and is 11/16 diameter. The necessary capacity was something of a guess and several holes were bored in the beam to adjust the output. It turned out that a stroke of 2in. was necessary which seems like a lot, but that is what was needed to keep the cistern filled. Both the bucket and foot valve are designed with a circle of holes which are alternately covered and uncovered by a loose fitting disc of the same inner tube.

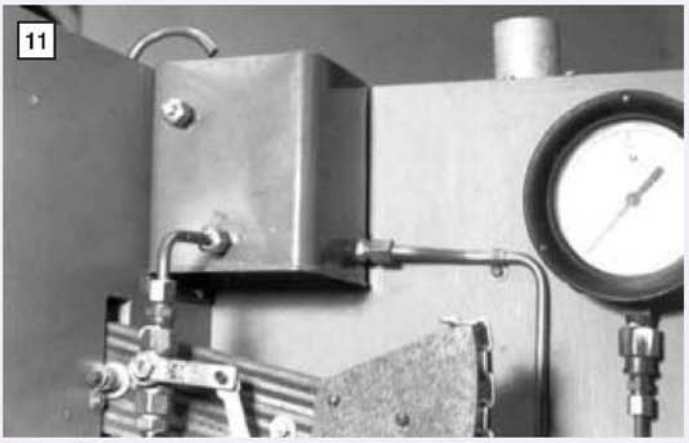
There are three tanks involved. The largest tank simulates the sump of the mine and supplies water for the pumps as well as accepting the discharge of the pit pump and the hot well. The hot well (a Spam can) receives the flow of the snifting valve, the overflow from the piston seal water, and the drains from the try cocks. The cistern (a biscuit tin) receives water from the auxiliary pump and feeds the injection nozzle and the piston seal as well as being used to fill the boiler when the engine is dead, **photo 11**.

Newcomen had self-acting valves on his original engine in 1712. The steam valve was snap action both on opening and closing. The injection water valve was snap opening and slow closing. He accomplished snap action on the steam valve with a pivoting weight, the valve not starting its action until the weight was over centre.

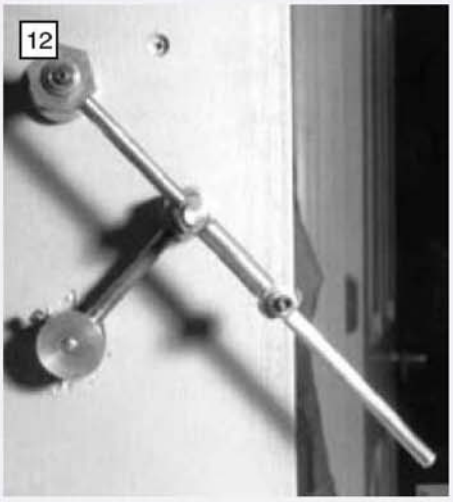
It was recognised early on that the snap action of the steam valve would have to be friction free and positive in its action. one of the construction articles mentioned suggests using a dead weight at



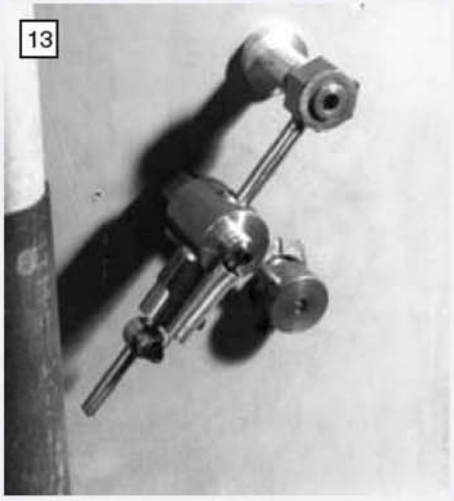
The black knob on the pit pump closes off the inlet valve to put a load on the pump and slow the engine down. The smaller pump feeds the cistern.



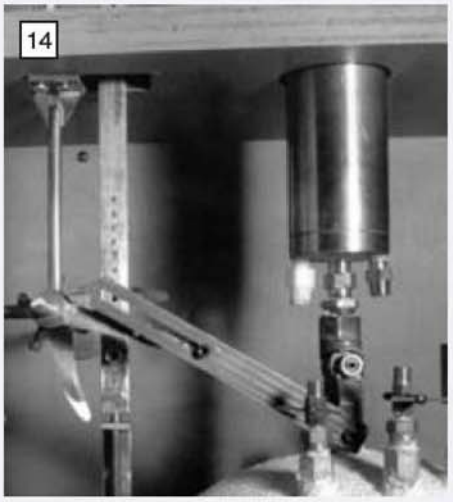
The cistern is mounted high in the 'house'. The plugged outlet was a 1/4in. overflow which couldn't take enough flow, 3/8in. is much better.



The first over-centre trip jammed and had too much friction. The steam valve shaft (lower) has a necessarily limited motion.



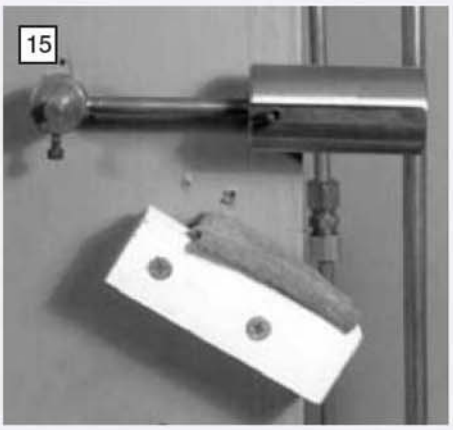
Linear bearings removed excess friction from the mechanism and the extra inertia helps it get it over centre.



The 'Y' lever in development which was trial and error, there being neither drawings nor dissertation on the subject

the end of a pivot arm. The other suggests a spring anchored under the shaft. The dead weight has a little better geometry in as much as the moment arm increases at a faster rate, but I used a different geometry all together. Whereas the moments of both the dead weight and the spring are zero at the centre position, increase as the arm moves, and are maximum at the extremes of movement, I have arranged a spring operated slide such that the moment goes very quickly to its maximum as the arm moves off centre and then diminishes to zero as the arm reaches its limit. It was originally made with a short slide which jammed because of a low length to diameter ratio, **photo 12**. A longer slide helped but there was still considerable friction. The final arrangement used two linear bearings with an overall length of about 1 1/2in., **photo 13**. This was quite free and the weight of the pump rod was enough to take it over centre. The greater inertia also helped.

The yoke which operates the steam valve (the Y lever) was first made in one piece, but it soon became apparent the I wasn't going to be able to guess my way to success. Two separate arms were made, as well as the operating lever, and they all



The water valve is opened by a weight on the back side of the mount. The leather pad is to reduce the noise.

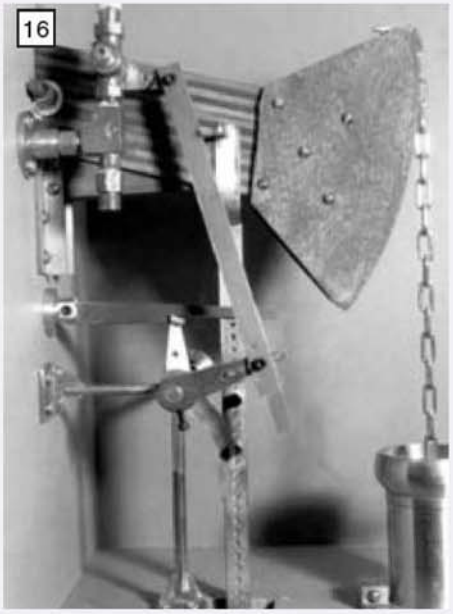
had individual adjustments, **photo 14**. It was the intention to use grub screws on the arms but I was out of them and had to use Allen head cap screws as an expedient. This was indeed fortunate as there were seemingly endless adjustments to be made to finally get the engine to run and the cap screws were much easier to get a wrench into.

The water valve is activated by a dead weight alone, **photo 15**, as it does not need an over-centre mechanism. The 'F' lever, **photo 16**, is released when the plug rod lifts the catch and is reset by the plug rod on its descent. All the pins on the plug rod are sintered bearings rolling on a steel stub.

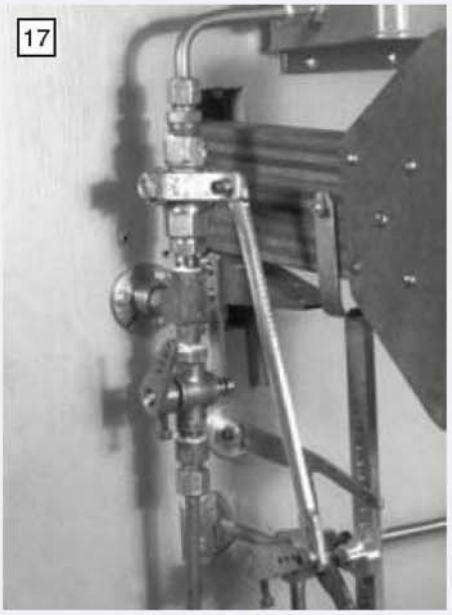
The plumbing on the engine got a bit complicated. The output of the pumps was easy. The pit pump goes directly back to the sump and the cistern pump goes directly to the cistern. The water path for the injection water, **photo 17**, goes through the plug rod operated valve and then past a shut-off valve which is used when the engine is shut down. Without this shut-off valve, the cylinder will fill with water and the cistern will need to be re-filled by hand. Another outlet of the cistern goes to the top of the cylinder to supply the water for the piston seal, **photo 18**. Boiler feed goes through a shut-off valve to a fitting on the boiler top which is shared with the pressure gauge. The eduction pipe has a tee which allows the vacuum in the cylinder to be monitored. What is left is the outputs of the try-cocks which drain into the hot well. **Photo 19** shows the somewhat crowded boiler top.

Making it run

At first I was using about 1 1/2psi in the boiler and could get only about 3 strokes before the machine stalled. The piston would shoot up to the top of the cylinder, the vacuum was only about 5in., and adjusting the weights on the pump rod didn't seem to help. Then, on shutting down, the boiler pressure would decrease to about 1/2psi and the engine would run better. It would seem that the greater amount of steam was too much for the injection water to condense. The lesser amount of steam increased the vacuum from 5 to 15 inch. Appropriate adjustments were made to the pump rod weights, the steam valve trips, and the water valve opening and now I could get about ten strokes. Then with the trip arms carefully adjusted to a centre point, the actuating arm remade, and more adjustment made for the water valve, I could get about 30 strokes before the cylinder got 'wind-logged'. The final answer was to lower the snifting valve about 4in. to help with the flow and to slow down the action of the outward stroke so that there was more time for the steam to expel the air in the cylinder. This was accomplished by restricting



The 'F' lever in development. The water valve must open the moment the steam valve closes. The lower pin controls closing.



The injection water valve must be free working. The lower valve keeps the boiler from overfilling when the beam is up.

Water is dripped onto the piston to seal the rings. The second valve is to feed the boiler. The clamp on the cylinder avoids possible distortion due to soldering.

The boiler top gets crowded. Pressure in the boiler can be adjusted by substituting weights on the safety valve.

Without a pump rod, there must be a dummy weight which is almost enough to lift the piston to the top of the stroke. Water supply pumps such as at Kew Bridge also had to have a dummy weight.

the bucket valve in the cistern pump. The engine would then run at 1/2psi, the vacuum going to about 15in., and it would run at 12 strokes per minute indefinitely. All this took about two weeks of 'tinkering'.

It should be noted here that there is a definite relationship between the strength of the vacuum and the temperature within the cylinder just as there is between boiler pressure and the temperature at which it boils. At 5in. vacuum, temperature in the cylinder is 203deg. F. If you can reduce the temperature within the cylinder to 175deg. F, 15in. vacuum will result. What this means is that if you can stand to pour a lot of water into the cylinder, you can reduce the vacuum accordingly.

The beam must be balanced so that with the piston disconnected the weight of the pump rod will be enough to operate the valve gear but no more, **photo 20**. The pressure of the steam is then enough to carry the weight and friction of the piston which has to have just enough squeeze on the packing to keep it reasonably tight but not so much as to cause inordinate friction.

Newcomen didn't have pressure or vacuum gauges but I made good use of them. The pressure gauge was modified to read 2psi full scale.

The gauges on the mount, **photo 21**, have been very helpful in getting the engine to work continuously. When first started I was lucky to get 7-8in. of vacuum. With the final adjustments, vacuum runs at 15in. when the stroke is slowed down to match the up stroke and this vacuum is maintained all the way down until the steam valve opens. If the engine is stalled by closing off the pump inlet valve, vacuum will go to over 20in. but will soon leak off through the piston seal and the engine will have to be restarted.

There is not enough capacity for the boiler pressure to be maintained. When the steam valve opens, pressure drops rapidly to zero. When the steam is shut off, pressure recovers to 1/2psi by the time it opens again. This is the way the original engine worked.

Piston sealing water is adjusted so that there is a little water returned to the hot well at each stroke. It doesn't take much water, but if it goes dry, there develops a sucking wheeze on the down stroke, the vacuum will drop to about 5in., and the engine will stall. Another way to make it quit is to release the suction restriction on the pit pump. The inward stroke is now very fast and there is not enough time for the condensing water to do its work and vacuum will fail. Optimum operating rate is about 12 strokes per minute, just as the originals did.

To start the engine, the boiler is filled to the top cock by opening the feed line from the cistern with the top cock opened. When water emits, the feed water valve is shut. It is necessary to hand feed the cistern during this operation The fire is lit with the top cock still open and in about six minutes steam emits. The top cock is now closed and steam pressure is allowed to build up and the safety to blow by for a few more minutes to get everything up to temperature. The cistern is topped up and piston sealing water turned on enough to cover the piston. It is now necessary to hold the piston at the top and let the bob down to open the steam valve to the cylinder. Steam is now heating up the cylinder and the pressure goes to zero. When there is a good emanation from the snifting valve, the injection water shut-off can be opened and the pump rod let down to open the injection valve. The engine will now start and run on its own, the vacuum being about 15in. on the down stroke and pressure in the boiler building back up to about 1/2psi during this period. In Newcomen's engine all the valves could be hand-operated with the engine at rest, i.e. with the pump rod down. The model has no such niceties.

At this point the piston seal is adjusted so that the water level just reaches the overflow and the pump restriction can be adjusted for equal inward and outward strokes. On shutting down, the only things to do are to shut down the piston seal water, the gas, and close the shut-off on the injection water so that the cistern doesn't drain away.

Injection water on Newcomen's engine was supplied from the cistern which was at the top of the house so that he had 20-30ft. (15psi) of head. on any model of this size you only have about 24in. at best, only 1psi. One of the first investigations I made was to see if the jet of water would be enough to reach the piston, and it was, just barely. The stream reached a height of about 8in. from the nozzle, **photo 22**. It has to be considered, however, that once a vacuum has been created in the cylinder, that will add to the effective head at the nozzle. At 15in. of vacuum, that would amount to an effective head of 15 feet!

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Manual of the Steam Engine, Thurston, 1903.
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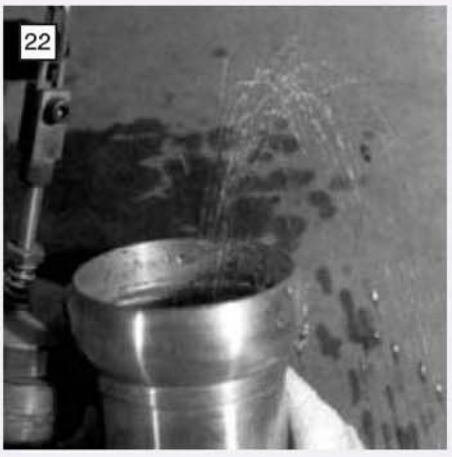
Model Engineer, 15 September 1972; 1 March 1923.



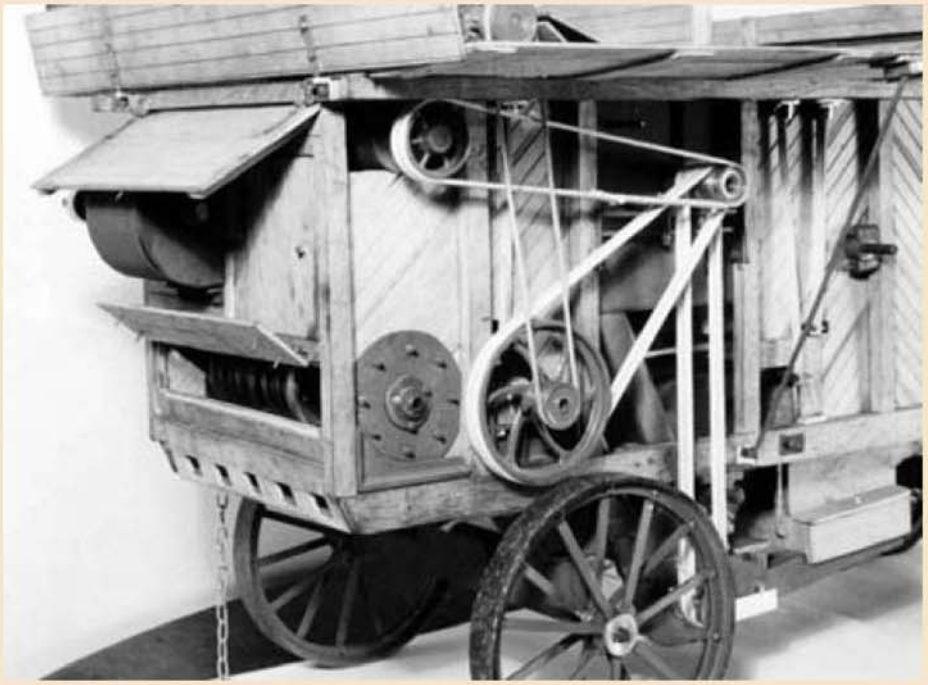
The spray of water from the injection nozzle was enough to reach the bottom of the piston and shuts off about half-way down.

COUNTRYMAN'S STEAM

John Haining

begins with some nostalgic memories of steam on the farm and follows by providing details on a root pulper model.

Part I



Above: This Ransomes 54in. thrashing box model illustrates the author's remarks regarding belts — "Despite the many open and unguarded belts, with open flywheels and pulleys, accidents were very rare indeed. Everyone handling threshing tackle, from the farmer downwards was aware of the dangers which could arise so easily". Below: An oil painting showing Steam threshing on the farm.

A BENTALL & Co. ROOT PULPER

(suitable for 2 or 3in. scale)

Midsummer days on the farm saw work being done on tackle which would soon be required for what we called the 'back end'. Many farmers preferred to have crops harvested as early as possible, and many, too, relied on crop sales to pay the farm rent in the autumn, if they were tenant farmers.

Shropshire did not see very much steam ploughing, and it was not thought of as highly along the Welsh Marches as it was in East Anglia and the Midlands, where the fields were larger and more suitable for working with the big five and six furrow balance ploughs and 13-tine 'drags' or turning cultivator. As children my sister and I, after hay harvest, used to be despatched by passenger train down to Bedfordshire and Hertfordshire to stay for a magical fortnight or so on uncles' farms. The journey down, by steam train, was also one of the highlights, allowing me to see and note the details of locomotives we never saw on the joint GWR and LMS (late LNWR) running through the heart of Shropshire.

At home the engines and threshing tackle were being slowly prepared for another season's work, but in and around my uncles' farm steam

ploughing tackle was busy everywhere 'stubble breaking' the arable fields, using the heavy Fowler cultivators in the first operation of the new tillage season. John Patten's reams and tackle afforded me the most joy, as they were working very intensively in the adjacent fields and the drivers and ploughmen always seemed to be friendly and free with the great knowledge of their jobs to interested youngsters who wanted to learn more about steam cultivation and the art of cable ploughing in the countryside.

I had high hopes that a small steam ploughing contractor would expand his business to cover our end of the Marches, although he preferred to use single-engine layouts rather than the double–engine system, mainly owing to the odd shapes of some of the local fields. To my great disappointment, after several of our fields had been ploughed my father expressed great concern over what he considered over-deep ploughing and interference with the sub-soil, and ruled that we should not use steam again, so that was the end of that, and we reverted to horse ploughing aided by the sole local tractor, when it was in working order and available. Now my son-in-law ploughs in five hours an acreage that occupied nearly a week, all those years ago!

In our local Rural Life Museum recently a visitor asked me if steam was ever put to any use on farms. When being shown albums of photos of steam ploughing all over the world and some fine photographs of threshing by steam, with traction engine, box and baler on a dozen local farms he expressed surprise and some doubt. I soon found out that he had been informed 'on good authority' that steam was rarely used in agriculture and had ceased to be used at all in the early 1920s. I did not bother to enquire whence this wealth of misinformation came, as it was obviously from a source unwilling to do much genuine research into the subject! John Patten, of Hall Farm, Little Hadham, Herts, kept his ploughing engines and tackle in work commercially until almost the ending of all commercial work. His drivers and ploughmen were a mine of valuable information, and I only wish that in those days it had been possible to record some of our conversations and the information they so willingly passed on to me and others. Threshing contractors abounded in the countryside, some with a couple of engines and boxes, plus a baler, others ran a small fleet, usually with their own maintenance and repair shops. Every farmer, and even many smallholders too, had at least an acre or two of arable, with the larger arable farmers running much larger acreages, and every crop of wheat or barley, however small, required threshing out. This kept the threshing contractors busy and made it essential to have facilities to deal speedily and reliably with breakdowns either on engines or threshing machines and balers to keep them at work.

Despite the many open and unguarded belts, with open flywheels and pulleys, accidents were very rare indeed. Everyone handling threshing tackle, from the farmer downwards was aware of the dangers which could arise so easily, and if a youngster failed to observe the safety rules a clip over the ears ensured that he did not offend a second time! As I well remember!

Another golden rule that was always hammered home was that an engine was never left unattended, whether running or idle, once it was in steam. It is good to see that this rule is observed by all who bring their engines to steam at Usk Farmers Club Annual Show each year (see pages 542/543, *M.E.* 4134, 1 December 2000).

Whilst on the subject of the Show, this year's has unfortunately been cancelled due to the foot and mouth outbreak. However, the date for next year's event has been scheduled for Saturday 14 September and this promises to be rather special as it will be the Show's Jubilee Year.

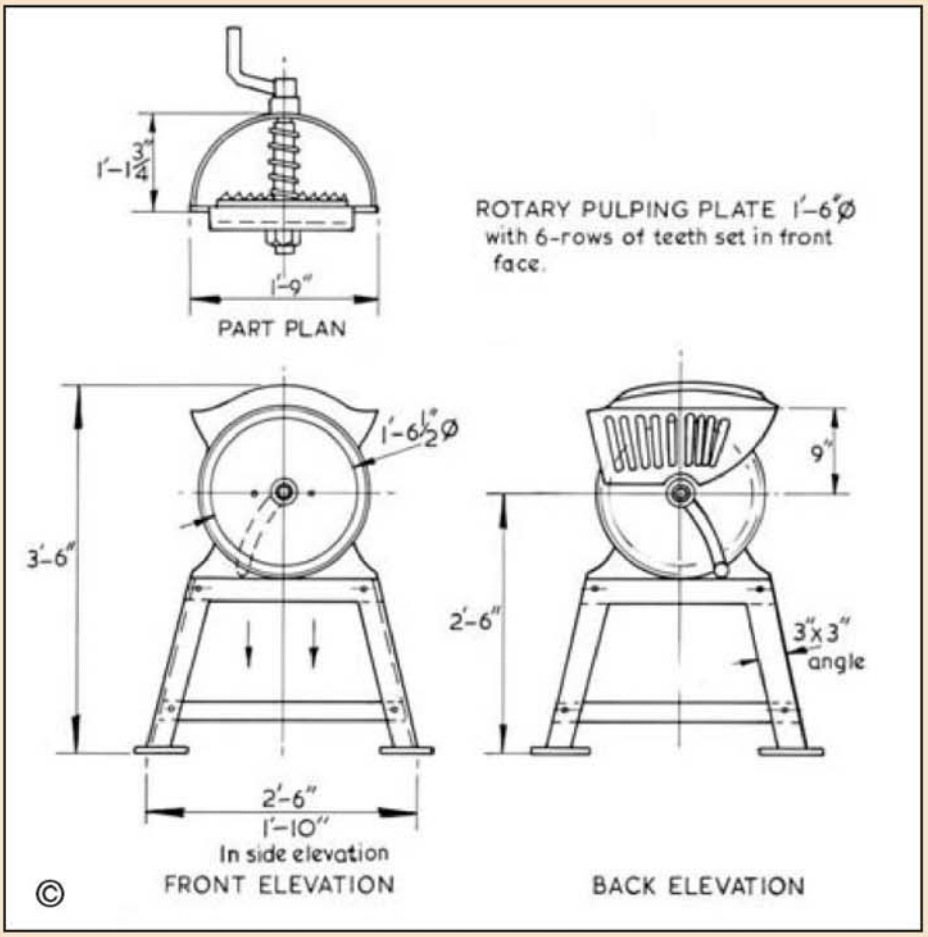
The Bentall & Co. 'Unchokeable' Root Pulper

Another small barn machine that was put to a great deal of use was the root pulper. This was used to slice root crops such as turnips and swedes into slices suitable for cattle to pick up and chew, and the name 'pulper' was a bit of a misnomer as the rotary pulping plate was really a heavy disc about 2in. thick with six rows of equally-spaced pointed teeth projecting out into the straight back of the hopper, rotated by a heavy spindle with a coarse thread running along its length which ensured that the root crops dropped into the top of the hopper were pressed hard against the six lines of projecting pointed teeth sticking out of the circular pulping plate. The 'pulped' fragments of turnips or swede fell out of a wooden receptacle or a bucket placed underneath, between the splayed legs of the machine. The pulper I used as the prototype for this model was fitted with a handle for turning, and had never been fitted with a belt pulley for driving from an engine. The snag about using power to drive the pulper was that it was a low speed tool, slicing the root crops well and evenly when rotated quite slowly. The trick was to load the hopper as full as possible and start a steady smooth turning action. A hopper fully loaded with piled-up turnips would be converted into pulped slices in a very short time, and the machine was very satisfying to use, even by hand. The makers of this pulper, Bentall and Co. of Heybridge, Maldon, gave it the name 'unchokeable' which was cast on the circular front face of the hopper, and their claims were very true as I found it almost impossible to make it choke on the turnips if overloaded. This was an excellent feature as it did away with the dicey business of having to dislodge wedged pieces of root crop from inside the pulping hopper and around the rotary plate by hand.

The full-size Root Pulper shown in my drawing has a steel stand of 3 x 3in. angle with a cast iron hopper with long slots in the curved back. The heavy circular pulping plate is either cast iron or mild steel, with hardened steel triangular shaped teeth let into the face in six rows radiating out from the hub all equally spaced, like spokes.

I have shown the dimensions of a full-size machine so that readers interested in small barn machinery can decide their own model scale. In my scale, 2in., radishes make excellent scale model turnips and 'pulp' well!

To be continued.



BRISTOL *AQUILA* ENGINE

Brian Perkins

concludes his construction notes on the 1/4 full-size Bristol Aquila Sleeve Valve Radial engine.

●*Part VII continued from page 134 (M.E. 4152, 10 August 2001)*

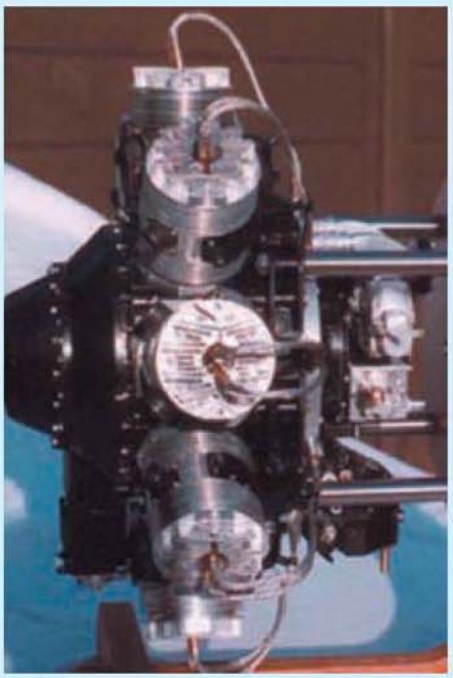
Another thing that had proved difficult to ascertain was the layout of the carburettor as the engine I was modelling did not have one but at about this time the engines which were on display at the Bristol Industrial Museum were returned to the works and the second Aquila had its carburettor fitted so at least I had something from which to take dimensions. Another friend who is building a *Mercury* had come across a handbook with details of the carb. so with this and the full size unit I was able to make a start.

The full-size unit is a twin choke S.U. with all the usual variable mixture controls and twin float chambers and obviously it would not have been desirable to incorporate all these features in the model, that's my story anyway!

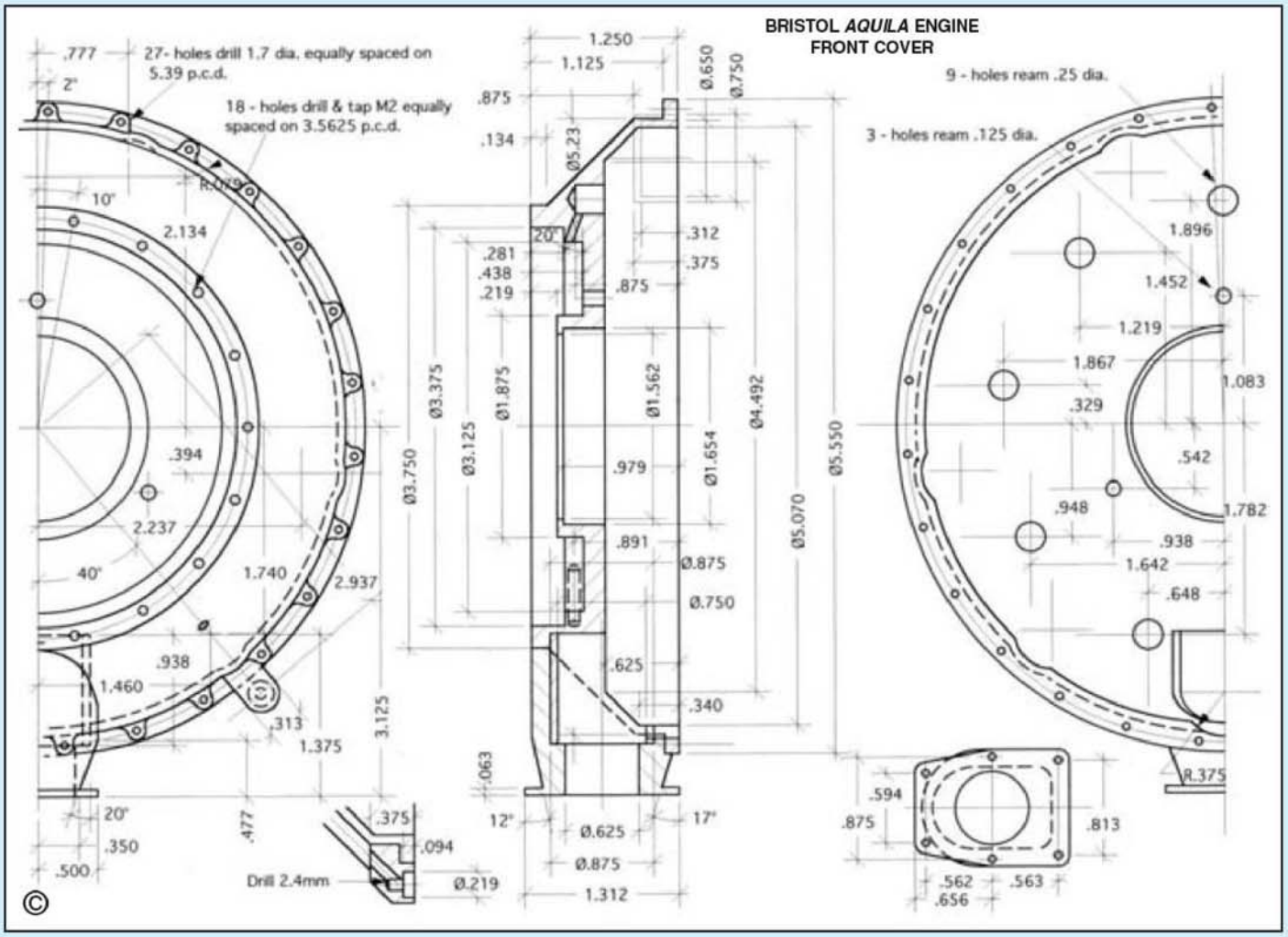
However, I have tried as far as possible to reproduce the overall shape with its twin choke layout and with the provision of the slow running jets as part of the butterfly throttles as on the full size but I have only incorporated a single float chamber and the main and slow running jets are controlled by needle valves rather than the fully submerged emulsion jets of the full size.

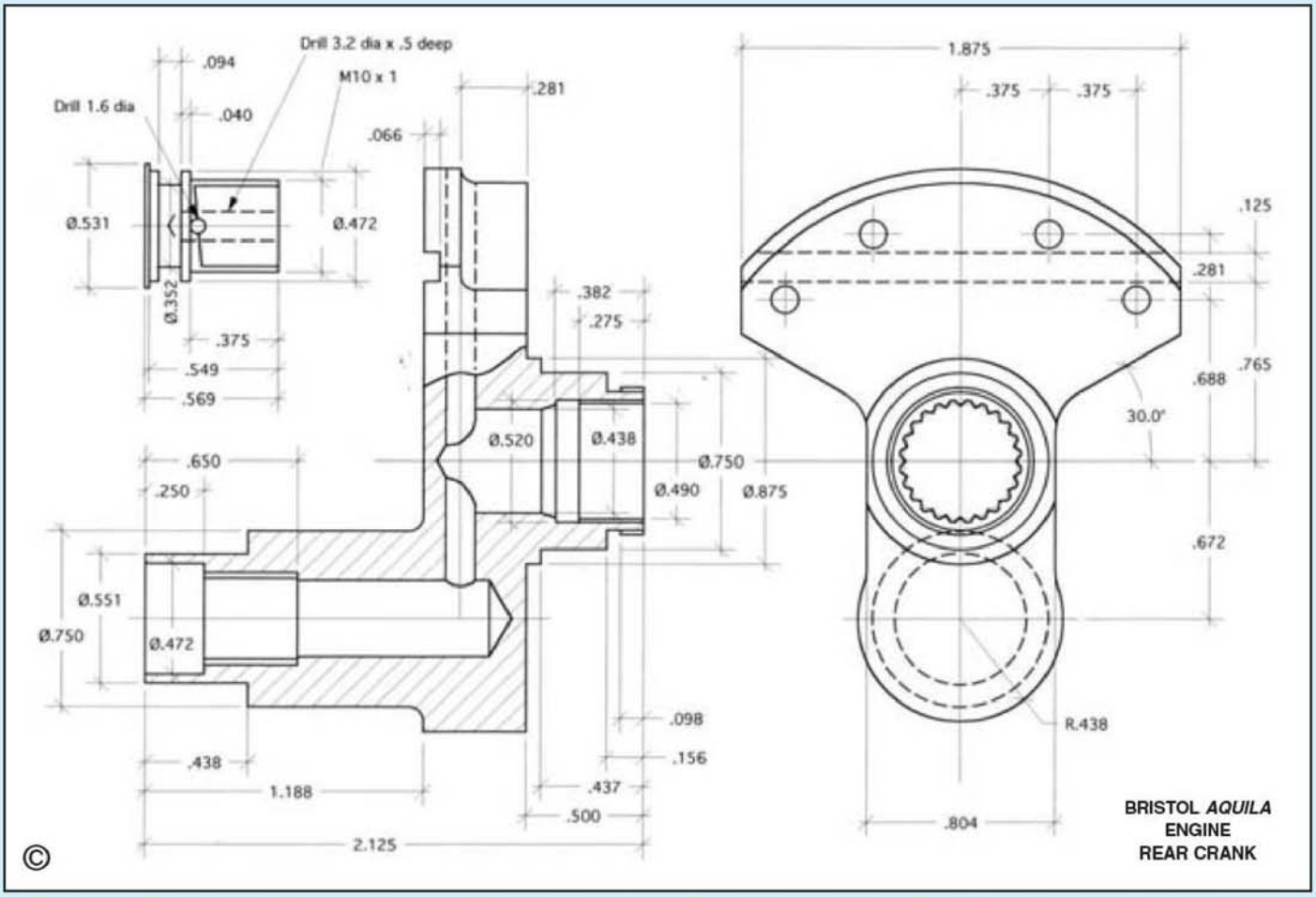
It was now the beginning of October and I realised that if I was going to enter the Model Engineer Exhibition, which had been brought forward to early December because of the Millennium, I would have to concentrate on finishing only one engine. So I sat down and made a list of the jobs which were required and estimated the required time which came to a total of 82 hours or 20 days at my usual average so I should have been finished by the end of October. It is just as well that I was not quoting for the work because the final touches were not completed until Saturday 4 December for me to take the model to London on the Monday and I had to work some very long hours towards the end.

Most of this time has disappeared in a blur because there were very few actual units produced but I do remember the exhaust stubs, distributor caps and their covers, assembling 18 spark plugs, the scavenge pump body (quite an intricate detail which I scrapped and had to remake), oil pump gears, piston rings and their fixture but mainly it was assembly and making hundreds of studs and special bolts and nuts.



The completed engine ready for entry in the Model Engineer Exhibition. However, it was a close thing as final assemby was completed just 24 hours before the start of the show!





The inlet manifolds are each held in place by 17 special square headed 10BA bolts for which the cylinders had to be tapped, a total of 153 bolts and tappings.

The 18 exhaust stubs are each held in place with four 10BA studs with special domed nuts.

The 9 cylinders are held in place with nine 8BA studs with special nuts.

The 9 cylinder heads are held in place with ten 7BA studs with special nuts.

and so on and so on! A total of 450 studs, 184 special bolts and 314 special nuts per engine, whose stupid idea was it to build *two*!

The assembly went reasonably well starting with the speed reducer which only had to come apart three times before I got the gear clearances right. The timing gears had already been assembled on to the crankcase and all the gears seemed to mesh satisfactorily but feeding the ends of the gear shafts into the bushes in the front cover was quite an exercise as you are working completely blind and having to get 12 shafts into 12 bushes.

I then started assembling the pistons to their rods and crankshaft, sleeves to their cranks and the cylinders to their sleeves so that I could set the timing. This timing is not difficult as, starting at No. 1 cylinder you put the piston and sleeve at tdc, turn crank until No. 2 piston is at tdc and place No. 2 sleeve at bdc and so on until you have done all nine.

However, having completed the first three and endeavouring to turn the crank to No. 4 there was a nasty clunk and the crank would turn no further.

I remembered that I had met a chap at the trust who had worked in the design office in the 1930s and he had a recollection that the full-size engine had a problem with a foul between the slave rods of cylinders 9, 1 and 2 (the top three) and it turned out that I had the same problem. Perhaps my internal design was not so different to the full-size after all.

Anyway slots were machined in the bottom of the sleeves to clear the foul and after the fifth rebuild the problem was solved. I became very good at fitting sleeves and piston rings!

The problem had not shown up at the drawing stage because, as is traditional I had drawn No. 6 cylinder at tdc and the problem does not arise until No. 1 is at tdc when the slave rods on either side are very flat. I think the problem probably arose because of the attempt to keep the diameter of the engine as small as possible which, with the nine cylinders, makes the crankcase very crowded.

Crankcase and front covers with the drill jig mentioned previously. I still do not understand what went wrong!

The assembly of the supercharger drive and rear accessory gearbox did not cause too many problems although getting some of the nuts on to their studs was quite interesting particularly the fixings for the magnetos where the nuts would be plucked out of the tubular box spanner and attach themselves firmly to the body of the mag. I have now found some nickel plated brass nuts which get over this particular problem.

Assembly of the engine was helped by the stands that I had made for the engine which allowed it to be rotated about its axis so now with the crankcase and other components painted to match the full-size engine I was ready for the exhibition a full 24 hours before I was due to leave for London—phew! (2019 hours from January 1997)

It was all worth the effort, however, as I was awarded a Gold Medal and the Edgar Westbury Trophy which has some very well known names engraved on its base.

Coming back down to earth this year and trying to complete the second engine has been difficult but I have almost completed all the details and the assembly should be easier if I can only remember how I did it last time. It's amazing how easy it is to find excuses for not going into the workshop when the work is not terribly interesting but I must persevere. The trouble is I have started working on the drawings for the next project - not a good idea with the second *Aquila* still not finished.

After many trials and tribulations throughout this period there appears to be light at the end of the magneto tunnel and I hope to have something to write about soon, either that, or perhaps I should take up needlework.

LETTERS TO A GRANDSON

M. J. H. Ellis

discusses gib-strips, keyway cutting, boring tools and nameplates

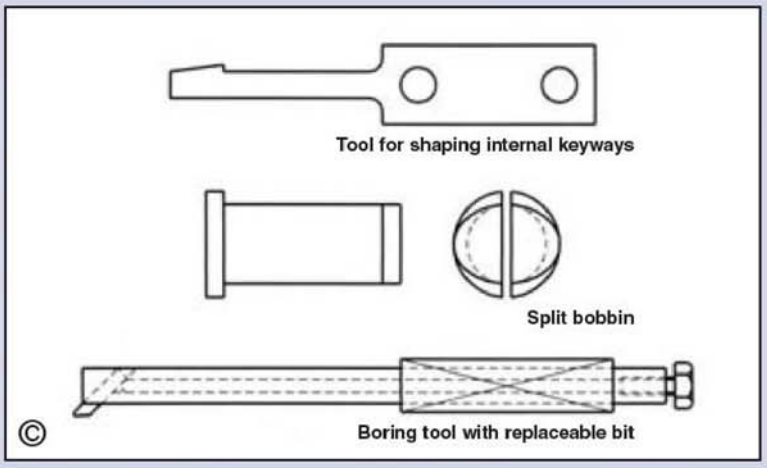
●*Part XXXII continued from page 138 (M.E. 4152, 10 August 2001)*

Dear Adrian, I said that I would finish off the dissertation on V-slides in my last letter by dealing with the fitting of a gib-strip in this one. To begin with, you have to make the gib-strip, which will be a parallelogram in cross-section, to fit nicely into the space between the top and bottom parts of the slide. I wouldn't try to mill the top and bottom edges to a 60deg. angle, but rather, mill them square, and form the bevel with a file—it wouldn't take long. The next thing will be to drill the tapping size holes for the screws, which will be half way up the gib-strip. The end holes should be 1/2in. or so from the ends of the gib-strip; and you should bear in mind that at the handle end of the slide this need not necessarily extend right to the end . For example, in the case of the Myford top-slide, the design of the screw and nut is such that when the handle is wound in as far as it can go, the top part of the slide still projects half an inch beyond the lower. While the gib-strip extends so that it is flush at the other end, at the handle end it stops short by 1/2 inch.

Four or five equally spaced screws are enough, and I recommend that they be headless grub-type screws and provided with lock-nuts. In a case such as this, where the holes will be drilled into the side of a rough casting, by far the best thing to do is to mount an angle-plate horizontal on the vertical slide, secure your work to it, and drill your holes in the lathe starting with a centre-drill. This avoids all messing about trying to make centrepops in the rough surface; it allows you to locate the holes accurately by means of the saddle cross-feed; and also makes it easy to make a tidy seating for each of the lock-nuts with an end-mill. In fact, this method has much to commend it whenever it is required to drill a set of accurately-located holes; where appropriate, using the up-and-down motion of the vertical slide in addition.

What I think I would do is, drill the holes tapping size, put the two parts together with the gib-strip in position, and drill through the middle hole into the gib-piece far enough (no more than 1/16in.) to make a crater for the screw to fit into. Then I would tap this hole and screw in one of the screws (already turned to a blunt point at the end) tight to hold the gib-strip in position, after which the other holes would be dealt with similarly. Finally, I would tap the other holes and fit the screws. To turn the points on the screws one could use a tapped bush in the 3-jaw, securing the screws with a lock-nut. As these screws are on the hard side, a carbide-tipped tool would be advisable. In concluding the subject, I would like to observe that time spent on making a slide smooth and silky in action is time well spent.

I suppose that I had been engaged in model engineering for thirty years before I got to know about the useful commodity known as gauge plate. It consists of tool steel in its annealed condition, ground to size, and it is available in a wide variety of sizes. 1/8 x 1 1/2in. is a useful size, as it is the ideal material for making keys for such things as flywheels. By the way, the standard proportion is a width of a quarter of the shaft diameter, so a 1/8in. wide key would-be appropriate for a 1/2in. diameter shaft. Gauge plate can also be used for making a tool for shaping a keyway inside a flywheel or something of that sort. The tool has a neck long enough to reach right through the bore, and has two holes through its shank, whereby it can be bolted to the vertical slide. It is easy enough to locate the tool centrally in the bore by sticking in a piece of silver steel on either side. For example, in the case which I quoted, a 1/8in. wide key in a 1/2in. bore, the silver steel would be 3/16in. diameter.



This arrangement works perfectly well, but if you like making unnecessary work for yourself there is nothing to stop you going in for the luxury version, which is the one I first thought of. You start by turning a bobbin, the centre of which would be a snug fit in the bore of the wheel, if only it were possible to get it in. The rims (or at least, one rim) of the bobbin must not stand up by more than half the thickness of the key, in this case, 1/16 inch. Through the centre of the bobbin is drilled a hole the size of the key, i.e., 1/8in. diameter. You part off the bobbin, and cut it in two axially. This reveals part of the hole on the two pieces. The purpose of the hole was to enable you to remove metal from the two flat faces, by milling or filing, until the last trace of the hole disappears. We now know that the two pieces are of the same thickness, and that the gap between them is just big enough to accommodate the shaping tool. In order to get the two half-bobbins into the bore all that is required is to file down the rim on one end on the two sides, at right-angles to the flat face. In spite of what I may have said, it can fairly be claimed that this method has the edge over the other, inasmuch as, if the tool is made with a hooked end, so that it cuts on the return (rightwards) stroke, enough of the tool always remains inside the bobbin to prevent the pieces, of the bobbin falling out.

Searching amongst my treasures, I found a couple of my boring tools with replaceable bits. No doubt, the bits could be held by a small Allen grub-screw, but not so firmly as my design allows. And besides, I have not found these tiny grub-screws entirely satisfactory. It is all too easy to over-tighten them, and this leads to enlargement of the hexagon socket. You then find yourself with a screw which has been spread, so that it is jammed in place, while at the same time, the Allen key turns round uselessly in the socket.

I have drawn a sketch of my design, from which you will see that it resembles my carbide-tipped design, in. that a piece of round rod is held in a square holder. The bit is held secure by a piece of round rod which passes through an axial hole, and which is tightened by a short bolt. You could simply drill a round hole to take a round H.S.S. bit, or get out a square hole for a square bit, as I have already described. I think I would go for the latter. As the pressure of the rod on the bit tends to spread the end of the rod, it is best to go to a little more trouble; make the rod from silver steel, and harden and temper the ends. To spring temper, or, at least, dark blue, I would say.

The time may come when you want to make an elegant nameplate to embellish your *pièce de résistance*. The way I set about this was by cutting out the rectangular frame and the letters from sheet brass, and then, when they had been daintily shaped, soldering them (with soft solder) to a back-plate. While the solder is molten you can move the letters about until they are in their correct position in relation to the frame, and if you make the back-plate a little larger than the frame, you can afterwards trim it down to the same size. These plates look quite well if, when they are finished, you paint them over with black paint, and then, before it dries, wipe it off with a rag moistened with petrol from the frame and letters, leaving a black background.

Before I close, I can think of a few more useful words to say on the subject of scraping. In what has gone before, it was assumed that the material was cast iron. This is particularly amenable for the purpose, as its crumbly nature is conducive to clean little scrapes. Cast gunmetal is also quite tractable, but steel can be rather troublesome. The scraper is inclined to leave here and there a tiny ridge of metal where it ended its stroke. It may not be perceptible, but it is enough to upset the process by creating a spurious high-spot. These places give themselves away by the blue which they scrape together, and now that you know what to look for you should be able to recognise them. But they can be a bit of a pest, and worst of all, they can produce scratches on the surface plate. That's a good reason for using a port-hole glass instead.

Your affectionate Grandpa.

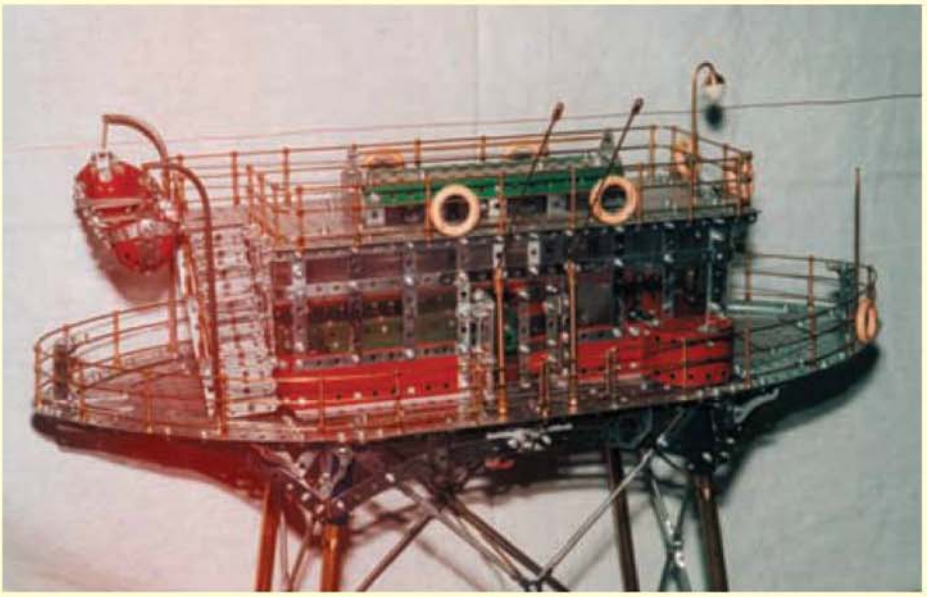
●*To be continued.*

VOLKS' *PIONEER* SPIRIT

Mike Dennis

concludes his description of how he built a 1/24 scale Meccano-based model of Magnus Volks' unique railway tram which operated along the Brighton seashore.

●*Part II continued from page 118 (M.E. 4152, 10 August 2001)*



A close-up of the model's deck and saloon, the trolley pick ups, poles and up-stands. One of the motor housings can be seen to the right of the central saloon doors. Clearance between the trolley upstands and the saloon is toe crunchingly tight! The lamp is mounted on a brass upstand made from 3/32in. dia. brass rod formed to shape and threaded 8BA for mounting via a Meccano bolt with an 8BA thread through the centre.

My *Pioneer* model is 25 1/2in. long and this is the only dimension outside my stated general tolerance of ± 12in. and translates to 51ft. on the full-size vehicle. This is where compromise comes in again. I always aim to achieve this tolerance with models of all large subjects, but Meccano does not always allow it. As the model looks right to the eye I can live with the lack of precision and as the width of the model is 10 1/2in. which translates to 23ft. it is acceptable!

The model is to 1/24 scale in the as rebuilt condition of 1897 with the legs extended by 2ft. and to a general tolerance of ± 12in. on the dimensions from published sources and photographs. Some overscale compromise was necessary due to the major use of Meccano for construction. 'Heretical' parts are used to maintain realistic scale proportion.

The track was the main deciding factor for scale and is Hornby 0 gauge 2 rail set at 7 1/4in. centres — 1/4in. less than for true 1/24 scale. The 18ft. outside track dimension should be 9in. but is 8 5/8in. which translates to 9in. less on the actual size. Other main factors determined by photographs and the only official drawing I have are as follows.

1) The legs were 11in. diameter but are overscale at 1/2in. dia. on the model. The 7deg. angle at which they are placed applies to the side view only as on the original and the legs are mounted on the sponsons by large tapered bosses (about 2ft. diameter) on sole plates so these are slightly overscale.

2) The lower underframe, its bracing and various collars are also made from brass tube and rod and are a slight overscale compromise in accuracy.

3) The handrail stanchions were designed by me for eventual use on other 1/24 scale models. They conform to actual dimensions of 3 3/4in. dia. and the 1/16in. dia. brass used for the handrails is 1 1/2in. dia. which are both realistic scale sizes as the height scales to about 3 feet.

General construction and non-Meccano details

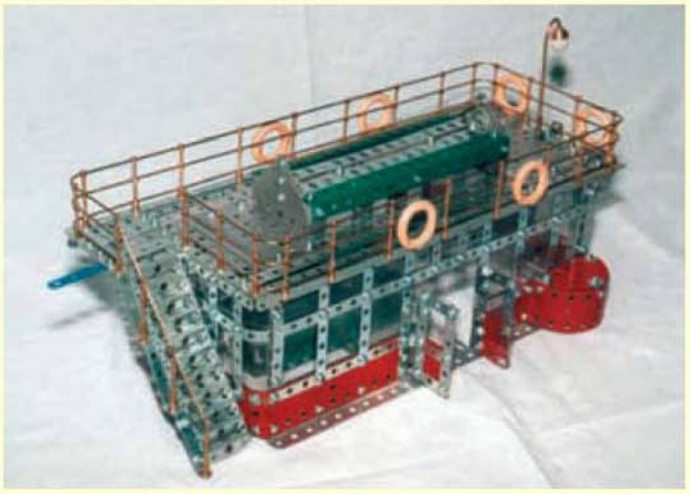
Legs—K&S Metal Centre 1/2in. Brass tube available at. model shops, fixed with my own design threaded adapter rings inside the lower ends of 2 1/2in. M.W. sleeve pieces which are fixed at the top under the deck by threaded chimney adapters, again of my own design on 2 1/2in. perforated strips with a 7deg. angled centre portion.

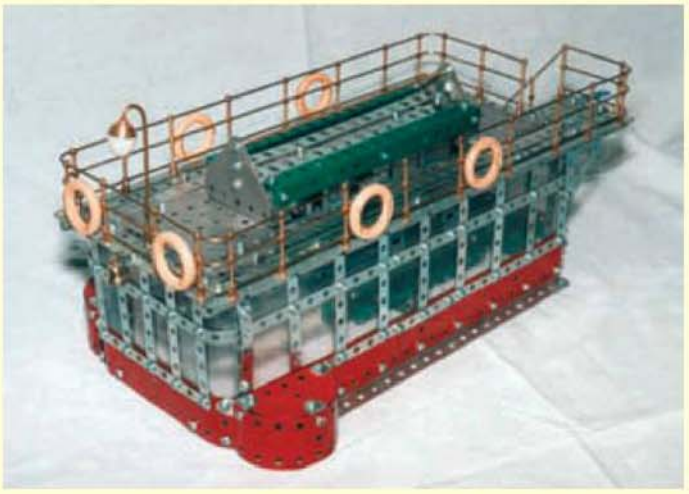
Lower Horizontal Underframe—K&S 9/32in. dia. tube with fourteen 1/2in. dia. collars threaded for Meccano grub screws and bolts. Three cross braces from 3/32in. dia. brass rod with 8BA adapters and 4 x 1/2in. bore collars threaded for Meccano short grub screws for fixing to the upper part of the legs. The centre brace is fitted to the cross braces by two reducing adapters from 5/32in. Whitworth to 8BA.

Handrail Stanchions—Brass hex 5/32in., turned and jig drilled in three positions and with 8BA ends, fitted to deck by two Table 2 sized brass washers and 1/4in. long cheese head screws. Handrails from 1/16in. dia. brazing wire soft-soldered to stanchions as appropriate, on the stairs.

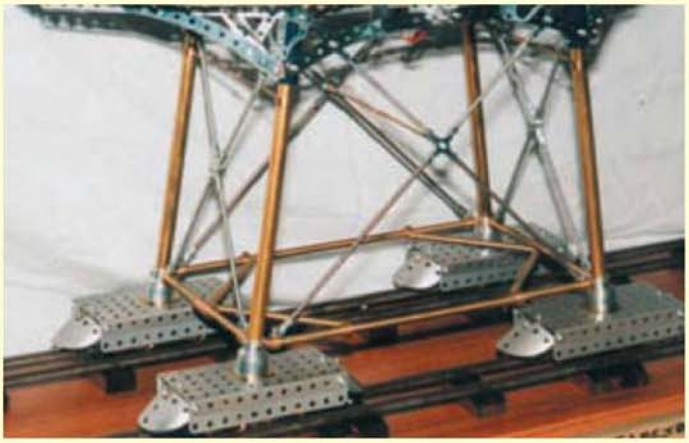
Trolley Pickups—Brass rod 1/16in. dia. with 5/32in. hex. ends threaded 10BA. The conductor is made from a 52in. length of 0.020in. (25swg) copper wire.

Upstands—A/F 1/4in brass hex, fitted to the deck by 5/8in. dia., Delrin Insulators. Lamp Glass



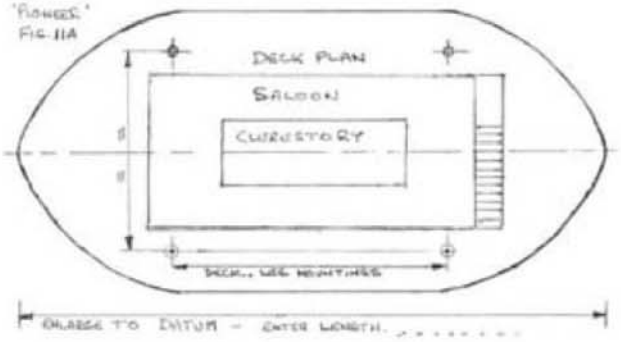


Two viws of the saloon detached from the deck. The author has made it removeable for access to the motor and upper ends of the drive shafts. Assembly of the whole saloon, plus handrails, took five eveningswork each of six hours duration.



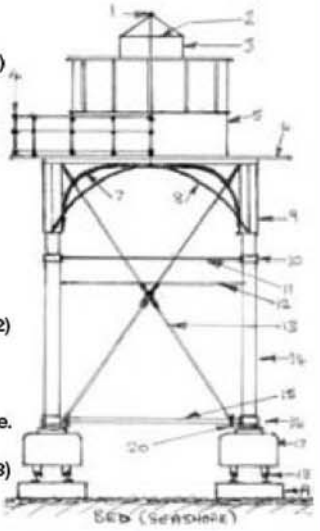
Lower leg construction and frame bracings. Also seen to advantage are the aluminium adapters and modified wheel disc sole plates for the leg mountings.

The author was determined to make the lifeboat from all Meccano parts, even if it took 'initiative' to achieve it. The judicious use of 'un-holey' instruments such as tin snips and a hammer were used to effect their modification!



Key to numbering. Quantities - One off unless stated in brackets.

1: Clerestory seat back rail.
2: Clerestory seat.
3: Clerestory assembly.
4: Hand rail stanchion (57) and rails (3)
5: Saloon assembly.
6: Deck.
7: Inner leg brace (2 each end)
8: Underframe brace (2 each end)
9: Leg Socket (4)
10: Cross brace collar (4)
11: Leg cross brace (2)
12: Centre cross brace.
13: End diamond brace assembly (2)
14: Leg, main tube (4)
15: Horizontal underframe cross brace (2)
16: Lower leg brace and sponson. socket (4)
17: Sponson (4)
18: Rail - Length/size according to scale.
19: Sleeper block - several!
20: Underframe/diamond brace collar (8)



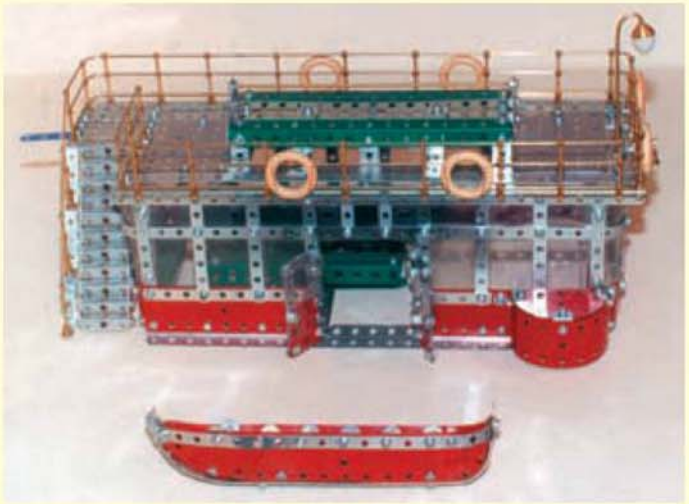
Delrin. The top is made from 5/8in. dia. brass.

The Lifeboat—All from Meccano but the davits are 5/32in. dia. E.N.1A bent to form with Meccano threaded ends. The life-belts are cafe rings from B&Q drilled for wiring to the handrails. The bell was bought at a local craftshop and is brass.

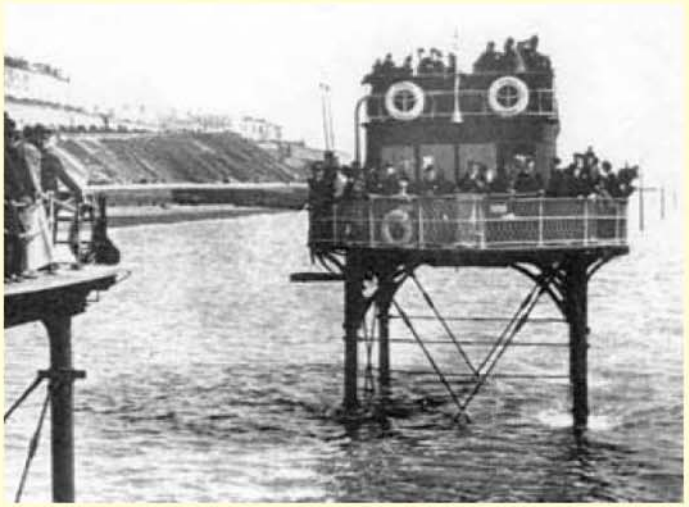
Motor and reduction gearing—This is a 24 volt D.C. Crouzet running at 22 volts. Drive is by worm and 13T pinion on one down shaft through one leg to a powered bogie. Transfer is by 18T sprockets on both down shafts with a 14T jockey for adjustment. The lower end reduction and drive to the bogies is via 19T pinions with faces reduced to 1/8in. and radiused teeth to compensate for the 7deg. misalignment. The 19T pinions each drive a 50T gear an a 1in. axle carrying a 25T narrow pinion inside the bogie sub-frame meshing with 50T gears on 2in. axles, each being fitted with two No. 20 flanged wheels.

Wheels, sponsons and bogie sub-frames—Most of the flanged wheels are single tapped type from the 20s and for the sponsons I used old style flanged plates with two flanges to facilitate the fixing of eight radiused semi-circular plates forming the ends. The sides are 11 hole flat girders. The sub frames are each made from two 11 hole strips with two No. 11a double brackets at the ends spaced from the underside with washers to provide correct meshing of the modified pinions with the 50T contrate gears.

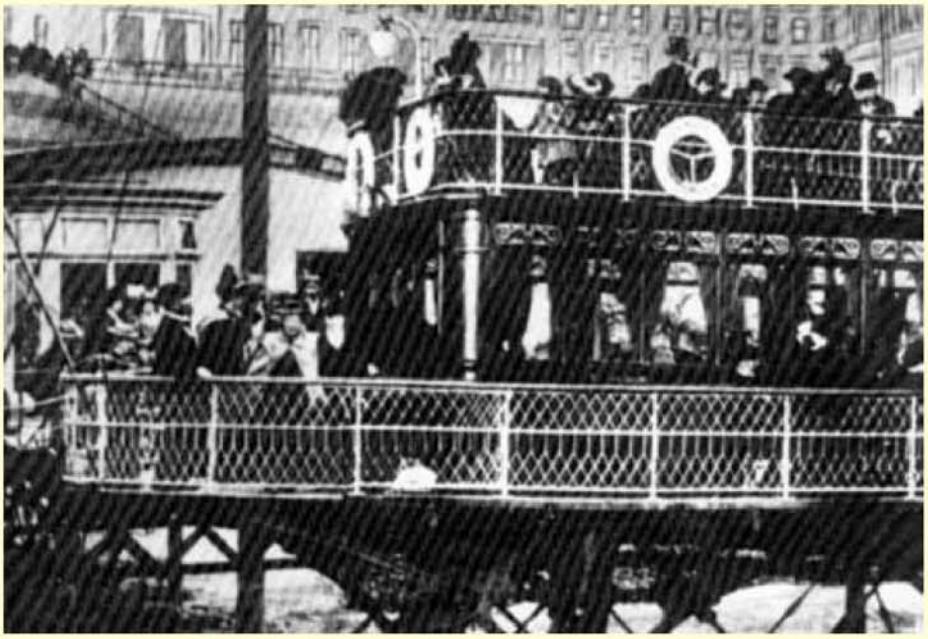
Lower leg construction—The main parts are made from four modified 187e wheel centres with four 1in. dia. special adapters (HE 30 Aluminium) held by one standard bolt from the underside. These allow fixing of the four legs by grubscrews. The 187e wheel centres are machined to 7deg. taper across the faces on an offset mandrel and bored to take four 1in. dia. x 2mm thick centring discs (HE30) drilled to suit the 187e and fixed to four similarly modified 8 hole wheel discs acting as sole plates by an 8BA csk screw x 1/8in. long in each. Each log is then fixed to the top of the sponson by two 1/2in. long bolts upwards from the underside. The leg and underframe dia-



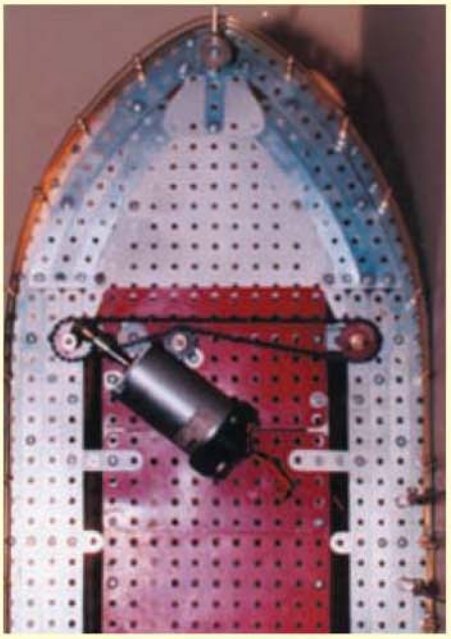
The saloon and lifeboat removed from the deck.



Pioneer *arriving at Paston Place during high tide.*



Taken at, or around, the recommencement of railway operations in July 1897, this photo of Pioneer is interesting in that it shows the lattice pattern of the railings and the ornate window fanlights in the saloon. Also of note is the lamp standard and life-belts that adorn the upper deck railings.



The motor upper reduction gearing by worm and pinion and the cross drive to the the opposite down shaft by chain and sprockets.

mond bracing is made from twelve 5in. and four 7 3/4in. Meccano axle rods held by 32 Rod/Strip connectors.

Upper leg fixings—Four 0.650in. O/D x 1/2in. I/D x 3/8in. long collars are located in the lower holes of four 2 1/2in. M.W. sleeve pieces. The sleeve pieces are fixed to the deck underside by four modified 5 hole strips with their centre portions bent to 7deg. to which threaded chimney adapters are attached by 8BA csk screws on 1/2in. P.C.D. in line about their centre holes.

Finish—Silver painted parts on the model are finished with primer and Pulsar Silver. The seats inside the saloon are Modena Green. The red parts used on the saloon and drive covers are mostly natural but some were 'touched up' with Monza Red. All paints are from the Halfords range. Strips and girders are all BZP finish.

Parts analysis

Total number of parts 842; non-Meccano 148. This number includes 18 David Fellows parts so the model is therefore within my 70-80% Meccano parts criteria. I have not included the two tram standards which are made using Meccano and David Fellows narrow angle girders and my own parts, or the eight 12in. lengths of Hornby 0 gauge clockwork railway track, copper wire for the conductor, and wood blocks to raise the sleepers of the teak finish baseboard.

General information

K&S Metal Centre tube references: 12in. lengths. 1/2in. dia — 139; 9/32in. dia. — 132 For parts and handrails made from 1/16in. dia. brass I used brazing wire obtained in 3ft. lengths from welding material suppliers but the K&S reference for 1/16in. brass rod is 125. For other parts I used Brass CZ121 Round, Hexagonal and HE 30 Aluminium rod which can be obtained from most model engineering materials suppliers in 12in. lengths. The 1/16in. dia., brass rod may be obtained in 2ft. or 3ft. lengths.

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Volks Railways, Brighton - An illustrated history by Alan A. Jackson, published by Plateway Press PO Box 973 Brighton B12 2TG, ISBN 1871 1980.

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Model Engineer November 3 1955.

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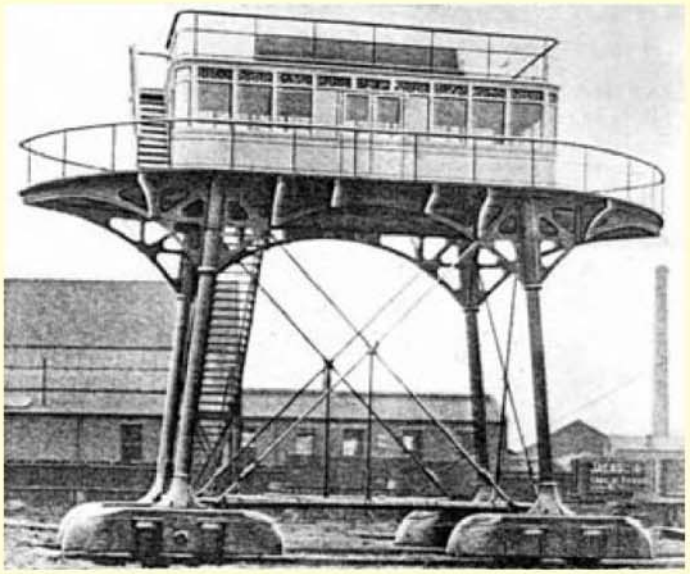
Notes and drawings provided by courtesy of the Volks Electric Railway Association.



Above,* Pioneer *pictured in all of its splendour at the Gloucester Railway Carriage & Wagon Co. works.

Left, seen at low tide during 1898, this view of* Pioneer *clearly shows the construction of the double track. The people on the shore line give a good indication as to the vehicle's large size.

KEITH'S COLUMN

THE TOAD

A GWR Brake Van in 7¼in. gauge

A commercial Toad van with a GWR prairie tank built by Keith and photographed at the Reading SME Grand Opening of the ground level track.

Keith Wilson

adds footrests to complete his brake van build and also provides details of an erection stand to aid construction of larger scale locomotives.

●*Part V continued from page 137 (M.E. 4152, 10 August 2001)*

Methought that the last part was indeed the last, but of course something is always forgotten, and 'twas only a fluke memory that prodded me into remembering that I had forgotten the footrests. They are quite simple, but very important. Used full-size in conjunction with the handrails to give shunters a quick 'lift', they are no less invaluable for us, for where else could a driver plonk his 'plates of meat?'

The originals were held on by forged brackets, strong enough for full-size, but if we consider that a scale driver would be about 7½in. high, weighing some ½ a pound, they would be approximately eight times too strong. Pause for thought, a full-size driver on our Toad would be rather over-scale(!) and somewhat stronger means of construction and materials are needed. The originals were wood planks, however steel welded together as shewn is adequate.

Whilst I shew ¾ x ¼, it will probably be more easily obtained as 20mm x 6mm. If it be stitch-welded into angle form it will take two sets of feet if needed. Do not forget the cut-outs level with the axleboxes, in theory they detract from the strength, but not so much as to matter. Note that the rounded edges of this 'black' resemble the plank-shape of the original footrests.

The whole footstep unit is assembled using the chassis as an assembly jig, begin by spotting-through the support brackets into the buffer beams, tapping and putting in studs. Then assemble the brackets onto the chassis, following which assembly and welding-up of the remainder is easy. You will need to open out the holes a little in the brackets after welding (experience again!).

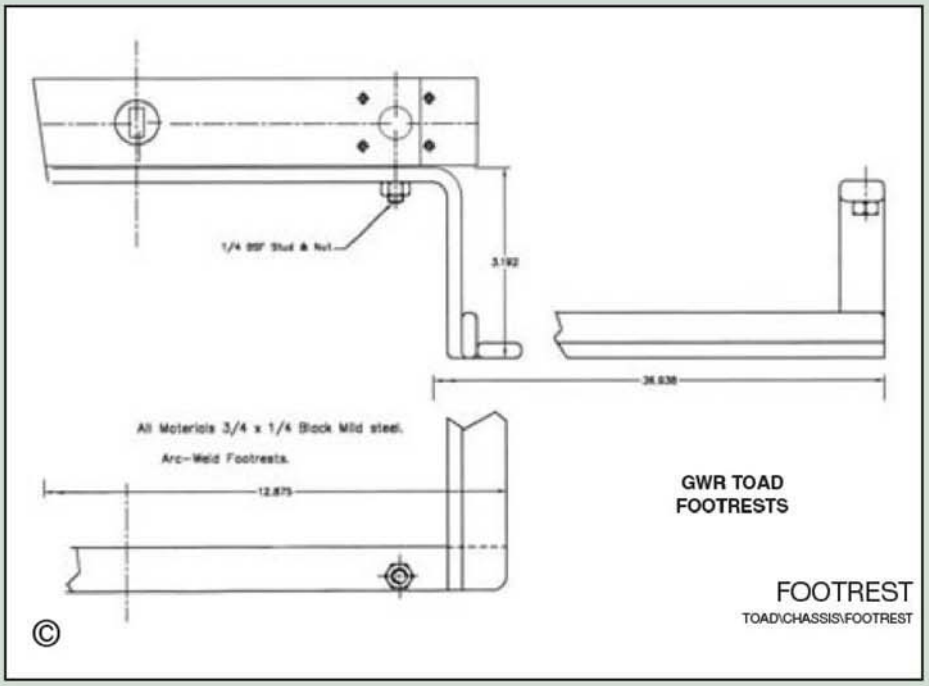
Note that the footsteps can be removed as a unit. Not that they should need removal, but 'tis nice to know it's possible.

United We Stand

Those who are fans of old 'Curly' may possibly recall that in his workshop he had not only quite a few machines, but a workbench and an erecting bench, presumably this latter being where he glued the bits together after they were made.

However, whilst this may be perfectly adequate for 2½ and 3½in. gauges, it becomes less useful with 5in. gauge and just about impossible with 7¼in. gauge, the more so if we build more than one locomotive at a time. Some people have built excellent rotating stands (i.e. the locomotive can be rotated about a lengthwise horizontal axis for working underneath). I find no problem with this, but the person who is willing to adjust the order of assembly of bits can usefully make the erection stand I shew here. I made eight of these about 15 years ago as I was making eight engines at one go - twit!

With a little forethought, the chassis can be assembled easily with only one turnover. The stand as shewn will handle up to 4-6-0s, but it is very useful to be able to 'wheel her along a bit' (such as when setting valves) so if you go in for a Pacific or larger than I suggest about 300mm longer.



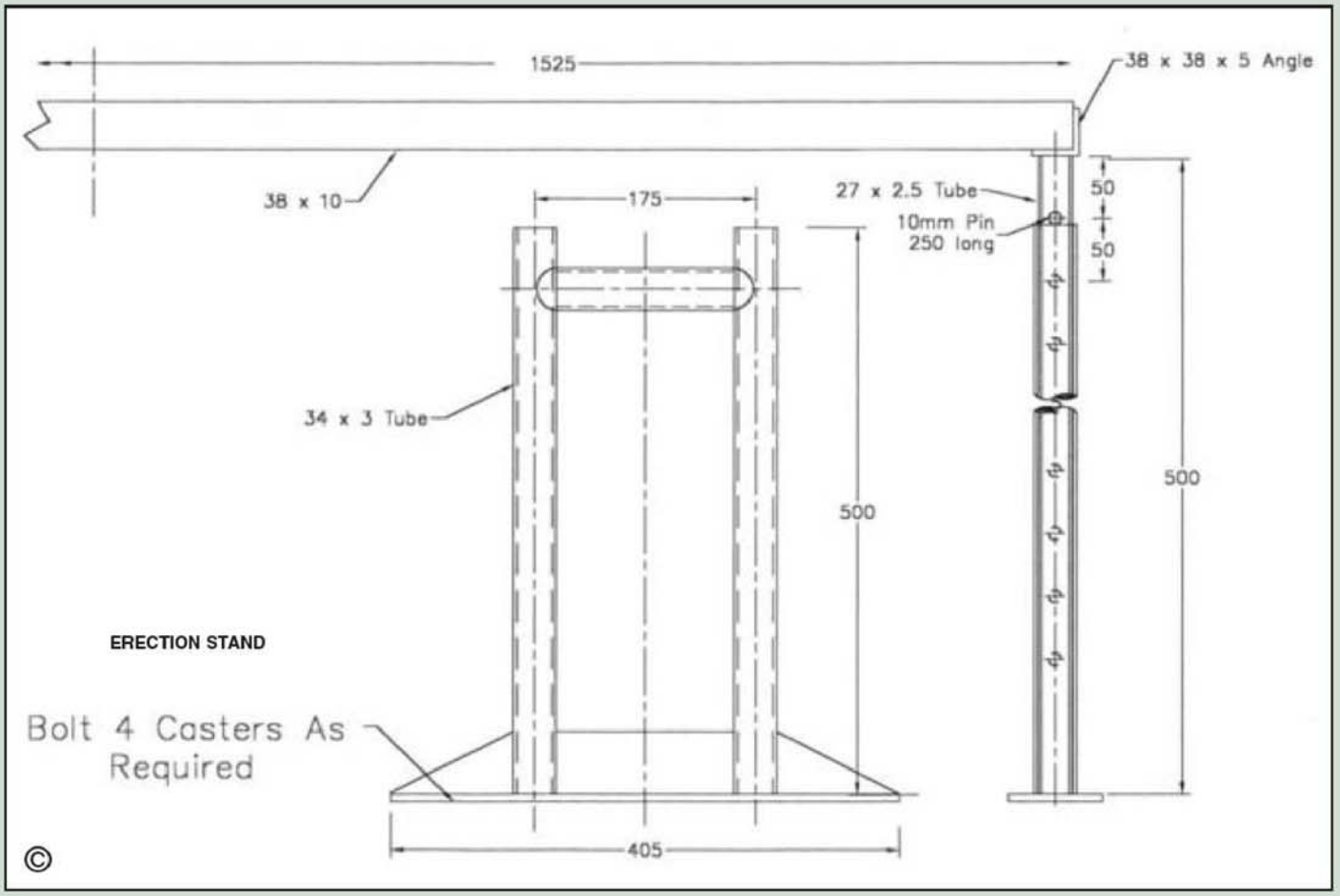
Above: The author's erection stand with a part finished locomotive chassis in place. Right: End view of the erection stand clearly showing its simple construction and the use of castors.

The discerning reader will note that the stand is height-adjustable in increments of 50mm (approximately 2in.). In connection with this, firms like Clarkes or Machine Mart etc. sell electric hoists rated at about 125kgs direct load. I bought one of these some time ago, it is mounted underneath a small trolley which runs along the lower flange of the I-beam along the middle of the workhouse roof.

By adding a twin pulley pair on the 'hook' end and a single pulley on the side of the trolley, this beastie will comfortably lift 1100lb. which means that a King or larger can be lifted en block, but take care to use a 'spreader' beam so that the chains do not damage the locomotive. Using a bar through the wheel spokes to prevent the chassis rolling too far, the stand can be lifted (or lowered) step by step.

The various catalogues seem to shew identical hoists, albeit in different liveries, so methinks they are all made by one firm (in Italy) and distributed accordingly.

The dimensions on this drawing are *all* in metric, so beware. I repeat a message given out every time a new design is described by me, anyone can make what use of the information in this design they wish, but if re-publication is effected then a courtesy acknowledgement is appropriate albeit not obligatory. As usual, when you spot an error *please* pass on the information to me a.s.a.p. Full-size drawings will be available in due course for those who find it tricky to work direct from the perforce smaller drawings appearing in 'ours', and in course of time will be updated if and when clangers appear (not sure why I put 'if' there).



I.C. ENGINE DESIGN

David Boote

describes an unusual swing beam arrangement together with a more conventional 2-stroke diesel.

●*Part IV continued from page 121 (M.E. 4152, 10 August 2001)*

The Armstrong Whitworth swing beam engine design did not survive to production but is, nevertheless, of interest. Feasibility studies for a small high output diesel engine started in 1977 and resulted in the Swing Beam configuration to meet the objectives of excellent first order balance, low vibration, and weight plus easy starting. The following information has been taken from *Chartered Mechanical Engineer* February 1979 published by Mechanical Engineering Publications and thanks are due to them for allowing its use.

The basic mechanism of the swing beam engine is shown in **figs 12** and **13**. It comprises a pair of vertical rockers with a three-throw crankshaft between them; the lower ends of the rockers are pivoted on bearings and the other ends are attached to the pistons. As a result the crank throw is only a quarter of the piston stroke. This means that with such a small throw that the crank pins can be joined without webs and still retain enough area of overlap to transmit the torque. By having no webs there is room for three throws in a width no greater than the cylinder bore.

The last opposed piston model known to the author is Roy Amsbury's superb Deltic type locomotive engine.

With this design the reaction loads are balanced. The crankshaft itself absorbs the high pressure forces and by using eccentric pins in the bottom pivot bearings of the rockers the compression ratio can be varied from about 20:1 for starting to 13:1 for running.

The crankcase of the experimental engine was machined from solid aluminium a practice favoured by many model engine constructors and during test runs an air supply of about 3-5psi above atmosphere was used for induction and scavenging. Full-size practice has favoured Roots type blowers but a vane type would be adequate and provides another area for experiment.

For consideration as a model, diesel operation would be very difficult but glow plug or spark ignition offer possibilities. (The Roy Amsbury Deltic used spark ignition). The prototype cylinder bore was 65 mm and stroke 71.5 x 2mm. For glow plug or spark ignition the compression ratio would need to be reduced. Overall, constructors are offered the possibilities of a different well balanced and smooth running engine with multi cylinder configuration by combining a number of single cylinder units.

I know of one single cylinder experimental model but much too early to include.

Coventry Climax H30 engine

In order to simplify logistic support NATO countries started programmes on multi fuel engines circa 1950s. One outcome of these was the H30 2-stroke diesel engine designed for auxiliary power supply in large AFVs (armoured fighting vehicles). The layout is generally as **figs 14** and **15** and shows a vertical three cylinder engine with six pistons and two crankshafts connected by a gear train with provisions to drive fuel injection equipment, Roots blower, lubrication and coolant

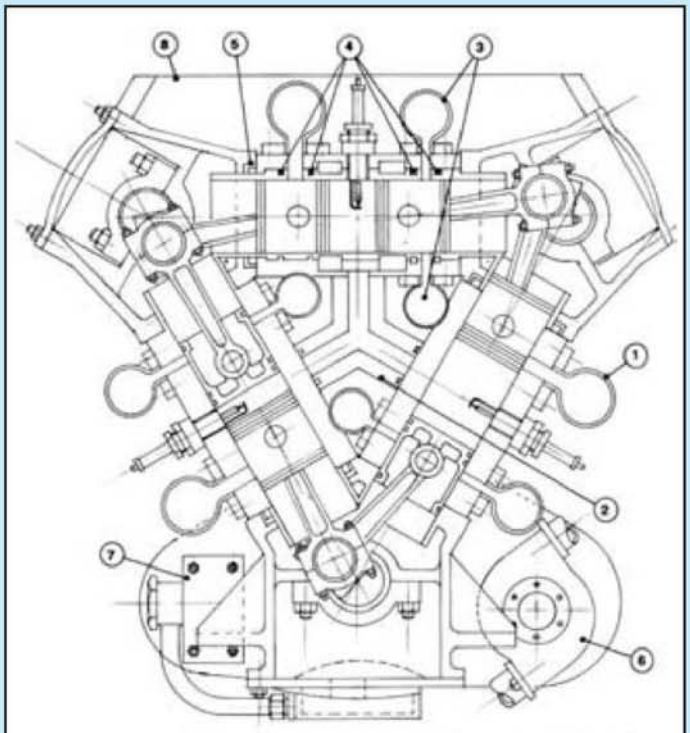


Figure 11:
Deltic engine section.

1: Exhaust manifolds (6)
2: Water passage link
3: Inlet manifolds (6)
4: 'O' ring seals
5: Liner clamp ring
6: Water pump
7: Oil pump
8: Gear case

Right: cylinder from Armstrong Whitworth's 2-stroke diesel showing the combustion and breathing section.

Below right: basic mechanism of the swing beam engine built by Armstrong Whitworth.

Below: the swing beam components layed out.

Figure 12

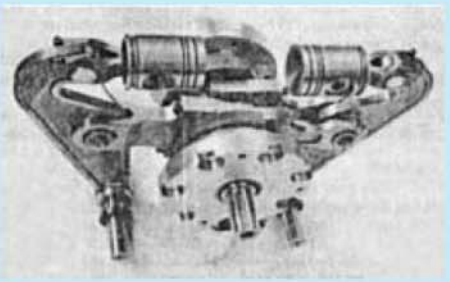
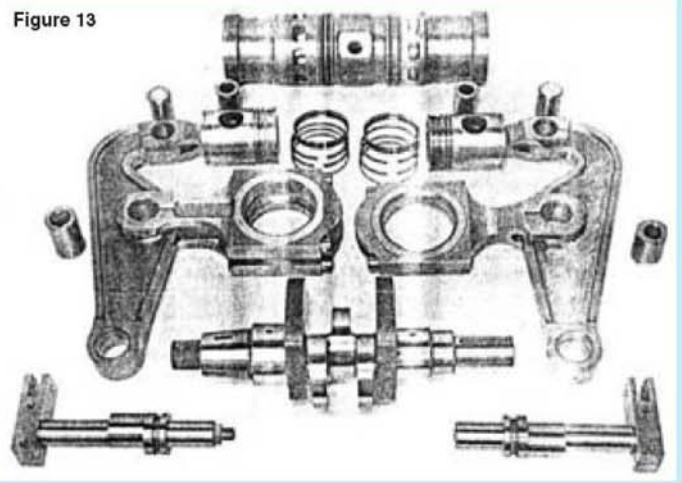


Figure 13



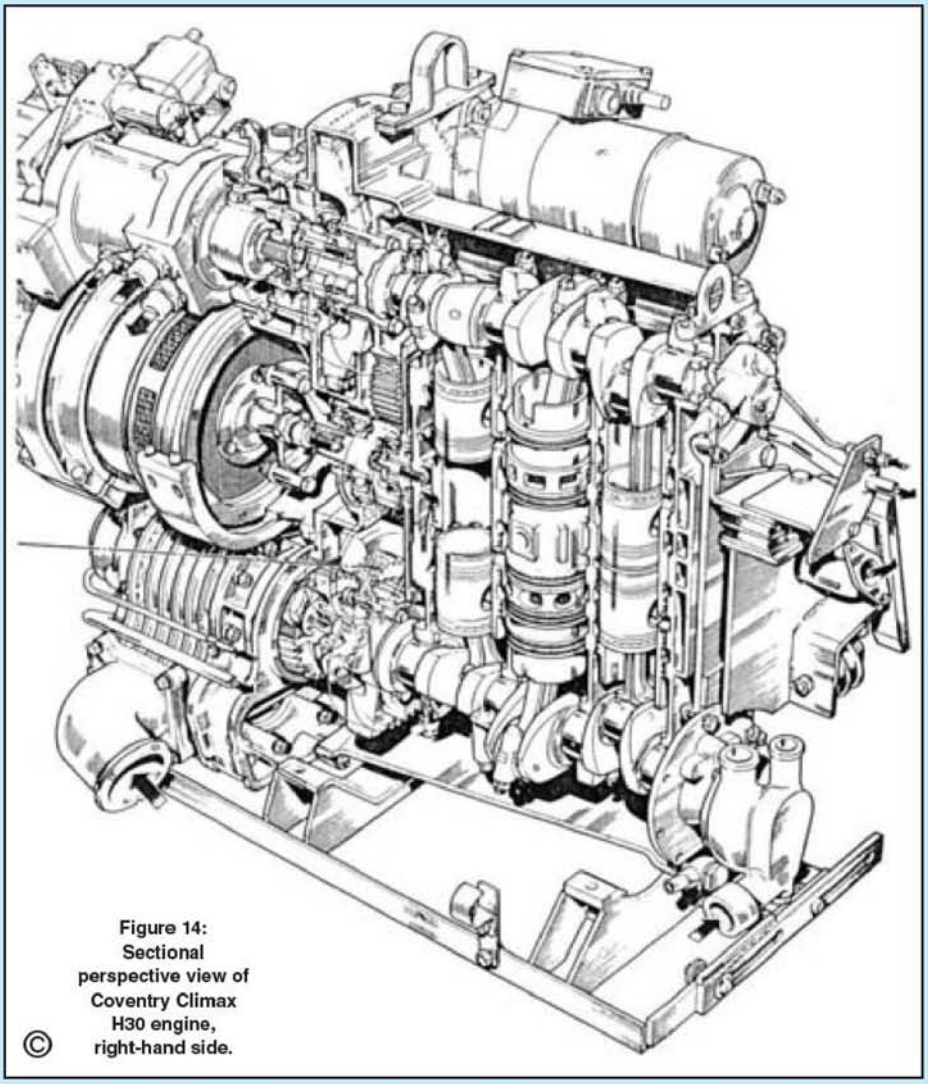


Figure 14: Sectional perspective view of Coventry Climax H30 engine, right-hand side.

pumps, hydraulic pump and an output shaft at twice engine speed. To attempt the entire unit as a scale model is difficult but when simplified by omission of some ancillary units, the configuration of opposed pistons and two crankshafts connected by a gear train becomes more attractive.

Previous comments regarding glow plug or spark ignition and compression ratio apply. The bore is 55mm and stroke 69.85 x 2mm. Other possible simplifications:

The transverse section through the engine **fig 15** shows special piston crowns. The pistons are of cast iron and the crowns are Nimonic. Normal aluminium pistons should suffice with reduced compression ratio.

The crankcase/cylinder block casting is in light alloy and the wet liners are cast iron with 'O' ring seals **fig 16**. To produce as a working model I suggest semi-scale as a good compromise. Each crankshaft has three throws and four journals and the connecting gear train is shown schematically in **fig 17**.

As said earlier, this is a difficult engine to attempt as a model and I have suggested to the editor that the readership be invited to contribute to see if this subject can be taken further. Experience, facts, and informed opinion are welcome. I have enjoyed putting this article together and hope others might find the less than usual interesting.

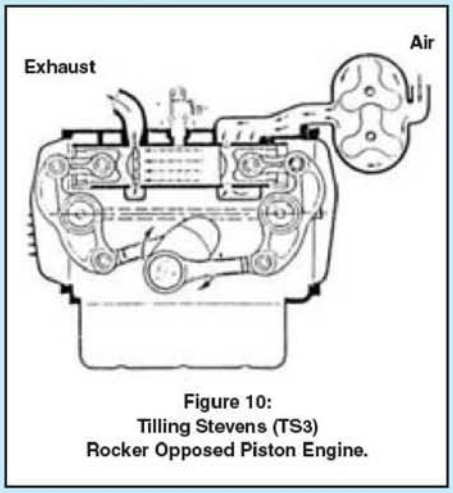


Figure 10: Tilling Stevens (TS3) Rocker Opposed Piston Engine.

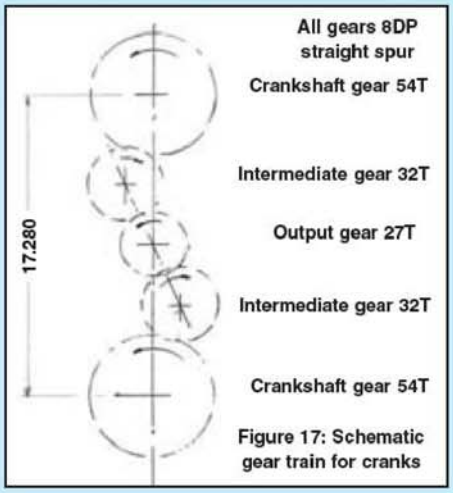


Figure 17: Schematic gear train for cranks

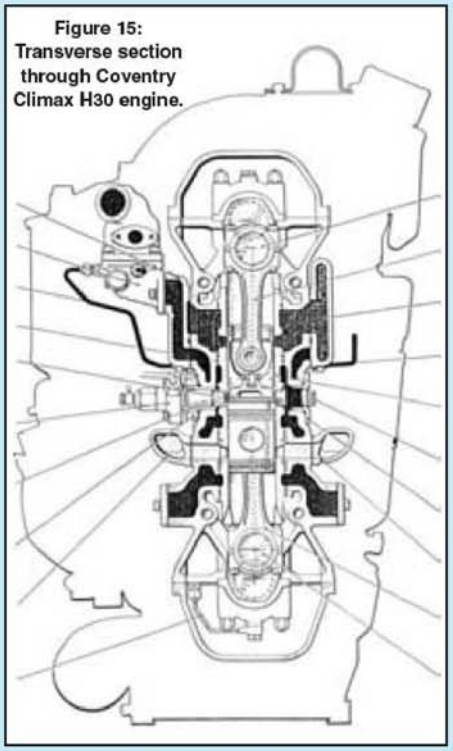


Figure 15: Transverse section through Coventry Climax H30 engine.

Additional reading

Some Unusual Engines by L. J. K. Setright, ISBN 0 85298 208 9.

Fedden - Biography - Sir Roy Fedden by Bill Gunston, ISBN 1 872922 13 9.

Alternative Engines, Curiosities or Competitors by Dr. C. C. J. French.

I. Mech E Proceedings, Vol. 202, No. 135 1988.

Engines and Enterprises - Biography - Sir Harry Ricardo by J Reynolds, ISBN 0 750917 12 1.

Acknowledgements

Thanks are also due to the staff of the REME Museum Arborfield for their co-operation and similarly to Horstman Defence Systems. Very valuable input was also received from Messrs E. Brain and J. V. Edwards and finally the usual disclaimer concerning the three single cylinder air cooled sleeve valve engines.

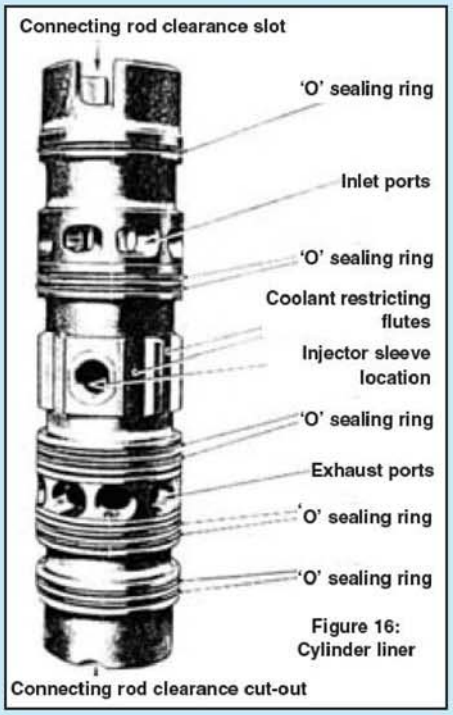


Figure 16: Cylinder liner

CLUB CHAT
With Stan Bray

UK News

Photographs in the Gazette from St. Albans DMES give views of the track they are now able to use that they have dubbed 'The Puffin Field'. The raised 3½ and 5in. gauge track runs through a wooded area and, in spite of being neglected for years, it appears to be in a reasonable condition. There is a concreted and paved station area which has obviously been cleared by the members, but in one photograph there is plenty of overgrown meadow land that still needed dealing with. The club is optimistic enough to have organised a running day for early September that will include a barbecue.

Bedford MES report a very successful exhibition with a wide variety models on display, particularly pleasing was the fact that the junior members played a big part in the proceedings, including supplying some of the exhibits. There were also full-size exhibits including some trailermounted engines that were in steam as was a traction engine. In addition, Club President, John Saunders sent along his full-sized showman's engine and he also presented the awards, which were made as follows. The Eddie Lancaster Cup for the best steam model to Dave Gulliver who exhibited his late father's GWR *County Kilkenny* this also won the Winifted Hinde Cup the winner of which is decided by a vote amongst visitors to the exhibition. The Coombes Plate, to Dorothy Millard for a collection of knitted dolls; Best Stationary Engine to Geoff Brandon; Best Engineering Section Work to John Lawson; Best Unfinished Model to Alan Beard; the Chairman's Award for the most promising junior to Hanna Heys. Now the new clubroom is complete the old building is to be used as a storeroom this will ease the congestion in the workshop, where space has been taken up by store track materials. Part of the building will form a library with some comfortable chairs so that anyone wishing to sit and browse will be able to do so.

The complete closure of a long stretch of the A10 road means that **Kings Lynn DSME** have been unable to hold their regular monthly meetings at the William Burt Centre in West Wynch. Temporary arrangements have been made for them to be held at Lynnsport in Kings Lynn, although this is not the most satisfactory of arrangements. If the work is completed on time it may be possible for them to move back into their usual premises for the mid December meeting, but knowing how construction work tends to lag behind schedule even this is not at present certain. In January the lease on their track site is due to expire and at present there is no indication whether or not it will be renewed, if not they will have a period of six months in which to vacate the site and find a new one, should this happen it will also mean finding storage facilities for all the club equipment, so it is not the happiest of times for them at present.

It was an excellent idea of the **Birmingham SME** to organise a Junior Proficiency Driving Day, something to really encourage the youngsters, who we so desperately need in the hobby. Those taking part had to prepare the locomotive, light up, check the water level and oil all round, before doing so they had to check that the tubes and smokebox were clean. This was followed by some shunting operations and then a complete circuit of the track, which had to be completed in a given schedule and finally preparing the locomotive for disposal. Five youngsters took part in the trails and all acquitted themselves well, the winner was Stephen Harrison who was presented with the trophy by Cyril Milward, the organiser of the event. The annual Gala Day was also successful, in spite of a gloomy weather forecast that proved to be untrue, although may have caused a slightly reduced number of visitors. As well as a large number of trains in operation on the various tracks there were a variety of amusements such as a Bouncy Castle, Hook a Duck and Bash a Rat available for the children to expend their energy on. However, these imported amusements apparently proved no match at all for the trains, which were kept busy throughout; for the first time it was compulsory for all steam locomotives to be fitted with spark arrestors and this also seems to have been a successful move.

We are pleased to hear that **Bournemouth DSME** appear to have found a new site at Littledown for their track, borings have been carried out to ascertain ground conditions and drawings were prepared for presentation to the council in September. Although a couple of clubs offered running facilities to members it is not the same as having a track of their own, however two club outings were arranged during the summer, one to a 16min scale layout, the other to a 7¼in. gauge railway in the grounds of a local school, this together with regular monthly meetings has allowed them to function as a club during this very difficult period of time.

A scaled-down version of the main station canopy has been erected over the siding area of the popular 'G' Scale Track of **Vale of Aylesbury MES** to give shelter during those sudden downpours of rain, when there is little or no time to get stock stored away. There are also roll down side canopies and end awnings to really ensure the maximum comfort of everyone concerned. Because foxes have torn open rubbish bags and strewn the contents they have decided not to eat all over the place, a secure cage has been built and installed-they will now have to go elsewhere for their night-time snacks. The club portable track has now been completely refurbished and, in addition to its use for outside events, members are being urged to consider taking it home and erecting it in their gardens. This will then allow them the opportunity to test locomotives and hone their driving skills. An evening entitled 'Chairman's Cup Night' gave everyone the opportunity to display their work and it was noted that there are quite a few very large models under construction. The judging for the competition was done by all present, everyone having a vote and the winners were: Chairman's Cup - Dave Andrews, for a 'G' Scale Ffestiniog Railway 0-4-0 locomotive; Secretary's Cup - Vic Hodges for a 20 note, paper roll, pipe organ and Junior Cup- Joe Hughes for a 'G' Scale Ffestiniog Slate Wagon,

We have been notified that there has been a change of Secretary for the **Rotherham DMES**, the new incumbent is Ken Staniforth who can be contacted by e-mail at **kensta@globalnet.co.uk** or by telephone on 01709-703794. On 28 May, the local authority decided to celebrate the centenary of Victoria Park otherwise known as Rosehill, where the club have their track and a during a chance conversation it was mentioned to a senior official that the club locomotive Victoria Rose was named after the park. On hearing that he immediately enquired whether the locomotive had been officially named or not and upon receiving a negative answer asked if the council could perform an official naming ceremony during the celebrations. In no time at all a brass band was arranged and it was agreed that Councillor Keith Goulty should perform the ceremony. The club members organised a hasty tidy up and the riding cars were repainted, the club also decided they would like a plaque to commemorate the event the artwork for which was done by Ken Staniforth who is now the Secretary, four plaques were etched and the one thought to be the best presented to the council. Following the official ribbon-cutting (with gold scissors no less) councillor Goulty drove the locomotive and then free rides were given to the public for the rest of the afternoon.

During the annual general meeting of **Bristol SMEE** the President of the society presented the annual awards as follows: H. M. Webb Trophy, L Tann - Foster Traction Engine; Founders Cup, R. Burns ~ Miniature Gear Box; Steam Locomotive Cup, J. Coleman - South Eastern & Chatham Locomotive; I/C Engine Cup, D. Hanstead - Diesels' First Engine; Roy Fedden Power Boat Trophy, A. Worner -Tug Boat; Machine Tool Cup, G. Sheppard - Cutter Grinder; Junior Cup, D. Nemeth - Meccano Locomotive; Chairman's Plate, K Rawlings - 20 Note Busker Organ, Eric Griffiths Trophy, S. Bond-Coach Driving Services; Ted Knight Trophy, A. Church - 2112in. Gauge LMS 4F; Joe Ginn Trophy, P. Davis - Assistance Given; Bristol Shovel, S. Durican - Winning Brimlec. A number of Certificate of Merits were also awarded for general work on behalf of the society. At the end of the running season it is intended that a number of tasks be undertaken to improve the railway they include improvements to the facilities as well as the track, they also hope to start work on an extension.

World News

New Zealand

At the annual general meeting of the **Southland SME** it was suggested the number of events undertaken by the model engineering section is to be reduced quite drastically as the resources of the section have been over stretched in recent years. The overall membership of the society is showing a healthy increase, including a number of juniors, which looks well for the future of the club. The pond has for some while been giving cause for concern and it has now been decided that it will be necessary to spend a proportion of the club funds to execute a permanent repair, sources of possibly obtaining grants towards the costs will be examined to see if the club expenditure on it can be reduced. During the meeting the

In Memoriam

It is with the deepest regret that we record the passing Philip (Pip) Vine, a long-serving member of the *Bristol SMEE* who died aged 80 on 15 March. The sympathy of the staff at *Model Engineer* is extended to the family and friends he leaves behind

Club President, Keith Douglas presented the President's Trophy to Donna Clark in recognition of her work in preparing the club newsletter. It was also decided that where possible, in order to save money in future the newsletter would be sent to recipients via e-mail.

A minor derailment caused the staff at the booking office of **Hutt Valley MES** to temporarily leave it to give assistance. Although they concealed the money and tickets before leaving, this did not prevent someone from stealing a whole book of tickets. During the afternoon these were presented by people wanting rides but, as the numbers had been recorded, the would be passengers were told in no uncertain terms that the tickets were stolen and could not be used. It seems everyone who had them had been given them by an auntie who was not around at the time. Later the remainder were handed in by a young girl who stated they had been found and so in the end there was no loss to the club. The local water authority have suggested that the club has been using excessive water and offered assistance in searching for possible leaks, although the cause could be that taps have accidentally been left running.

The battery electric locomotive owned by **Maidstone MES** is being re-gauged to suit the 7¼in. track; the work will also involve replacing the body. A couple of passenger trolleys are also undergoing renovation to make them easily convertible to run on either elevated or ground level tracks.

Many, if not most, societies suffer from vandalism and theft from time to time and it appears to be something that just has to be lived with. Generally the thefts are of track, particularly if it is aluminium, plus tools and machinery. **Canterbury SMEE**, however, had all their colour light signals taken. They were unscrewed from the bases and the wires neatly cut, so such a happening must surely come from someone wanting them as signals rather than the more usual scrap. Modified signals have been made and are now in use. Ten new trolleys are under construction for the ground level track and a new dual gauge locomotive has been built and tested. In spite of all the effort that goes into their existing site the club are, nevertheless, hoping to move to new one where they will be able to expand, which they are unable to do at present.

The **Palmerston North MEC** is organising Modex 2002, a major convention and exhibition, from 10 to 14 January 2002. To be held at the club track and the Manawatu Science Centre Museum, they would be pleased to hear from anyone who would like to attend. In addition to the exhibition and model engineering attractions, a number of visits to preserved sites are being organised. Alternative arrangements will be made for members of the family who do not have an overriding interest in engineering matters. During the event judging will take place for the Canterbury Award which is a challenge to all New Zealand Societies. All have been sent sets of castings with which to build a miniature traction engine, customising it as they wish, and the model adjudged to be the best will be given the award. Information can be obtained from Modex 2002 Registrations, 12a Hereford Street, Palmerston North, New Zealand, email **modex2002@clearnet.nz** or by telephone at 64-6-635-7000, fax on 64-6-635-7008.

Excessive rain caused the cancellation of public running by **Auckland SME** on at least two occasions during the early part of the year although on one very wet day, everyone was so determined not to be put off that passenger carrying continued in spite of everyone getting soaking wet. Having obtained a professional quote for painting the engine shed it was decided to make it a DIY job instead. Not only will it save the club a considerable amount of money it is hoped that if everyone takes part it will bolster the club spirit; a quote has been accepted though for cleaning and polishing the floor of the clubhouse. The club awards were made at Easter, the winners were as follows; ASME Shield, Mike Jack - clamp set and milling vice; Peter Baker Trophy, Dave Watts - traction engine; Les Fitt Award, Ken Francis - two aero engines and Stuart Turner 10V; Kresta Cup, Derek Simmons - spindle moulder cutter head and cutter grinding attachment; Jackson Championship Cup, Allan Roberts - nine cylinder aero engine; Jack & Ethel Hocking Trophy, Allan Gasteen - Rebuilt Royal Scott; Concours d'Elegance, Martin Smyth - P. V. Baker.

Australia

The new workshop of the **SLS Victoria** has been fitted out and a pleasant surprise was in store when the cost of all the machinery was totalled up as it came to considerably less than had been estimated. It has, therefore, been decided that an effort be made to buy a better quality lathe when one can be found at the right price. The 'Silvertops' continue to hold their regular Thursday meetings and in June they entertained a group of children from a local primary school. It turned out to be cold and showery but the children were all wrapped up and appear to have not even noticed the weather, the result was that everyone seemed to enjoy themselves, not least those operating the railway. When running had finished the children were taken into the clubroom for a warm up, supplemented by coffee and biscuits and they had a brief discussion about locomotives.

Zimbabwe

Some hard work is ahead for members of the **Mashonaland SME**, the roof of the new storage tunnel used to house the passenger trolleys is leaking and all the soil has to be removed in order to put on a new plastic sheet. The roof was sheeted before the soil was originally piled on but it seems the plastic used was not of the right quality for the job and a much heavier gauge sheet will be used this time. In spite of the troubles in the country the club report that generally speaking the public turn out in considerable numbers for rides on open days. At the July meeting Russell Franklin brought along his Stuart Turner number 5 engine for everyone to see and all agreed it was a faultless piece of work, which ran as well as it looked. No doubt many readers have seen very fine examples of such engines but the difference is that Russell is blind and has to devise methods of machining, fitting and finishing to suit his disability and it is quite incredible that someone without sight should be able to make such a model.

Canada

The weekend of July 7/8 was the anniversary of the opening of the track in Confederation Park belonging to **British Columbia SME** and, needless to say, was considered a cause for a celebration. A number of visitors arrived with their locomotives and running continued until after dark, an exhibition was set up in the club room by the local 'N' Gauge Club and proved popular with the visitors. A dinner was organised for Saturday evening to ensure that it really was a special event. For several months there have been discussions going on regarding the construction of a raised track and having been put to the vote at a general meeting this will now go ahead. It will be quite extensive and one end will go round a pond the minimum radius will be 30 feet. It will cater at first for three gauges with the possibility that at a later stage another rail will be added allowing the use of models of five different gauges, construction will be organised in a series of stages.

Once again this year the Ontario Model Locomotive Efficiency Trials (OMLET) was hosted by the **Golden Horseshoe LS** at their track in the grounds of the Museum of Steam and Technology in Hamilton. There were ten competitors, some of whom had travelled considerable distances to be present. The overall winner was Rick Intini of the home club driving a 4¾in. gauge Pacific. In his closing address to the assembled crowd, the Museum curator, Mr. Kerr-Wilson thanked the society for their continued support of this annual event. A full tabulation of the results will be available for members to view at the September meeting.

The competitor travelling the furthest to OMLET was John Stewart from **Ottawa Valley LS** who took along his recently refurbished model of a French 2-8-2. Originally a family outing was planned but John found that there was not sufficient room in the car for them and the locomotive, so a compromise was made with daughter Gillian accompanying him to provide support. An interesting snippet appears in *The Link* from OVLS, informing readers that the Amusement Devices Inspectors had visited the **Algonia MES** and banned them from using their portable track on the grounds of safety, although the exact reasons are not given. The inspectors also visited **Richmond Hill LS** and, although they were allowed to run their locomotives, they were banned from hauling passengers on their Open House Weekend, again the full reason is not given.

Toronto MES had a particularly interesting bits and pieces evening with a wide range of items on show. The evening started with President Dave Powell presenting Jaap Weymnan with his Herb Jordan award plaque, followed by no fewer than 12 members demonstrating things under construction. These ranged from fixtures for lathes, small steam engines, a drill press with a Meehanite base, robots working from tiny watch batteries and an electronically timed i/c engine, with timing changes being used for speed control. About as diverse a collection as it could be possible to see and discuss during an evening.

CLUB DIARY

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

To 21 October Talyllyn Railway. *First Class for Sunday Lunch.* Enquiries: 01654-710472.

OCTOBER

15 **Leicester SME.** *David Barrie: Darjeeling & Himalayan Railway.* Contact Raymond Wallis: 0116-285-8824.

16 **Basingstoke DMES.** *Bits & Pieces.* Contact Ian Shanks: 01420-561741.

16 **Chesterfield MES.** *Meeting: Trophies & Photo Competition.* Contact Mike Rhodes: 01623-648676.

16 **Nottingham SMEE.** *Roy Whiting: Heat Pumps.* Contact Graham Davenport: 0115-8496703.

16 **Romney Marsh MES.** *David Kelso: The Channel Tunnel Rail Link.* Contact John Wimble: 01797-362295.

16 **Taunton ME.** *Noel Whiting: Electric Motors.* Contact Don Martin: 01460-63162.

17 **Birmingham SME.** *John Jones: Boiler Making.* Contact John Walker: 01789-266065.

17 **Bristol SMEE.** *Geoff Sheppard: On the Table.* Contact Trevor Chambers: 01454-415085.

17 **Guildford MES.** *Bits & Pieces.* Contact Dave Longhurst: 01428-605424.

17 **Hull DSME.** *Members' Current Projects.* Contact Chris Parsons: 01964-630563.

17 **Maidstone MES.** *Members' Afternoon Playtime.* Contact Martin Parham: 01622-630298.

17 **MELSA.** *Meeting.* Contact Graham Chadbone: 07-4121-4341.

18 **Cardiff MES.** *AGM.* Contact Trevor Jenkins: 029-20755568.

18 **Halesworth DMES.** *Chat Night.* Contact Chris Walliman: 01362-695735.

18 **Isle of Wight MES.** *Dave Kennett MBE: Highlight Rescues.* Contact Ken Stratton: 01983-760762.

18 **Reading SME.** *AGM.* Contact Graham Bustin: 01189-615450.

18 **York City & DSME.** *Richard Evans: Humber Bridge Master.* Contact Ken Bateman: 01904-421445.

19 **Canvey R&MEC.** *Paul Strudwick: I.W.A. Canal Ramblings.* Contact David A. Clark: 01375 846921.

19 **Rochdale SMEE.** *Video Night.* Contact Mike Foster: 01706-360849.

19 **Romford MEC.** *Reg Davey.' Navigator in Bomber Command.* Contact Colin Hunt: 01708-709302.

19 **Romney Marsh MES.** *Video Evening.* Contact John Wimble: 01797-362295.

20 **Chesterfield MES.** *Running Day.* Contact Mike Rhodes: 01623-648676.

20 **Historical MRS (Scottish Area).** *Richard Chown: Building a Railway, The Scottish Central Line/George Davidson: Looking at Locomotives, Getting the Features Right.* Contact Richard Crockett: 01896-750730.

20 **National 2½in. Gauge Ass'n.** *Hook Get-Together.* Contact Clive Young: 01233 626455.

20/21 ***Model Railway Exhibition*** at Uckfield Civic Centre, Bell Farm Lane, Uckfield, East Sussex. 10am-5.30pm. £3 Adult, £2 Concessions, £1 Child, £6 Family (2+2). Information: 01825-733133.

20-25 **Meridienne Exhibitions.** ***Midlands Model Engineering Exhibition*** at The International Exhibition Centre Donington Park, Nr. Derby (M1 exit 24). 10.30am-5.30pm daily, last admission 4pm, (Wed: 10.30am-8pm). Adults £7, Senior Citizens £6, Children £4, Family (2+3): £17.50. Enquiries: 01926-614101.

20-25 **Guild of Model Wheelwrights** *at Midlands Model Engineering Exhibition,* Contact Biddy Hepper: 01492-623274.

21 **Frimley & Ascot LC.** *Club Run.* Contact Bob Dowman: 01252-835042.

21 **Ottawa Valley Live Steamers.** *Steaming Day.* Contact John Bryant: 761 -1109.

21 **Pinewood MRS.** *Running Day.* Contact J. Ephithite: 01344-885049.

21 **South Lakeland MES.** *Running Day (Visitors Welcome).* Contact Adrian Dixon: 01229-869915.

21 **York City & DSME.** *Running Day.* Contact Ken Bateman: 01904-421445.

22 **Bedford MES.** *Surgery Night.* Contact Alan Guildersleve: 01525-383010.

23 **Historical MRS (East Lancashire/North Manchester Group).** *Don Rowland: Of Accidental Interest.* Contact John Sykes: 01706-823989.

23 **Romney Marsh MES.** *Track Meeting.* Contact John Wimble: 01797-362295.

23 **Sutton Coldfield MES.** *Meeting.* Contact Roger Timings: 0121-308-5875.

24 **Birmingham SME.** *Chit-Chat Evening.* Contact John Walker: 01789 266065.

25 **Cardiff MES.** *Keith Richards: More about the Mines.* Contact Trevor Jenkins: 029-20755568.

25 **Leyland SME.** *Trade Topics.* Contact Alan Wilson: 01942-715072.

25 **Reading SME.** *Meeting.* Contact Graham Bustin: 01189-615450.

26 **Chichester DSME.** *Mike Ross: Portsmouth Naval Dockyard.* Contact Brian Bird: 01243-542266.

26 **Colchester SMEE.** *Hugh Pullen: The History of Firearms.* Contact L. G. Hammond: 01376-511686.

26 **Hereford SME.** *Ian Amor Building the Robey Tractor.* Contact John Arrowsmith: 01432-265151.

26 **Historical MRS (Essex Area).** *Chris Youett: And You Thought They Were All Clean, Part 3: 1940-48.* Contact Jem Harrison, 27 Colne Place, Basildon, Essex.

26-28 ***Axminster Tool & Machinery Exhibition*** at Bath and West Showground, Shepton Mallet, Somerset. Contact Sarah Fuller: 01934-822962. Tickets £5 on the day or £4 in advance.

27 **Basingstoke DMES.** *Hallowe'en Run.* Contact Ian Shanks: 01420-561741.

27 **GEC (Coventry) MES.** *Open Day & Run Night.* Contact B. P. Arthurs: 01203-440209.

27 **Guildford MES.** *Hallowe'en Night Run & Hot Dog Evening.* Contact Dave Longhurst: 01428-605424.

27 **Historical MRS (Bristol Area).** *Gerald Davies: The Railways of Blaenau, Gwent.* Contact Gerry Nichols: 0117-973-1862.

27 **Leicester SME.** *Steam-Up & Cheese & Wine Evening.* Contact Raymond Wallis: 0116-285-8824.

27 **Mashonaland SME.** *Braai Lunch & Club Run.* Contact Ian Andrews: 263-4-882893.

27 **Holy Trinity Meccano Club.** *Meeting.* Contact Philip Webb: 1 Amherst Close, Maidstone, Kent, ME16 0JB.

27 **North West Meccano Guild.** *Meeting.* Contact Frank Smith: 208 Brodie Avenue, Liverpool, L19 7NB.

27 **Northampton SME.** *Running Night - Visitors Welcome.* Contact Pete Jarman: 01234-708501.

27 **The Society of Ornamental Turners.** *Bob Wade: "William Hartley and his Geometric Chucks" and AGM.* Contact N. S. Edwards: 01234-359392.

27 **York City & DSME.** *Bits & Pieces.* Contact Ken Bateman: 01904-421445.

27/28 **Amberley Museum.** *Childrens' Craft Workshops.* Contact Derek Kilburn: 01798-831370.

27/28 ***Bracknell RS Exhibition*** at Garth Hill School, Sandy Lane, Bracknell. 10am-5pm both days. 15+ layouts of various scales. Model Engineering Display and Live Steam Track (weather permitting). Trade and Society Stands. To be opened by Chris Awdry, current author of the Thomas the Tank Engine books. Adult: £3, Child: £1.50, Family (2+2): £7. Take the A3095 Maidenhead road out of town then follow the signs. Contact T. J. Wild: 01344-640095.

28 **Amnerfield Miniature Railway.** *Running Day.* Contact David Jerome: 0118-9700274.

28 **Ascot LS.** *Members'Steam-Up.* Contact Tony Alderman: 01932-854393.

28 **Elmdon MES.** *Steam-Up.* Contact Chris Giles: 0121-458-1291.

28 **Elmdon MES.** *Wythall Transport Museum Open Day. More Midland Reds.* Contact Chris Giles: 0121-458-1291.

28 **Leighton Buzzard NG Rly.** *Hallowe'en Haunting Event.* Enquiries: 01525-373888.

28 **Maidstone MES.** *End of Running Season.* Contact Martin Parham: 01622-630298.

28 **MELSA.** *Sunday in the Park.* Contact Graham Chadbone: 07-4121-4341.

29 **Canterbury DMES.** *Meeting.* Contact Granville Askham: 01227-463295.

30 **Basingstoke DMES.** *Meeting.* Contact Ian Shanks: 01420-561741.

30 **Chelmsford SME.** *Club Auction.* Contact D. Blake: 01376-324205.

30 **Wigan DMES.** *Bits & Pieces.* Contact Bob Connor: 01257-423048.

31 **Birmingham SME.** *Meeting.* Contact John Walker: 01789-266065.

31 **Historical MRS (Bedford Area).** *Eric Miller: The Buckingham Railway Centre, Quainton Road.* Contact John Chamney: 01442-851214.

31 **Hull DSME.** *Roy Crosslay: "Down Memories Tracks"- A Tram History.* Contact Chris Parsons: 01964-630563.

NOVEMBER

1 **Cardiff MES.** *Club Chat.* Contact Trevor Jenkins: 029-20755568.

1 **Great Central Railway Soc.** (Rotherham Branch). *Ken Horan: BR Main Line Steam on Film.* Contact Stephen Gay. Meetings held at The Fairways Hotel, Bawtry Road, Brinsworth, Rotherham at 7.30 pm.

1 **Halesworth DMES.** *Philip Hall: "Old Bill" Reminiscences.* Contact Chris Walliman: 01362-695735.

1 **Historical MRS (North West Area).** *Bob Miller LNWR Houses.* Contact David Goodwin: 01224-880018.

1 **Rotherham DMES.** *Meeting.* Contact Ken Staniforth: 01709-703794

1 **South Lakeland MES.** *Meeting.* Contact Adrian Dixon: 01229-869915.

1 **Vancouver Island ME.** *Meeting.* Contact Dennis Dalla-Vincenza: (250) 480-7042.

1 **Warrington DMES.** *G. Howard: Antique Tools.* Contact Bill Underwood: 01606-891225.

2 **Vale of Aylesbury MES.** *AGM.* Contact Clive Ellam: 01296-623433, Ian Meikle: 01844-291590 or Bob Jones: 01296-29468.

2 **Canvey R&MEC.** *Guy Fawkes Steam-Up.* Contact David A. Clark: 01375-846921.

2 **Maidstone MES.** *2001 A Train Odyssey (Review of the Year).* Contact Martin Parham: 01622-630298.

2 **Portsmouth MES.** *Sean Cullen: Hollycombe Steam Collection.* Contact Bob Aldred: 023-92-523366.

2 **Rochdale SMEE.** *Doug Hewson: Constructing Rolling Stock.* Contact Mike Foster: 01706-360849.

2 **Romford MEC.** *Competition Night.* Contact Colin Hunt: 01708-709302.

2-4 **Hornsby ME.** *Wagga Invitation Run.* Contact Ted Gray: 9484-7583.

3 **Chelmsford SME.** *Bonfire Night, Barbecue and Steam-Up.* Contact D. Blake: 01376-324205.

3 **Elmdon MES.** *Bonfire Night.* Contact Chris Giles: 0121-458-1291.

3 **Maiden DSME.** *Bonfire Night, Fish 'n Chips and Films.* Contact J. Mottram: 01483-473786.

3 **Romford MEC.** *Fireworks Night.* Contact Colin Hunt: 01708-709302.

3 **Romney Marsh MES.** *Bonfire Night. Barbecue & Steam-Up.* Contact John Wimble: 01797-362295.

3 **SM&EE.** *John Martin: Southwold and Other N. G. Locomotive Models.* Contact David Boote: 01202-745862.

3 **Stockholes Farm MR.** *Bonfire Night Open Day.* Contact Ivan Smith: 01427-872723.

3 **West Riding SLS.** *Bonfire Night.* Contact Margery Bradley: 01977-685782.

3 **York City & DSME.** *Bonfire Steaming Event.* Contact Ken Bateman: 01904-421445.

4 **Bedford MES.** *Boiler Blow Down Day.* Contact Alan Guildersleve: 01525-383010.

4 **Hereford SME.** *Hereford Leisure Centre Exhibition and Swapmeet.* Contact John Arrowsmith: 01432-265151.

4 **Pinewood MRS.** *Guy Fawkes Run.* Contact J. Ephithite: 01344-885049.

4 **Reading SME.** *Running.* Contact Graham Bustin: 01189-615450.

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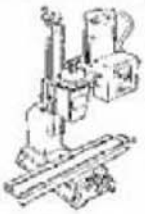

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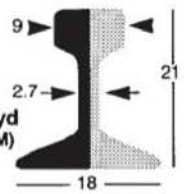

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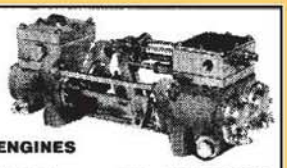

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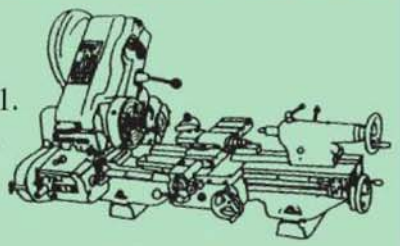

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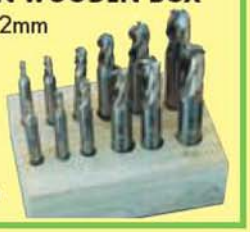

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Code	Price	
XM26	~~£4.95~~	**£3.50**

SMALL MILLING VICE

Jaw Width 60mm - Jaw Depth 20mm
Jaw Opening 40mm - Two mounting holes 45mm apart

Code	Price	
XM27	~~£29.95~~	**£20.00**

OPEN END BA SPANNERS

Set of 6 0-11 BA

Code	Price
XM28	**£12.00**

BOX SPANNERS

Set of 10 0-12 BA

Code	Price
XM29	**£15.00**

BOTH SETS ONLY **£25.00** - CODE XM30

PRECISION V BLOCKS IN MATCHED PAIRS C/W CLAMPS

Code	Capacity	Price
XM31	1"	**£18.00**
XM32	1 1/2"	**£24.95**

GAUGE BLOCK SET

GRADE B 81PC 0.05 - 4"

Code	Price
XM33	**£99.00**

COMBINATION SQUARE 0-180"

Code	Price	
XM34	~~£49.95~~	**£35.00**

SET OF THREE 90' HSS COUNTERSINKS 6.3 & 8.4 & 10.4 MM

Code	Price	
XM35	~~£19.95~~	**£15.00**

SET OF SEVEN FC3 MINIMILLS!! FANTASTIC VALUE!!

Code	Sizes	Price	
XM36	1/16, 3/32, 1/8, 5/32, 3/16, 7/32, 1/4	~~£21.75~~	**£15.00**
XM37	1.5, 2, 3, 4, 5, 5.5, 6 mm	~~£21.75~~	**£15.00**

ANGLE PLATES

Code	Size	Price
XM38	3 1/2"	**£16.95**
XM39	6"	**£24.95**

TILTING ANGLE PLATE 5 X 7"

Code	Price	
XM40	~~£69.00~~	**£64.00**

R8 DRAWBAR FOR MILLING MACHINE 21"

Code	Price	
XM41	~~£15.95~~	**£9.95**

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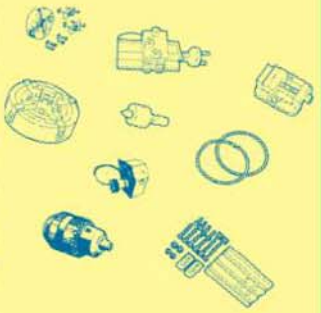
ACCESSORIES FOR UNIMAT 3/4/MILLENNIUM AND COMBI 218 LATHES

Code	Item	Price
XM42	4 Jaw Ind Chuck	£69.00
XM43	Taper Turning Topslide	£29.00
XM44	Auto Feed (not Combi)	£32.00
XM45	German Drill Chuck	£10.00
XM46	Live Centre	£ 8.00
XM47	Milling Table 3" x 4 3/4"	£30.00
XM48	Faceplate & Clamps	£28.00
XM49	Machine Vice	£20.00
XM50	Woodturning Accessories	£32.00
XM51	Set Woodturning Chisels	£11.00
XM52	Pair Spare Unimat 3/4 Belts	£ 3.50
XM53	Inserted Blade Parting Tool 6mm	£ 6.00
XM54	QC Toolpost with 3 holders	£75.00
XM54M	Rep. Motor Unit Unimat	£99.00



FANTASTIC OFFER !!

Collet Chuck to suit Unimat/Combi (14 x 1mm) with set 10 ER 16 Collets!!

Code XM55
Price **£120.00 !!!**

SET OF 3 FLYCUTTERS WITH SMALL HEADS 3/8 SHANK COMPLETE WITH READY GROUND HSS TOOLBITS

Head sizes 1/2, 3/4 & 7/8

Code	Item	Price
XM56	Set Flycutters	£20.00
XM57	Set Spare Bits	£6.50

4" ROTARY TABLE

PLUS SET TNUTS, STUDS & CLAMPS WORTH £15.00 ABSOLUTELY FREE!!

Code XM58 Price **£99.00**

MINIATURE BRASS WOODWORKING PLANES

Only 3" long & 1" wide

Code	Type	Price
XM59	Bull Nose	£7.95
XM60	Flat Nose	£7.95
XM61	BOTH —	£14.00

52 PC MILLING MACHINE CLAMP KITS

Code	Slot*	Stud	Price
XM62	3/8	5/16	£39.95
XM63	1/2	3/8	£42.00
XM64	5/8	1/2	£45.00

*This measurement is the narrower part of the T nut

TRANSFER PUNCH SET

Manufactured from tool steel — hardened & tempered

Code XM65 Price **£9.95**

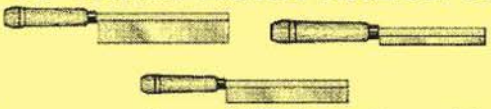
SET OF 9 RIVET SNAPS

Code XM66 Price ~~£22.00~~ **£14.95!!**

SET OF 6 TELESCOPIC BORE GAUGES

Code XM67 Price ~~£20.00~~ **£12.95**

SET OF THREE ZONA RAZOR SAWS



Our three most popular models for Brass, Copper, Wood etc.

Blade thickness from 0.008". Range of TPI.

FREE PIERCING SAW WORTH £9.75 WITH EACH SET!!!

Code XM68 Price **£20.40 !!!**

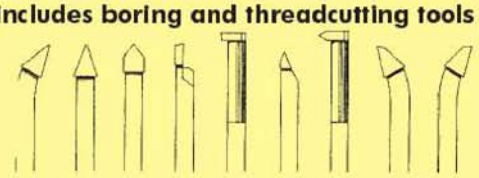
ENGINEERS BENCH VICES — SUPERB QUALITY !!

Do not confuse with inferior imported vices

Code	Width	Price
XM49	4"	£22.95
XM70	5"	£28.95
XM71	6"	£48.95

SET OF 12 BRAZED TIP TCT LATHE TOOLS!!

(Includes boring and threadcutting tools !!)



Code	Shank	Price	
XM72	1/4 sq	~~£35.00~~	£27.50
XM73	5/16 sq	~~£35.00~~	£27.50
XM74	3/8 sq	~~£35.00~~	£27.50
XM75	1/2 sq	~~£45.00~~	£35.00

VERTEX POSILOCK COLLET CHUCKS

For threaded shank cutters.
C/w 8 Collets 1/4, 3/8, 1/2 & 5/8 Imp, 6, 10, 12 & 16 mm

UNBELIEVABLE VALUE THIS YEAR!!
SET OF FIVE HSS THREADED SHANK ENDMILLS WITH EACH SET!!

Code	Taper	Price
XM76	2MT	£99.00
XM77	3MT	£99.00
XM78	R8	£99.00
XM79	INT30	£115.00
XM80	INT40	£115.00

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APEX MODEL ENGINEERING TAPS & DIES

IN SETS OF THREE TAPER, PLUG & DIE

Code	Size	Price	
XM81	1/8 x 40	~~£9.05~~	£7.25
XM82	5/32 x 32	~~£9.65~~	£7.75
XM83	5/32 x 40	~~£10.45~~	£8.35
XM84	3/16 x 32	~~£9.95~~	£7.95
XM85	3/16 x 40	~~£10.50~~	£8.40
XM86	7/32 x 32	~~£15.15~~	£12.20
XM87	7/32 x 40	~~£10.50~~	£8.40
XM88	1/4 x 32	~~£13.20~~	£10.60
XM89	1/4 x 40	~~£10.50~~	£8.40
XM90	9/32 x 32	~~£15.90~~	£12.75
XM91	9/32 x 40	~~£19.40~~	£15.50
XM92	5/16 x 32	~~£15.20~~	£12.10
XM93	5/16 x 40	~~£17.70~~	£14.10
XM94	3/8 x 32	~~£15.70~~	£12.50
XM95	3/8 x 40	~~£17.60~~	£14.10
XM96	7/16 x 32	~~£22.45~~	£17.95
XM97	7/16 x 40	~~£22.45~~	£17.95
XM98	1/2 x 32	~~£24.65~~	£19.75
XM99	1/2 x 40	~~£24.65~~	£19.75

NEAL DRILL PRESS VICES

These are superior drill press vices — no slop and no jaw lift!! Can also be used for light milling!!

Code	Size	Price
XM100	3"	£19.95
XM101	4"	£22.00

6MM SQUARE INSERTED BLADE PARTING TOOL

With 2 spare blades worth £7.50 FREE !!

Code	Price
XM102	£11.00

EZELAP FINE BLOCK 6" x 2"

Code	Price	
XM103	~~£29.95~~	£20.00 !!

SET OF 6 EZELAP DIAMOND FILES

Superb Quality

Code	Price
XM104	£17.95

NEW EZELAP CREDIT CARD STONE 2" x 3 1/4"

Code	Grade	Price
XM112	Fine	£6.95
XM113	Med	£7.95
XM114	Coarse	£9.95

ONMARK (USA) OPTICAL CENTREPUNCH

This is a precision tool and invaluable for the Model Engineer

Code	Price	
XM107	~~£87.95~~	£76.00 !!

VITREX ABRAFILE BLADES

TO SUIT JUNIOR HACKSAWS — WILL CUT IN ANY DIRECTION !!

PACK OF 3

Code	Price
XM108	£3.95

MJ189 LATHE

46mm centre height — 200mm between centres, 92mm swing — spindle bore 10.2mm

FANTASTIC VALUE !!!

Code	Price	
XM109	~~£299.00~~	£279.00

10PC PRECISION ANGLE BLOCK SET

For setting and checking angles 3" long 1/4" thick — accuracy 0.0001"

Code	Price		
XM109G	~~£79.95~~	£29.95 !!	Limited quantities available !!

ROUND BAR CENTREFINDER

Code	Price	
XM109C	~~£12.95~~	£9.95 !!!

VERTEX GROUND PARALLEL SET VP100 18PCs

Code	Price	
XM109P	~~£120.00~~	£99.00

MOVEABLE JAWS DRILL/MILL VICE

Rigidly holds round bar up to 50mm dia. 4" jaw width opens to 4 5/8"

Code	Price	
XM110	~~£39.95~~	£35.00

DRILL/COUNTERSINK SET

Set of 4 drills a hole and countersinks in one operation. Suitable for wood only

Code	Price	
XM111	~~£22.95~~	£9.95 !!

BOXED MICROMETER SETS

Code	Description	Price
XM105	0–4" set 4 mikes	£39.95
XM106	0–100 set 4 mikes	£39.95

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NEW GLANZE R8 INDEXABLE ENDMILLS

Complete with 6 spare tips FOC !!

Code	Head Dia	Tips	Price
XM115	32 mm	2 (+ 6 FREE)	**£44.95**
XM116	40 mm	3 (+ 6 FREE)	**£46.95**
XM117	50 mm	3 (+ 6 FREE)	**£48.95**

2PC ADJUSTABLE 6" MILLING VICE

Code	Price
XM118	**£55.00 !!**

2 WAY SWIVEL/TILT VICES

Precision made, hardened & ground, fully graduated

Code	Jaw	Price
XM119	2"	**£ 69.00**
XM120	3"	**£ 92.00**
XM121	4"	**£115.00**
XM122	6"	**£130.00**

INDUSTRIAL QUALITY 1/2" CAPACITY KEYLESS CHUCK & ARBOR

Code	Shank	Price
XM123	2 MT	**£26.95**
XM124	3 MT	**£26.95**

5PC INDEXABLE TIPPED LATHE TOOL SETS

Code	Shank	Price
XM125	6 mm	**£17.65**
XM126	8 mm	**£19.95**
XM127	10 mm	**£19.95**
XM128	12 mm	**£24.95**

Code	Item	Price
XM129T	Spare Tip (6&8mm)	**£2.95**
XM130T	Spare Tip (10&12mm)	**£2.95**

WORKSHOP PRACTISE SERIES BOOKS

Code	Title	Price	Code	Title	Price
WPS1	Hardening & Tempering	£7.30	WPS18	Basic benchwork	£7.30
WPS2	Vertical Milling	£7.30	WPS19	Spring Design	£7.30
WPS3	Screw Cutting in the Lathe	£7.30	WPS20	Metalwork Hints & Tips	£7.30
WPS4	Foundry work for Amateurs	£7.30	WPS21	Adhesives & Sealants	£7.30
WPS5	Milling Ops in Lathe	£7.30	WPS22	Workshop Electrics	£7.30
WPS6	Measuring & Marking	£7.30	WPS23	Workshop Construction	£7.30
WPS7	Art of Welding	£6.75	WPS24	Electric Motors in Workshop	£7.30
WPS8	Sheet Metalwork	£7.30	WPS26	Workshop Hints & Tips	£5.75
WPS9	Soldering & Brazing	£7.30	WPS27	Spindles	£7.30
WPS10	Saws & Sawing	£6.30	WPS28	Simple workshop Devices	£7.30
WPS11	Electroplating	£6.75	WPS29	CAD for Beginners	£7.30
WPS12	Drills, Taps & Dies	£7.30	WPS30	Workshop Materials	£7.30
WPS14	Making Small Workshop Tool	£7.30	WPS31	Useful Workshop Materials	£7.30
WPS15	Workholding in the Lathe	£7.30	WPS32	Unimat Lathe Accessories	£7.30
WPS16	Electric Motors	£7.30	WPS33	Making Clocks	£7.30
WPS17	Gears & Gear Cutting	£7.30			

TOP QUALITY HSS PRECISION GROUND DRILL SETS IN RETRACTABLE METAL STORAGE CASES

Code	No	Sizes	Price	
XM129	29PC	1/16–1/2 x 64ths	~~£26.50~~	**£15.00**
XM130	19PC	1–10mm x 0.5mm	~~£10.50~~	**£ 8.00**
XM131	25PC	1–13mm x 0.5mm	~~£26.00~~	**£15.00**
XM132	50PC	1–5.9mm x 0.1mm	~~£28.00~~	**£19.50**
XM133	41PC	6–10mm x 0.1mm	~~£59.50~~	**£45.00**
XM134	60PC	Number drills 1–60	~~£29.95~~	**£19.95**

SELF CENTERING LATHE CHUCKS

(Plain Back)

Code	Size	Price	
XM138	80mm (3 jaw)	~~£62.50~~	**£49.00**
XM139	100mm (3 jaw)	~~£68.50~~	**£55.00**
XM140	125mm (3 jaw)	~~£75.50~~	**£64.00**
XM141	80mm (4 jaw TOS Czech)	~~£85.00~~	**£69.00**
XM142	100mm (4 jaw TOS Czech)	~~£89.00~~	**£72.00**
XM143	125mm (4 jaw TOS Czech)	~~£95.00~~	**£80.00**

SET OF 1–2–3 BLOCKS & 2–4–6 BLOCKS

Code	Size	Price
XM135	1–2–3	**£15.00**
XM136	2–4–6	**£49.95**
XM137	Both Sets	**£59.50**

4 JAW IND CHUCK (PLAIN BACK)

Code	Size	Price	
XM144	80mm	~~£65.00~~	**£55.00**
XM145	100mm	~~£75.00~~	**£65.00**
XM146	125mm	~~£92.00~~	**£80.00**

ORIGINAL AUSTRIAN EMCO COMPACT 5 LATHES

C/W 3 Jaw Chuck

Code
XM147C5

Price
~~£799.00~~ **£599.00**

20MM DIA TOUCH POINT SENSOR WITH BLEEPER

Code	Price	
XM147	~~£42.95~~	**£35.00 !!**

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CROSS VICES

Code	Size	Price	
XM148	3"	£29.95	**£22.00**
XM149	4"	£39.95	**£30.00**

EASYFLO NO 2

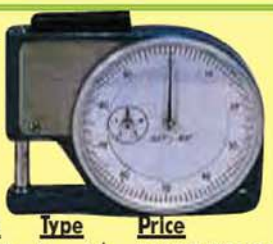
SILVER SOLDER

1.5MM x 600MM LONG

Code	Qty	Price
XM150	1	**£1.60**
XM151	10	**£14.00**
XM152	50	**£60.00**

POCKET DIAL THICKNESS GAUGES

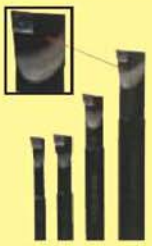
A very handy pocket gauge for measuring sheet metal etc. Accurate to 0.02mm (0.001")



Code	Type	Price	
XM153	Imperial	~~£29.95~~	**£22.00**
XM154	Metric	~~£29.95~~	**£22.00**

SCLCR BORING TOOLS — TOP QUALITY!!

3 FREE TIPS WORTH £10.50 WITH EACH TOOL!!



Code	Shank	Price
XM155	6mm	**£19.95**
XM156	8mm	**£19.95**
XM157	10mm	**£19.95**
XM158	12mm	**£22.95**
XM159	Spare Tip	**£ 3.50**

UNIVERSAL MULTIPURPOSE METALBENDER

FREE TUBE CUTTER WITH EACH KIT !!

Code	Price
XM160	**£49.95**

NEW!! VERTEX FLUORESCENT MAGNIFYING WORK LIGHT

COMPLETE WITH 22W DAYLIGHT TUBE, TABLE CLAMP AND 1.8 METRES OF FLEX. 3 X MAG QUALITY LENS

Code	Price
XM161	**£49.95**

ASK FOR OUR FREE 112 PAGE TOOL CATALOGUE NO 36 OR VISIT

WWW.CHRONOS.LTD.UK FOR TOTALLY SECURE ONLINE ORDERING!!

QUAD HEAD INDEXABLE TAILSTOCK

MT2 Shank with MT3 Sleeve included. Complete with four indexable heads, 2 drill chucks, die holder, live centre, extremely versatile

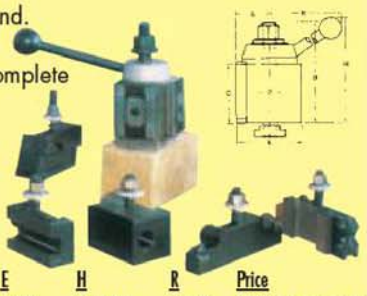
Code XM162

Price **£129.00!!**

PISTON TYPE TOOLPOST SET FOR UP TO 12" LATHES

All working parts are hardened & ground. Maximum rigidity is maintained for chatter free performance. Each set is complete with five holders inc. standard, boring, parting & knurling.

Save £26.00 and get a drill chuck attachment totally FREE!!



Code	A	B	C	D	E	H	R	Price	
XM163	2 1/2	3 7/8	2 1/4	9/16	13/8	4 11/16	5 3/4	~~£125.00~~	£99.00

MODEL ENGINEERS BADGER STARTER KIT

Contains airbrush, 3 tips, spray regulators & needles, 8ft hose, 3 asstd. jars, hanger and CP0100 compressor

Code	Price
XM164	**£237.50**

APEX BRITISH MODEL ENGINEERS TAP & DIE SET IN WOODEN BOX

1/8 - 5/32 - 3/16 - 7/32 - 1/4 - 5/16 & 3/8

Code XM165

Price **£94.00**

2 TAPS & 1 DIE PER SIZE PLUS HOLDERS

SET OF MORSE TAPER SLEEVES

1-2MT, 1-3MT, 2-3MT

Code	Price
XM166	**£11.00**

WING DIVIDER WITH CARBIDE SCRIBER

Code	Size	Price	Code	Size	Price
XM167	6"	**£6.96**	XM168	10"	**£10.95**
XM169	8"	**£7.95**	XM170	12"	**£13.95**

SET OF 4 BRITISH HSS HAND REAMERS

1/8, 1/4, 3/16 & 5/16

Code	Price	
XM171	~~£52.50~~	**£29.95!!**

SET OF 5 SOFT BLANK END ARBORS 2MT

Code	Price	
XM172	~~£19.50~~	**£15.00!!**

SET OF 5 SOFT BLANK END ARBORS 3MT

Code	Price	
XM173	~~£26.00~~	**£19.00!!**

ZEUS BOOK AVAILABLE AGAIN

Code	Price
XM174	**£6.95**

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QUALITY MEASURING EQUIPMENT

Code	Item	Price	
XM175	0-25mm Micrometer	~~£14.95~~	£ 9.95
XM176	0-1" Micrometer	~~£14.95~~	£ 9.95
XM177	Met Inside Mike	~~£29.95~~	£24.95
XM178	Imp Inside Mike	~~£29.95~~	£24.95
XM179	6"/150mm Vernier	~~£14.95~~	£10.00
XM180	Metric Dial Test Ind	~~£29.95~~	£22.00
XM181	Imp Dial. Test Ind	~~£29.95~~	£22.00
XM182	6"/150mm Steel Rule	~~£ 1.85~~	£ 1.50
XM183	12"/300mm Steel Rule	~~£ 2.10~~	£ 1.75
XM184	12"/300mm height Gauge	~~£79.00~~	£45.00
XM185	Set of adj. parallels	~~£22.00~~	£22.00

ALL GUARANTEED FOR TWO YEARS!!

DIAL GAUGES & MAGNETIC STAND

Code	Description	Price
XM186	0-1" Dial Gauge	£10.00
XM187	0-10mm Dial Gauge	£10.00
XM188	60kg Mag Stand	£14.95
XM189	0-1" Dial Gauge & 60kg Mag Stand	£22.00
XM190	0-10mm Dial Gauge & 60kg Mag Stand	£22.00

ADJUSTABLE CIRCLE HOLE CUTTER

10mm Shank dia, c/w 3 Blades plus Drill Bit — all M2 HSS — Graduated Beam !!

Code XM191

Price **£5.95 !!**

HSS HOLE TYPE DEBURRERS 90'

Code	Size	Price	
XM192	2-5mm	~~£11.00~~	£ 6.95
XM192A	5-10mm	~~£14.20~~	£ 8.95
XM192B	10-15mm	~~£24.00~~	£14.95
XM192S	**Set 3**	~~£49.20~~	£27.50

3" x 1/16 HSS SLITTING SAWS & ARBORS

Code	Item	Price
XM193	1/2 shank Arbor & Saw	£12.00
XM194	R8 Shank Arbor & Saw	£15.00

12PC ANGLE GAUGE SET

INC — 29-30-33-34-36-38-40-45-60-75-90'

Code XM195 Price **£9.50**

RUST INHIBITING PAPER

Protect your tools, large sheet 24 x 36", TOP QUALITY

HURRY! LIMITED QUANTITY AVAILABLE!!

Code	Qty	Price
XM196	1 Sheet	70p
XM197	5 Sheets	£2.50
XM198	10 Sheets	£4.50

SET OF WAVY PARALLELS

High quality spring steel — excellent for many setting up applications !!

Code XM199 Price ~~£39.95~~ **£25.00**

DUSTPROOF HALOGEN LAMP

TOTALLY ENCLOSED HEAD KEEPS LAMP FREE FROM DUST, COOLANT ETC, ETC.

C/W TRANSFORMER !!!

CE APPROVED Code XM200 Price **£49.95**

PACKING BLOX

Great for setting up !!

Code XM201 Price **£6.50**

GOOSENECK HALOGEN LAMP

Flexible Arm Model

C/W TRANSFORMER !!!

Code XM203 Price **£29.95**

CE APPROVED

VERTEX 2MT COLLET CHUCK

C/W 15 ER25 Collets 2-16mm in wooden box

Code XM204 Price ~~£190.00~~ **£165.00**

DRILL GRINDING JIG (1/8-3/4 Drills)

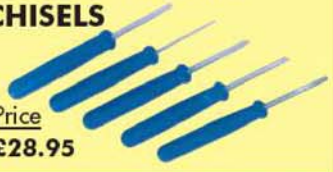
Code XM205 Price ~~£22.00~~ **£9.50**

VERTEX COMPOUND MILLING TABLE

180 x 180 square – 120mm travel – 16mm T slots

Code XM206 Price ~~£122.00~~ **£99.00**

SET OF 5 HSS MINIATURE WOOD CHISELS



Code XM207 Price **£28.95**

500ML ROCOL RTD METAL CUTTING COMPOUND

Code XM208 Price **£9.95**

HALL HSS TAPER REAMER 3-12MM

Code XM209 Price **£18.50**

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SET OF 5 HSS ENDMILLS WITH THREADED SHANKS

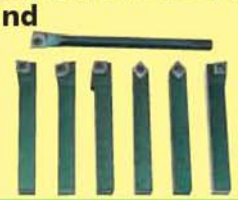
Code	SIZES	Price	
XM211	1/8, 1/4, 5/16, 3/8 & 1/2"	~~£21.00~~	£18.50
XM212	3, 6, 8, 10 & 12 mm	~~£21.00~~	£18.50

SMALL DRILL PRESS VICE 1 1/2" WIDE

Code	Price
XM213	£10.00

SET OF 7 ASSORTED SCLCR INDEXABLE LATHE TOOLS

Set of 6 Turning Tools and 1 Boring Tool C/W Tips



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Code	Shank	Price
XM214	8mm	£89.95
XM215	10mm	£94.95
XM216	12mm	£99.95

STEP DRILLS HSS

Code	Size	Price	
XM217	4-12mm	~~£19.95~~	£ 9.95
XM218	4-20mm	~~£25.95~~	£14.95

HSS CONECUT DRILLS

Code	Shank	Price	
XM219	3-14mm	~~£ 9.40~~	£ 4.95
XM220	6-20mm	~~£13.25~~	£ 7.95
XM221	16-30mm	~~£21.00~~	£11.95
XM222	**Set 3 above**		**£20.00**

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Includes Regulator with Hose Failure Valve — 2 metres of Hose – Handle – Neck Tube – & 8 Assorted Burners

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Code	Price
XM223	£250.00

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Code	Size	Price	
XM132T	2MT	~~£94.20~~	£75.00 !!
XM133T	3MT	~~£94.20~~	£75.00 !!
XM13R8	R8	~~£94.20~~	£75.00 !!

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XM130	Spare tip	£ 2.95

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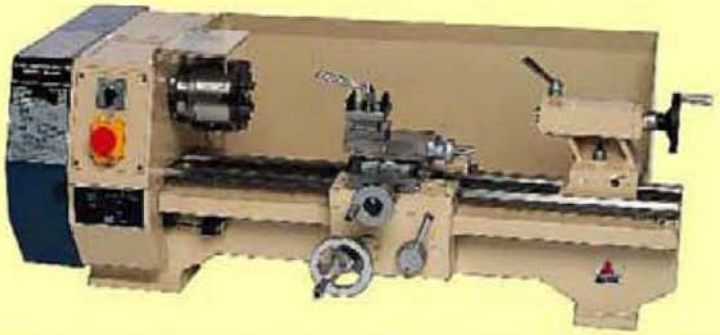

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