MODEL ENGINEER

Vol. 195 No. 4260

11-24 November 2005

75TH MODEL ENGINEER EXHIBITION

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29-31 December

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IN THIS ISSUE

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On the cover ...

Stunning detail in the model Blackburn Firecrest built from scratch by Alan Clark. In the article starting on page 552, Alan gives plenty of advice and guidance on this fascinating branch of modelling, which incorporates a variety of materials and techniques. The article also looks at the variety of models he has built. No less than eight have won Gold Medals at earlier Model Engineer Exhibitions, and Alan welcomes the return of the non-flying aircraft class at this year's event at Sandown Park.

(Photograph by Kelvin Barber)

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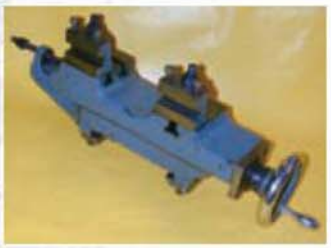

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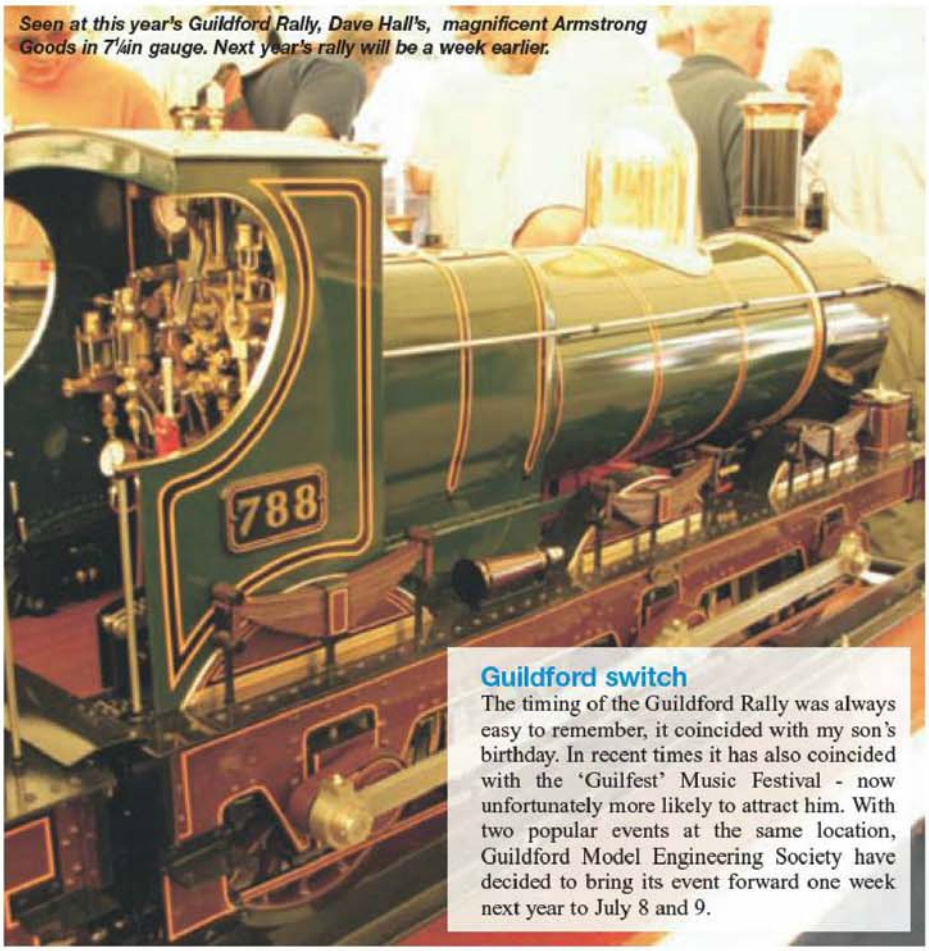
SMOKE RINGS
With the Editors



Seen at this year's Guildford Rally, Dave Hall's, magnificent Armstrong Goods in 7¼in gauge. Next year's rally will be a week earlier.

Guildford switch

The timing of the Guildford Rally was always easy to remember, it coincided with my son's birthday. In recent times it has also coincided with the 'Guilfest' Music Festival - now unfortunately more likely to attract him. With two popular events at the same location, Guildford Model Engineering Society have decided to bring its event forward one week next year to July 8 and 9.

Join the clubs

At the time of writing, a couple of dozen clubs have already booked their space for Sandown Park in December. And more are expected.

In the past, that would have filled the available space. However, with the extra space we have available this year, we can accommodate even more. So call Colin Taylor on 01689 886649 to book your club's space at the world's greatest model engineering exhibition.

It is a great opportunity for clubs to meet old and new friends, and chat on the stand, or over a glass of beer and a bite to eat in the bars and café.

The same is true for individual visitors. If you haven't been to Sandown Park before, you will be impressed with the facilities. Lots of parking right next to the entrance, easy access, a warm welcome, and exhibits to inspire, displayed in bright, airy halls.

Why not also take advantage of a reduced price advanced booking?

Many model engineers prefer to plough their own furrow rather than belong to a club. For a few days a year, they, too, join the M.E. 'club' at Sandown Park.

Way out west

With Bristol and Taunton, the West Country is now well served for model engineering exhibitions. Even further west is the Liskeard Exhibition, and this year saw the 25th time that this annual event has taken place. It continues to grow in popularity.

David Brown, chairman and exhibition organizer for the Liskeard Model Society tells us that next year the society will once more host model clubs and individual model makers from all over Devon and Cornwall at the exhibition on the March 4 and 5. It will be held at the Liskeard School and Community College, from 10.00 to 17.00 each day. It is hoped that the numbers exhibiting next year will be further swelled by budding engineers from the college.

Contact David on 01579 343096.

Video nasty

We heard from Stockholes Farm Miniature Railway Society that it had an unfortunate accident at its track. A carriage overturned dumping passengers onto the track ballast.

That was the second accident of the type in 12 months. In both cases, the driver, locomotive, carriage, and location were different.

However, there was one factor common to both. One of the passengers was videoing.

The Society reports:

"*We think that when they start filming they concentrate on getting the good shot and forget what they are actually doing, i.e. travelling on a miniature railway. Perhaps because someone is sat in front of them they lean out just that little bit further, and before you know it, that is it.*

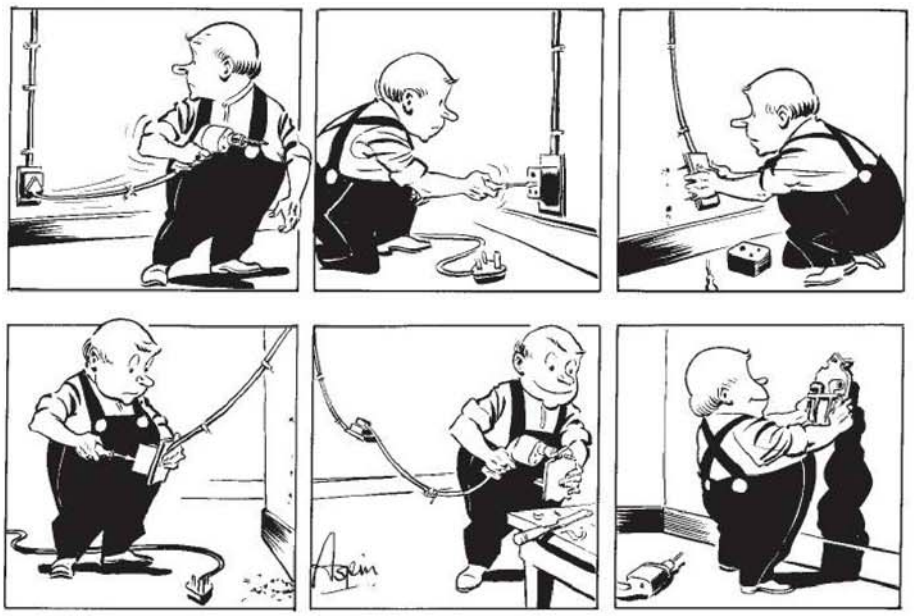
"*There are general signs asking all passengers to keep their arms and legs inside the carriage. There are now some more specific notices asking passengers not to video while travelling with other passengers.*"

Quick

A gas turbine just 22mm diameter, that runs perfectly at 55,000 rpm burning butane is reported by the Gas Turbine Builders Association. The Tesla Turbine is the work of Keven Chappell.

Details for home build will be made available later.

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



POST BAG

Moist fuel

SIRS, - Re. Moistened Air and Fuel and the I/C Engine. The above mentioned article in (*M.E.* 4247, 13 May 2005) really stirred the cobwebs of my mind. I refer to it as 'moistened air' not fuel because that was the principle that the theory was based upon, that the I/C engine ran sweeter when the air was damp than at other times.

The year would have been about 1952 and I operated a business involving London taxicabs. In the Goldhawk Road at Shepherds Bush was a shop called Goldhawk Motor Mart, a useful outlet for motor spares of all kinds and I was well acquainted with the proprietors. It was on one occasion when purchasing some spares that I was approached by one of the proprietors, telling me that they had the option of marketing a device called 'the water atomising bomb' and would I be interested in helping them to publicise it, because if it could be said *"As fitted to London Taxicabs"* the selling point would be great. As stated in the article and bearing in mind that this was around the time of Suez and petrol was at a premium, the benefits to be reaped in petrol consumption by this added component would be considerable. To do this however one had first to obtain 'approval' from the P.C.O. (Public Carriage Office) which necessitated the submission of detailed drawings and fitting locations of the components. It was agreed that I would be supplied with all necessary items F.O.C. and I submitted drawings of installation which were accepted. I then had to submit a vehicle for inspection by P.C.O. who did in fact give their approval, but this meant that the test must be run over a full twelve months before full approval could be given for adoption by all London taxicabs. I suggested that a transparent water container be fitted with a 'Ping Pong' ball so that the driver could see the level in the water container.

The petrol engine in the London Austin Taxicab at that time was a 2 litre O.H.V. unit with a petrol consumption of around 18mpg in town. The test vehicle did record 22mpg, but now the downside, when left overnight the water siphoned into the cylinders and naturally the engine would not turn against a solid wall of water. So, a tap was fitted to be turned off when the engine was at rest for any period of time. In those days the necessity to 'de-carbonise' an engine, bearing in mind the mileage covered, was annually, in the case of the test vehicle it was not a case of carbon deposit, but RUST.

The improvement in petrol consumption did not justify the problems that occurred, like the driver who forgot to turn the tap off, and final approval of the P.C.O. was never sought and the component was never universally accepted.

If I can throw any more light on this subject, because the article I was involved with is exactly what Dr. M. J. Metcalfe described. I would be more than happy to oblige.

H. H. Richardson, Surrey.

Answer on a postcard

SIRS, - Re. the question on page 764 of *M.E.* 4250, 24 June 2005, you will have to be scared to death to evaluate if you get half scared to death, so the latter will be impossible to measure (and in what units?) twice.

Colin Young, Essex.

The answer was on a postcard as suggested in Club Chat.

Flying hoops

SIRS, - There has been intermittent correspondence related to the power pack in the fuselage of a Wellington Bomber, quite correctly related to the 48ft. dia. hoop, electrically energised to activate magnetic mines. I was aware that somewhere I had a little information on this subject which I have just uncovered due primarily to my lack of a sensible filing system.

The following is an extract from the *Profile* publication on the Wellington;

"In the air war, Wellingtons ranged over Germany, the Middle East and the Far East. They were introduced into Coastal Command to join the Battle of the Atlantic later on in specially developed variants. A Mark IA, P2516, was converted at the end of 1939 to carry a large electrically energised hoop of 48ft. diameter as an enemy magnetic mine destroyer and the type, known as 'DWI', was successfully used for this duty in British coastal waters and later in Mediterranean harbours and the Suez Canal."

The photograph at bottom shows the 48ft. hoop on the aircraft.

I do not claim to know any more, but no doubt the Royal Air force Museum at Hendon could satisfy any inquires.

Roy Simmons, Bristol.

Carrots - boiled or raw

SIRS, - I read with interest in the *Club Chat* column of *M.E.* 4253, 5 August 2005, an extract from a Wigan DMES newsletter regarding the heating of steel for hardening purposes to *"the colour of boiled carrots"*. The Editor of *Club Chat*, somewhat tongue in cheek, asks for reader's views.

I have just retired from running my own blacksmithing business for the past 24 years. My day to day work involved the hot forging of mild steel, high carbon steel and wrought iron. Visitors to my forge would often come out with the comment *"you heat it to cherry red don't you"*. My reply was always *"that depends on how ripe the cherry is"*. Only yesterday I was eyeing up some cherries in my local greengrocers shop and they were very nearly black! So much for cherry red. And yet many books on metalwork and model engineering, including this magazine, often use this meaningless term.

Many readers will no doubt have memories of former blacksmith's shops in their locality, some may even be fortunate to still have one. These buildings were nearly always somewhat lacking in window area and even those that were provided were usually caked in grime. This provided an excellent environment in which to judge by eye the colour of hot metal. Model engineers and blacksmiths generally do not have sophisticated methods of controlling temperatures; they have to use judgement by eye. It is surprising how accurate you can get with practice as long as the light is subdued. I frequently carried out fire welding of the metals mentioned above. The 'window' during which this would work is very narrow but can be judged quite easily by eye in the correct light.

LBSC would often suggest that the best time and place to silver solder a copper boiler was at dusk on a summer's evening in your garden. He was absolutely right - try it! To prove the point try silver soldering a brass fabrication in direct sunlight in your garden at midday in June, good luck! If you wait for any form of redness to appear in the brass it will probably be too late and your fabrication will look a little sad. Blacksmithing outside at agricultural shows in summer was also a nightmare for the same reasons.

So the moral of all this is; set up your brazing/heat treatment area in very subdued light. Get to learn the correct heats by eye and do not try to compare them to the dubious colours of fruit and vegetables, leave them for eating.

Andrew Breese, West Sussex.

Wellington Mk. IA bomber equipped with a 48ft. mine hoop.

Gauge glass seals

SIRS, - I was very disturbed to read the letter from E. P. Moxham (*M.E.* 4254, 19 August 2005) as I have modified the gauge glass on our club *Netta* to the design as the *Penrhos Grange* article. I immediate inspected our installation and found that there was a restriction on the bottom exactly as suggested by E. P. Moxham, not completely blocked but a serious restriction, the top fitting was perfectly okay. I had no wish to return to the unsatisfactory situation of an O-ring on the outside of variable dimension glass tube, I therefore experimented with fitting a very short, approximately 1/4in. long, thin walled, manufactured PB tube installed in the bottom of the glass tube through the O-ring, this was completely successful. There is no doubt in my mind that the idea of O-rings sealing the end of the glass tube is a considerable improvement on all other methods that I have seen.

R. J. Hobdell, Croydon Society of Model Engineers.

Lathe information sought

SIRS, - May I through *Post Bag* request some information from readers. Recently I have become interested in model engineering and subsequently clockmaking, and on slowly collecting the tools and equipment before starting The BHI

distance learning course, I have been given an oldish Minilor TR-1 lathe. It's a nice little machine and I think about 13 years-old. I have in my possession a part copy of *M.E.* Vol. 169 No. 3925, which describes a milling attachment for the TR-1. Could I enquire through the learned readership if anyone knows anything at all about this machine and does anyone know where I can buy a milling attachment, second-hand I believe as the original distributor no longer deals in these machines, and any accessories for it. I'm new to this interest and am eager to progress so any information would be most welcome.
Mark Gould, Isle of Man.

Fake Myford spares

SIRS, - I felt that I should bring this matter to the attention of readers. I recently purchased a cross-slide feed screw, nut and handle assembly on eBay. It was advertised as being 'Myford'. When the item arrived, I found that it was a very poor copy of a Myford handle and screw, the finish is dreadful and I would not insult my lathe by fitting it.

I contacted the company and they claimed that it was advertised as *"fits Myford"*, which was not the case. The person told me that I could get my money back if I returned the item but the cost of return postage makes this a waste of time. The man I spoke to would not give me his name but said he was 'the owner'. I hope other readers do not get caught out like this.
Bob Strunz, Co. Clare, Ireland.

Leaky clacks

SIRS, - I am building a 7¼in. *Elidir*, and having just finished testing the boiler it occurred to me that I should test the boiler fittings, and this has now turned into a problem as follows: I have made a test rig which comprises simply of an air-line from the compressor fitted with an adaptor into which the boiler clacks and safety valves are screwed, one at a time. Air is then applied at boiler pressure (80lb/in.^{2}). I can hear the ball seat, but air very slightly hisses past the ball. I have tried several clacks and two safety valves and all dribbled. I am a reasonably experienced machinist and as a result of these failures at test, I machined up a 'special' to the same design as the others but using extra care, used a new ball as the valve (not the one used to make the seat), a reamer and 'D' bit, but it still dribbled.

The design of the clacks and safety valves are to standard published drawings. In the normal course of things these dribbles may not matter, I have seen plenty of dribbling safety valves both full size and on models, and a dribbling clack will only dribble as far back as an injector water valve or to the feed pump, but I do not like this thought. My questions are: Does anyone else test bolier fittings, if so do they experience similar problems? Is my test rig design flawed? Have they resolved them? What advice can readers offer me?
Russ Turner Yorkshire.

Changing lathe bearings

SIRS, - I read with great interest about the number of people who own a C3 mini lathe (or Conquest by Chester UK). It appears that a lot of them wish to know how to remove the deep grooved ball bearings and install a set of taper roller bearings (part number 30206S) from Arc Euro Trade. I am also one of those interested.

So I am wondering if an article could be written describing how to carry out such a change, especially since we don't all have computers! If word gets round that there will be such an article, you will have more people buying the magazine and perhaps some of those who have not previously bought the magazine will continue to do so.
William McMaster, Liverpool.
Any volunteers? ED.

Wheel spinners

SIRS, - May I comment on *Building a 1946 MG TC* by Stephen Atkinson (*M.E.* 4253, 5 August 2005).

In his first paragraph he mentions the making of the wheel spinners and states that the right-hand spinners had right-hand threads whilst the left side used left-hand threads.

This is incorrect as the Rudge-Whitworth wheel spinners as fitted to the MG and many other cars of the period were right side - left-hand thread and left side - right-hand thread.

A small point but I feel the correction should be made.

As a matter of interest, Lotus cars of the 1960 period used similar centre lock spinners and they were right side - right-hand thread, left side- left-hand thread.

This was because the MG used a Rudge hub with a female coned nut while the Lotus used a male coned nut.

I enclose a sketch *(shown at bottom)* showing the two types.
David Carter, Hereford.

Replica firearms

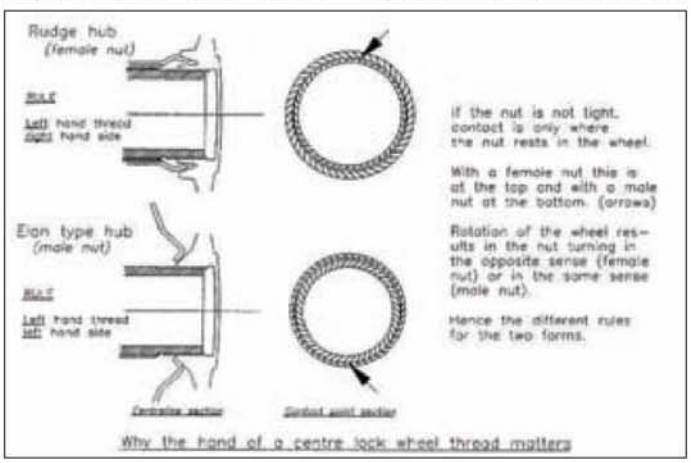
SIRS, - I am amazed the correspondence on this subject has become so lengthy. As I understand it the intention of the law is to prevent the proliferation of guns and replica guns in order to make more difficult those criminal acts that involve their use.

The drafting of the law apparently uses the words 'replica' and 'imitation'. This law then holds no problems for model engineers as a model at any scale other than 1:1 is technically neither a replica nor an imitation. A reasonable person's understanding of a replica being required to be a 100% clone and an imitation being as near to a clone as required to be mistaken for the real object. No ordinary scale model is likely to be anywhere near a 100% and thus very unlikely to cause a prosecutable offence under the Act. The practical answer for modellers then is to restrict ourselves to the making, buying and selling of only those firearm models in scales that are unlikely to be construed by any reasonable person as being a replica or an imitation of the full-sized firearm.

The *M.E.* ban on an advert for a plan of a firearm, if such adverts are not explicitly banned by the Act., would seem a step too far as a plan itself is not a firearm and I understand it the Act refers only to firearms and not to plans, materials or tools etc. The idea that somebody stumbling upon an advert for the engineering plans of a Gatling Gun is more easily able to commit a crime is about as improbable as it gets. Spending a few hundred, if not a few thousand, hours making a Gatling Gun from scratch, presumably first acquiring lathe, mill and other machine tools, tooling for those tools, specialist steels and so on, and then furnishing the finished item with homemade live ammunition, cannot be considered a realistic method of acquiring a firearm, or replica firearm, in order to carry out a criminal act.

We are all aware of accidents where police have misconstrued objects to be firearms and taken fatal actions accordingly and any model engineer who walked the streets carrying or towing a large scale model of an artillery piece behind him would be best advised to desist in these terrorist besmirched times! (One wonders if Chuck the Muddle Headed Engineer might be killed off in this way?)

I own a modest collection of Britain's Toy artillery pieces that was built up largely by purchasing cheap examples in poor condition and then using model and model engineering skills to restore them. They all now fire projectiles, usually spring powered match-sticks, and I am wondering if I may continue to add to this collection as strictly speaking I am no doubt technically guilty of *"re-arming a dormant projectile firing artillery piece"*. If the Act is very poorly drafted and it does indeed confuse scale models with replicas or imitations then I dread to think what havoc could be wreaked by my now fully functional Britain's 4.7in. calibre naval gun!
Paul J. Weighell, Surrey.



Why the hand of a centre lock wheel thread matters

Fairey Swordfish Mk. I in 1:24 scale.

Short Singapore III Flying Boat in 1:36 scale.

SCRATCHBUILDING GOLD MEDAL SCALE AIRCRAFT

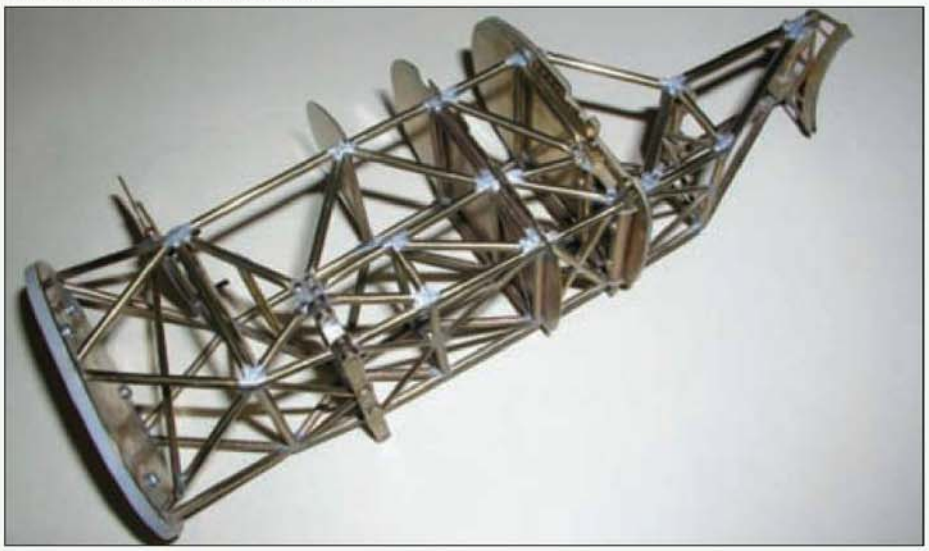
Alan Clark

welcomes the return of the non-flying aircraft class to this year's Model Engineer Exhibition and provides inspiration for others with his superb highly-detailed models.

Vickers Victoria Mk. IIIA in 1:36 scale.

Surprise! This could have been an alternative or sub-title to this article as it sums up my reaction upon receiving a telephone call some weeks ago from your Production Editor who requested that *Model Engineer* would like to do a feature on my collection of self-built scale aircraft models. This had been brought about by the fact that the magazine wished to re-introduce certain classes of model aircraft to its pages. Up until the year 2000 I had competed for many years at various Model Engineer Exhibitions, being fortunate in winning eight Gold Medals in addition to a number of lesser hue. Then, for some reason, it was decided by the organisers to eliminate all aircraft classes as they were not considered to be 'engineering'. Strangely though, model ships of all classes were retained...go figure!

Upon the insistence of the editors I reluctantly begin this introductory feature with a brief résumé of my adult career. Born in 1933, my working life divided itself into four phases: 25 years as a draughtsman/electrical design engineer; 20 years as a Technical Writer (ultimately to be employed by BAe at Hatfield); four years as Exhibitions Officer at the Shuttleworth Collection and finally, retirement. Each career change being brought about by company closures and/or subsequent redundancies - such is our modern world! I shall now go on to give my thoughts on the subject of scratchbuilding model aircraft.



Metal tube being utilised in the construction of a HawkerTempest Mk. V.

Model scales and sizes

Generally, a favourite scale is that of 1:24

depending on the size of the prototype being modelled. However, some of my models range from 1:18 for the Albatros DVA to 1:36 for the heavy stuff, e.g. the Singapore, Halifax, Victoria and Viking etc. This brings the models to an acceptable near common size for display and storage. Of course there are many that would argue that a common scale should be adhered to for reasons of comparison, but the writer has found this not to be practicable.

Materials

Selection of materials is generally dictated by the subject being modelled and are usually wood, metal, glass fibre and styrene (sounds better than plastic!). Referring to my Westland Wessex and Vickers Viking V amphibian models, these slab-sided fuselages were built up as 'boxes' utilising 0.75 and 1.0mm 3-ply hardwood. In the case of the Viking V this 'box' was subsequently planked in mahogany veneers. Of course, these basic boxes could then be sheathed in thin styrene to depict other finishes and details. This method is currently being used on a Handley Page Heyford biplane under construction.

A favoured method of construction for more rounded types of fuselage (as in my Albatros DVA, Delta and Flamingo airliner models) has been the use of glass fibre formed over two halves of a carved wooden male mould pattern. This is then smoothed and variously finished in wood veneers or metal (more on this later)

The material most used by myself has been styrene. This can be either be used plank-on-frame or moulded by vac-forming. Heating and stretching over a male pattern is a further option. Examples of my plank-on-frame models are the Halifax, Viking, Singapore and Whirlwind etc. Moulded fuselages feature on my Vickers 253, Helldiver and Bristol 133 etc.

The above methods can be cosmetically covered, where appropriate, in sheet metal. For this finish, printer's offset-litho plates are used; being fixed to the model with contact adhesive. Double curvatures can be formed by heating individual panels for a few seconds over a gas ring before applying to the model. For particularly difficult areas pewter sheet can be used. Lines of rivets are embossed via suitable clock wheels set in handles, after

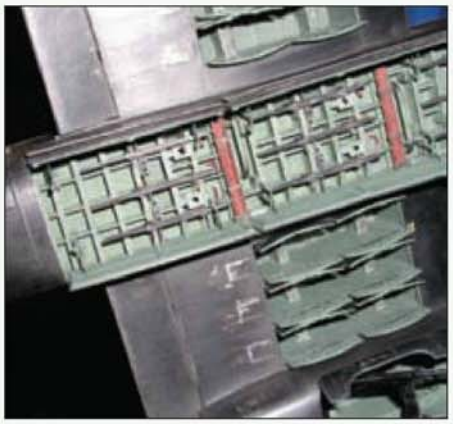
Two views of the author's Albatros DVA in 1:18 scale.

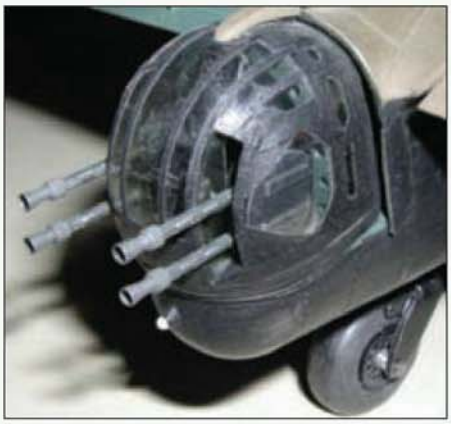
Two views of the author's Albatros DVA in 1:18 scale.

Westland Whirlwind in 1:24 scale.

Curtiss SBC-4 Helldiver in 1:20 scale.

Handley Page Halifax B Mk. I in 1:36 scale. Close-up photos show the nose and tail turrets, bomb bay and engine detail.





assembly for flush riveting. From the rear of individual panels before assembly for protruding heads.

For the wings of models, the method invariably used is that of built-up construction. Spars and ribs of the previously mentioned 1.00mm 3-ply hardwood are cut out and mounted on a building board; the whole then covered in smooth or rib embossed sheet styrene as appropriate. Again as appropriate, further finishing in metal sheet can be applied.

While all the above methods have their place in the aircraft modeller's repertoire, I have in recent years been fascinated and inspired by the models and writings of that doyen of car modellers, Mr. Gerald A. Wingrove. For some time now an attempt has been made to reproduce Mr. Wingrove's car building methods into the aircraft field.

The building of a metal airframe from the longerons and frames up, in metal tube and sections as in full-size aircraft, gives a great sense of achievement. Models which I hope go some way to emulating these methods are my Blackburn Firecrest and Martin Baker MB5. The next model in line to employ this method will be a Hawker Tempest V and its basic fuselage framework can be seen in the photo on page 552.

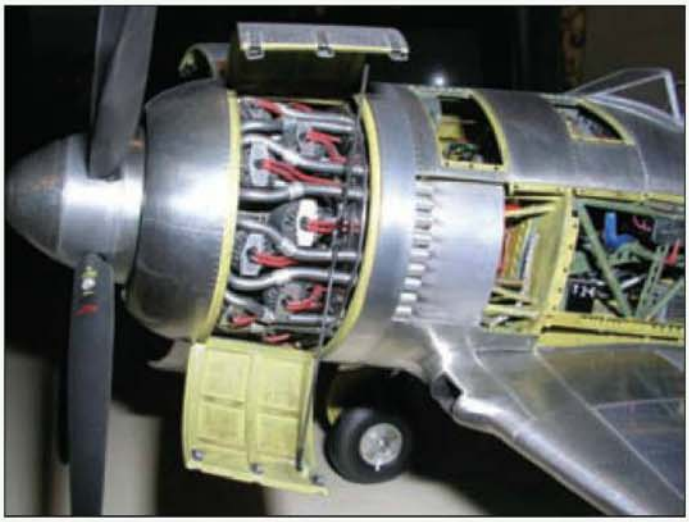
Of course all the foregoing only briefly describes the basic methods of building the various types of airframes. Such components as undercarriage, propellers, engines, interior cockpit details etc., constitute probably at least 60% of the total time and effort in constructing a model.

Martin B-26B Marauder 1: 28 scale

Referring to the photos of the part-built Marauder, a more detailed description of the techniques involved are as follows.

As with most model aircraft the fuselage was commenced first and utilised a styrene plank-on-frame method which entailed cutting 30 formers from 40 thou. sheet styrene. All the formers were then divided into their respective port and starboard halves, each half former being heavily scored on its inside former line (about 1/4in. from its outer edge). This scored line was to facilitate the eventual breaking away of the inner portion of the former at a late stage of construction, after all the planking had been completed. However, as will be seen from the photographs, a number of

Northrop Delta 1A in 1:24 scale.



Blackburn YA.1 Firecrest in 1:24 scale.

formers are in fact major bulkheads and as such would have only had door apertures cut.

Two outline (handed) shapes of the complete fuselage profile were cut from 5 thou. styrene and lightly fixed to a building board with strips of double-sided adhesive tape. The port and starboard sets of half formers were then cemented to their respective positions on the profiles.

Both fuselage halves were then planked with 1/4in. wide 40 thou. styrene strips. After planking, the complete half assemblies were liberally coated with liquid cement and allowed to dry out for a considerable period.

The two fuselage halves were then removed from the building board and cleaned up generally on their exteriors, all imperfections treated with body putty and rubbed down. The thin sheet profiles upon which the formers were mounted were cut away to reveal the inner surfaces; after which the previously scored sections of the formers were broken away by the use of long-nosed pliers, thus leaving the basic ribs. The inside surface of the fuselage halves were cleaned up and additional false formers fitted to conform to their scale positions. Floors were now fitted, not forgetting lead-shot which was affixed in all available cavities to ensure the model sits on its nosewheel undercarriage.

All furniture and fittings were now made and fitted e.g. wireless and navigation tables, consoles, seats, bomb racks, wiring etc. Of course, all painting of the interior and of components was completed before fitting out.

Thus the description has taken the model to the stage shown in the photos. Further details will be added (pilot's controls, instrument panels, further wiring etc.) upon which the two fuselage halves will be cemented together.

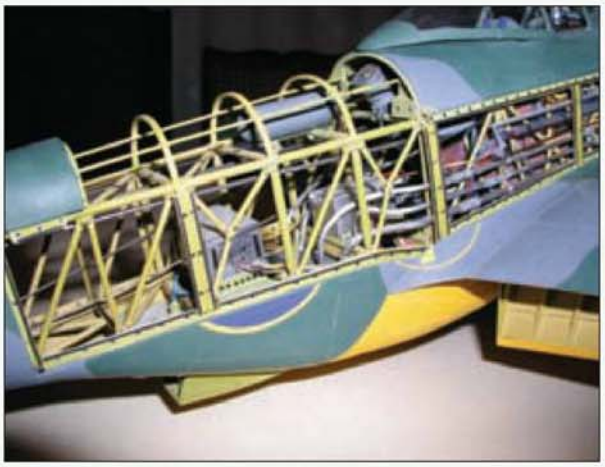
Conclusion

I hope the foregoing is of interest and that I may be allowed at a later stage to complete the description of my Marauder build. Also, it may be obvious that I have three models under construction at the same time, these being the Marauder, Tempest and Heyford. Being completely different types of aircraft, to different scales (the Tempest is to 1:20 scale, the Heyford to 1:36) and methods of construction/materials etc., I find that boredom is never a factor as I can switch from model to model as interest dictates.

Vickers Type 253 in 1:24 scale.

Close-up details of the author's 1:36 scale Vickers Viking Mk. 1, Britain's first post-war airliner.

Above and below left, Martin Baker MB5 in 1:24 scale. The model's incredible internal detailing is nicely revealed by leaving off a few panels.



Martin B-26B Marauder in 1:28 scale features a styrene plank-on-frame method of construction.

Three close-up detail views of the Martin B-26B Marauder's internals - it's a shame that these beautifully detailed fuselage halves have to be joined together!

PETE'S PAGE

CENTRING LONG SHAFTS

Peter Spenlove-Spenlove describes some of the tricks of the trade used to mark out and centre long shafts and introduces us to witness circles.

Long shafts occasionally need to be turned in the model engineer's workshop. When preparing to mount long work pieces in the lathe it is not always possible to centre drill the ends of the bar in the lathe itself. Perhaps it is too large in diameter to be held in the chuck with the other end held in a fixed steady. Maybe there is simply no room for the tailstock and tailstock drill chuck on the lathe bed. In these situations it is usual to drill the centres using a hand held pistol drill or hand drill. If the position of the centres is fairly critical then care needs to taken in marking them out. If this applies to one of your projects then proceed as follows.

First you need to mark out the centre of the bar as accurately as you are able and centre punch the position. Several methods of marking the centre are possible. If you have a reasonably flat surface available e.g. the drilling machine table, a scriber can be placed on a raiser block and several lines marked as in fig 1. You could also use your scribing block (surface gauge) of course. This method can be used on square and hexagon bar as well as round.

Alternatively set your jenny callipers to just under the radius of the shaft and scribe several intersecting radii as shown in fig 2. A centre square as supplied with many combination squares can also be used (fig 3).

The final approach is to use a bell centre punch as shown in fig 4. However, please note with this method that for the bell centre punch to work correctly the end of the bar must be square to the outer diameter, clean and burr free. The tool must also be held upright. Bell centre punches are available commercially but were often made by apprentices as part of their training.

Now, using your dividers, scribe a series of concentric circles around the centre pock mark (fig 5). The smallest circle scribed is normally made the size of the required hole. Now as you drill the centre you will be able to check progress and correct any drill wander before it become too serious.

Such scribed circles are called witness circles and were once used a good deal in high quality fitting practice. If you examine old pieces of equipment carefully you can sometimes see the remains of the circles and the centre punch marks. They can be used, of course, to help position any critical hole and are not just for use on shaft ends.

To make the circles easier to see it is common to lightly centre pock the circumference of the circles in several places. It is considered good practice to 'split' the centre marks on the periphery of the circles so that half disappears with the hole and half is left on the remaining work. Inspectors and supervisors used to look for these telltale marks and so unscrupulous apprentices soon learned to mimic them by nicking the edges of the hole with a needle file!

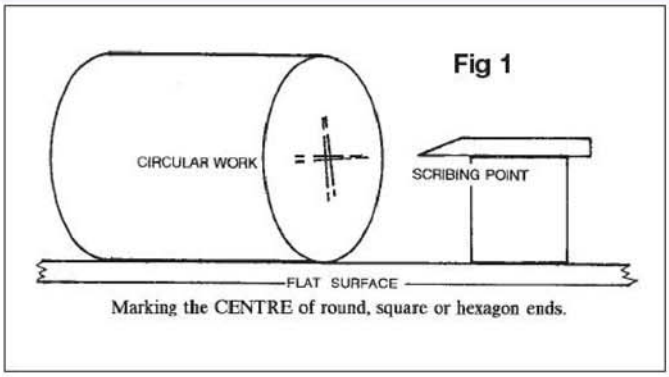


Fig 1
Marking the CENTRE of round, square or hexagon ends.

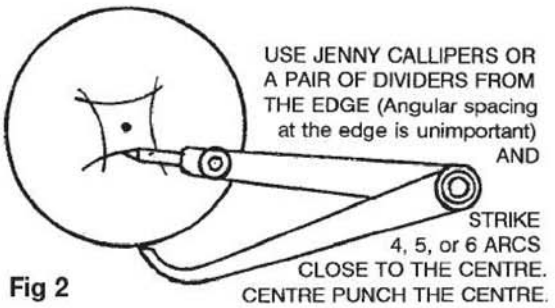


Fig 2

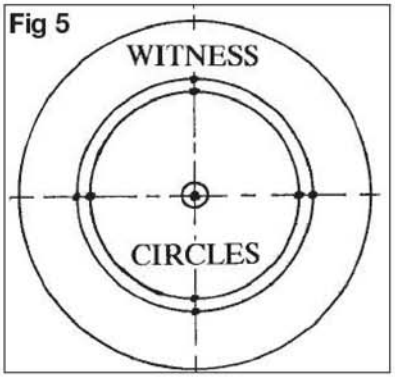


Fig 5

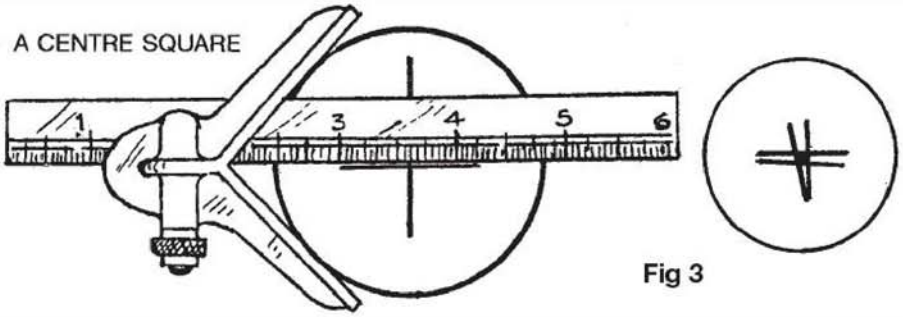
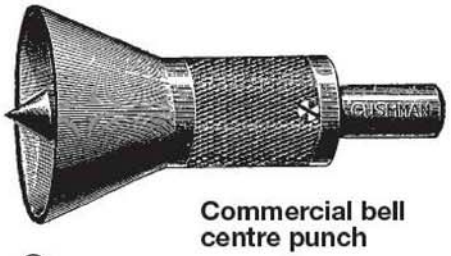


Fig 3


Commercial bell centre punch

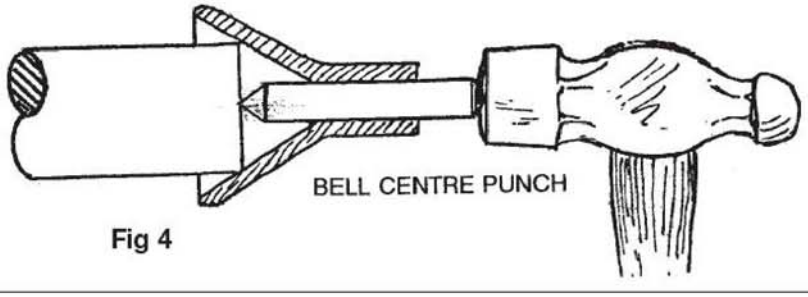


Fig 4

James Duncan runs through the station area with his little 'Pug', which successfully completed its run.

Local man Chris Dore had a relaxed run with his Hunslet and even found time to chat to his observer.

SEQLEC 2005 (OR FAREHAM FROLICS!)

Malcolm Stride
reports on the action at this year's efficiency competition for 7¼in gauge locomotives.

This year this annual competition for the Bristol Trophy moved near the south coast of the country to 'The Railway Field' at Titchfield, the headquarters of Fareham & District Society of Model Engineers.

'The Railway Field' is a very attractive site close to Titchfield in Hampshire and is owned by the society. The track site is approached from the road down a long drive, which means that the it is quite private, a benefit in this day and age. There are two tracks on the site, the dual 7¼ and 5in. gauge ground level track, used for this competition, and a raised 5 and 3½in. gauge track.

The Society has a very well appointed club house and also a model boating pond complete with a small boat house. The latter is located inside the far end of the track loops. The site is nicely landscaped and has many mature trees making it a very pleasant place to spend a SEQLEC Sunday.

The track poses several challenges for drivers.

Not in the competition but this tug was a pleasant sight on the boating pond.

After the start at the station, the track descends briefly at 1 in 114 before starting to climb by the steaming bays. This climb starts at 1 in 357 but then stiffens considerably to 1 in 71 up to the signal gantry on the back straight. The gradient then eases to 1 in 176 past the boating pool before reaching the summit and descending at 1 in 124 to the tunnel before steepening briefly to 1 in 65 and returning to the station area.

After a damp start from home, the weather improved as I got closer to Fareham and was dry but cloudy when I arrived. I was welcomed at the site by Chairman Dave Wrenn and event organiser Mike Machin before being presented with a coffee and very welcome bacon butty. Someone must have told them how to look after *Model Engineer* reporters properly!

Unfortunately this year, there were only four entries in the contest but this did mean that the day could be very relaxed without the hassle of trying to keep to a strict timetable. This was fortunate because a minor fault was found with the track after a test run to check the dynamometer car and so time was taken to correct this beforehand. The test run was carried out by John Painter with his LMS 8F 2-8-0 which was not running in the competition. The dynamometer car was loaned by Neal Harrison and Sutton Coldfield MES and Neal was on hand to provide advice and guidance during the day.

While the competition was getting under way, I had a walk round the track and came across a very nice *Smit Nederland* tug being sailed on the boating pond by Michael Lloyd. This caught my eye because I built the same kit in my model boating days (**photo 3**).

Under the rules of the SEQLEC competition, each competitor is allowed one trial lap to check the load before the fire and water levels together with the steam pressure are recorded and the driver is provided with his measured coal for the run. At the end of the half hour run the levels are restored to their starting values before all the measurements are taken. Competitors are allowed to drop passengers and trucks during their run if they desire.

Once the track was settled, the competition got under way and the first entrant took to the track. Readers should note a choice of fuel was available for competitors.

Stuart Duncan
L & Y *Pug* 0-4-0 saddle tank

This locomotive was the smallest in the competition and was driven by Stuart's son James this year (**photo 1**). James elected to take one truck and the five scale wagons in addition to the dynamometer car and brake car. He used his own driving trolley in front of the dynamometer car. Passengers were limited to the observer and guard.

James got away to an excellent start with no slip and was soon well on his way with no apparent problems on the steep bank. However after a couple of laps he came to a stop after the tunnel before restarting. He stopped again 15 minutes into the run and dropped two of the scale wagons before carrying on to complete an excellent run after which he commented *"Shaky, but a good run"*. James achieved an overall efficiency figure of 0.664 percent.

Chris Dore
Hunslet Narrow Gauge 0-4-0 *Ned*

Chris was the local man and *Ned* (**photo 2**) was

Run number	Entrant	Locomotive	Trucks/Passengers	Coal issued lb	Coal returned lb
1	James Duncan	L&Y 'Pug' saddle tank	9T*/3P	2.2	0.33
2	Chris Dore	Hunslet Narrow Gauge	3T/6P	4.4	1.914
3	John Painter	1400 Class GWR 0-4-2 tank	10T/3P	2.2	0.339
4	Melvyn Bright	BR Standard 9F 2-10-0	4T/9P	4.4	2.431

*Two trucks removed after 15min.

John Painter looks determined as he drives his GWR 14xx smartly past the boating pond.

Melvyn Bright on the run that was to lead him to first place - the third win in three years.

a very nicely turned out locomotive complete with galvanised water bucket hanging from the tank side. Was this perhaps a ploy to gain some extra weight?

Chris elected to take two trucks in addition to the brake wagon and started his run with five passengers. He made a good start with no slip and then settled down to a good steady run. In fact it was so uneventful that the only comment I wrote in my notes was *"very relaxed, singing to himself up the bank"*.

Chris' comment at the end was *"Nice steady run but starting to lose it two laps from the end"*. Chris achieved an overall efficiency figure of 1.031 percent and came third.

John Painter
GWR 14xx 0-4-2T tank

John has entered nearly all the SEQLEC competitions and this year was again driving the GWR 0-4-2 built to the late Martin Evans well known *Dart* design (**photo 4**). John took the largest load so far with five passenger trucks including the brake wagon plus all five scale wagons. On his initial test lap he dropped two of the four passengers, starting his run with two.

He made a good start with some slip but this was controlled and after a very slow but steady climb up the bank was soon into a good rhythm. Water was taken on in John's usual style with James Duncan running alongside the locomotive and pouring water into the tanks. John had a couple of minor derailments but apart from that it was another steady run. John commented after his run: *"That was one of the hardest, I was working all the controls all of the time. The only panic was one lump of coal jamming in the fire hole door"*. John achieved an efficiency figure of 2.27 percent to gain second place.

Melvyn Bright
BR Standard 9F 2-10-0
Evening Star

Last years winner, Melvyn Bright, was again campaigning his superb *Evening Star* (**photo 5**) and after a check of the track with just the locomotive elected to try four trucks including the brake truck with 16 passengers. On his trial lap, he slipped to a halt on the bank and dropped some passengers before coming back to the station. Melvyn then elected to take nine passengers and set off with some slip before settling down to a good steady run with no incidents. At the end of the run Melvyn commented: *"Good steady run with no problems"*. The best comment came after all the measurements had been taken when Neal Harrison, admiring the backhead on the 9F, asked *"What are all those gauges for?"* Melvyn's immediate reply was *"I dunno"*. The answer did make me wonder! Melvyn finished with an efficiency figure of 2.67 percent to take the trophy again this year.

So another SEQLEC competition was over and we again congratulate Melvyn Bright for his apparently effortless first place. Congratulations should also go to John Painter who again gained second place with an efficiency figure which in the past would have been good enough to take first place.

Once the results had been calculated and the certificates produced the presentation of the awards was made by Mike Chrisp (**photo 6**) in his role as President of the Fareham Society. The competitors then posed for the group photograph (**photo 7**). As I left John Painter was preparing to do a tender first run to check the efficiency of the 8F.

Thanks must go to Chairman Dave Wrenn, organiser Mike Machin and all members of Fareham DSME for putting on a very relaxed event which was enjoyed by all present. In particular our thanks go to the ladies of the catering corps who set a precedent by producing a hot meal for all present at lunch time. It must be a first for everyone to sit down to sausage and mash followed by a hot pudding at SEQLEC. There were also bread pudding and rock cakes for those still hungry in the afternoon.

We are also grateful to Neal Harrison and Sutton Coldfield MES for the loan of the all important dynamometer car which performed faultlessly as usual.

All in all, a very enjoyable day, thank you Fareham!

Melvyn Bright (left) receives the Bristol Cup from Fareham President Mike Chrisp.

Smiles all round as the competitors receive their certificates from Mike Chrisp.

SEQLEC 2005 Official Results

Coal used lb	Run time min.	Work done ft lb	Draw bar hp hp	Specific fuel consumption lb/hp/hr	Efficiency %	Final position	Fuel Calorific value Btu/lb
1.87	31.75	142035	0.136	26.068	0.664	4	14700
2.486	30.13	293252	0.295	16.785	1.031	3	14700
1.861	30.63	482580	0.477	7.636	2.267	2	14700
1.969	31.03	544775	0.532	7.156	2.605	1	13650

A GWR 1400 CLASS LOCOMOTIVE IN GAUGE 1

G. R. Thornber

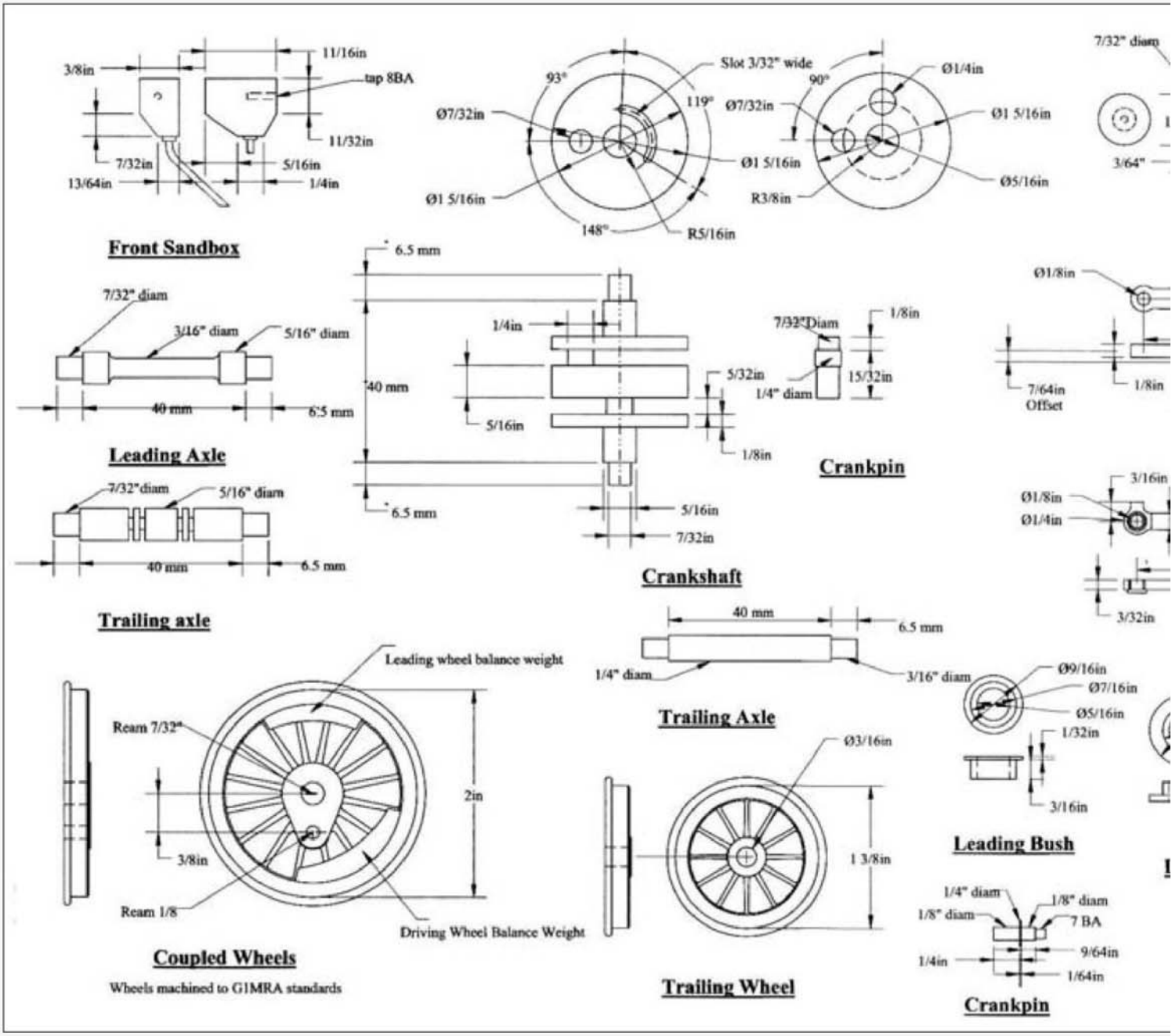
continues construction with the wheels, crankaxle and coupling.

●*Part III continued from page 455 (M.E. 4258, 14 October 2005)*

The wheels are machined, as usual, to G1MRA standards and need little or no description. The crankaxle is probably the most tricky part of the whole locomotive. The eccentrics have a pin in them that works in a slot in the crank webs. The accuracy of this slot determines the valve timing and there is no means of adjusting this. I suggest that two pieces of 1/8in. steel plate are cut and the relevant centres marked on one of them. Cheat by making a full size copy of the web on paper and then sticking it with super glue onto the steel before centre punching. Note that the only important part of the slots are the end points upon which the eccentric pins bear. The rest of the slot is not important so long as the eccentric moves easily from one end to the other. Again super glue the two pieces together before machining. I drilled the end points and then cut the slot with a slot drill, with the webs mounted on a dividing head held on the cross slide.

The centre piece is rather thick because originally there was an eccentric for the feed pump in the middle. As mentioned this has now been dispensed with. I argue that the centre disc now forms a useful flywheel! The main axle is made in one piece, but it is wise to cut grooves in it, which makes it easier to remove the portions that go between the webs. Two crankpins are also required.

To assemble, firstly countersink the centre web on the crankpin holes on the opposite side to the cranks, and both sides of the axle hole. The crankpins and axle are now silver-soldered into place, making sure that the silver solder runs well into the countersinks. Once this has been done,



the outer webs can be put into position, and also silver-soldered. All that now remains is to remove the pieces of the axle between the webs.

A word of warning - make sure that the webs are on the right way round. This is said from bitter experience! With the crankpin forward the slot should be such that the end that is nearly at 90deg. to the crank should be to the top.

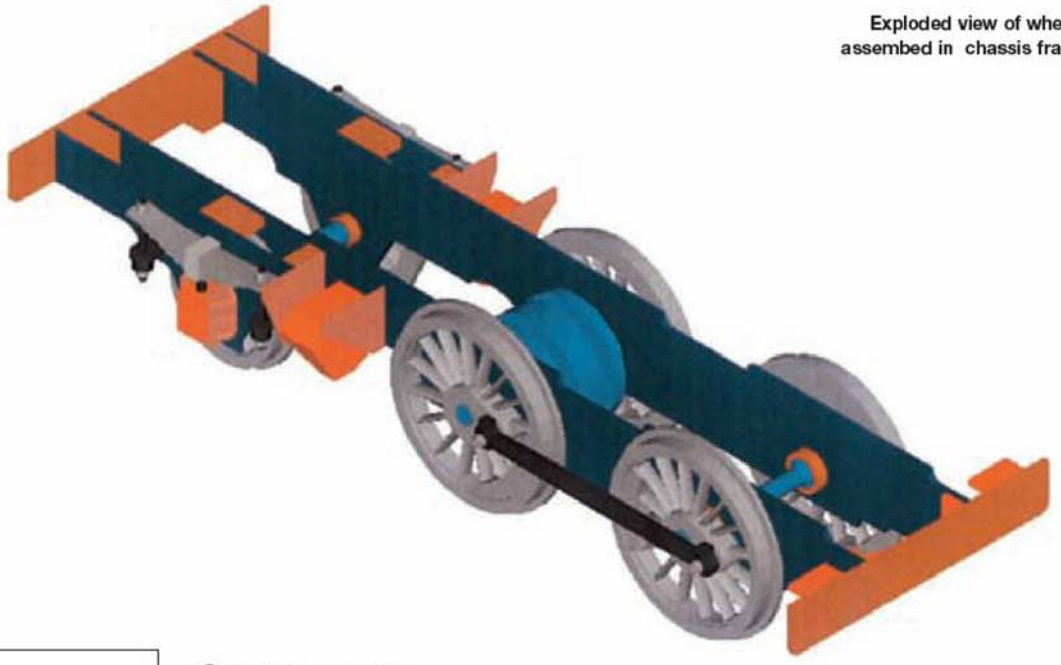
None of the other items on this sheet should prove difficult. The connecting rods can either be brass or steel. If steel is used then both ends should be bushed (a split bush at the crankpin end). On the laser cut sheet I have included the coupling rods - these will be 1/16in. thick, although I have said 3/32in. on the drawings.

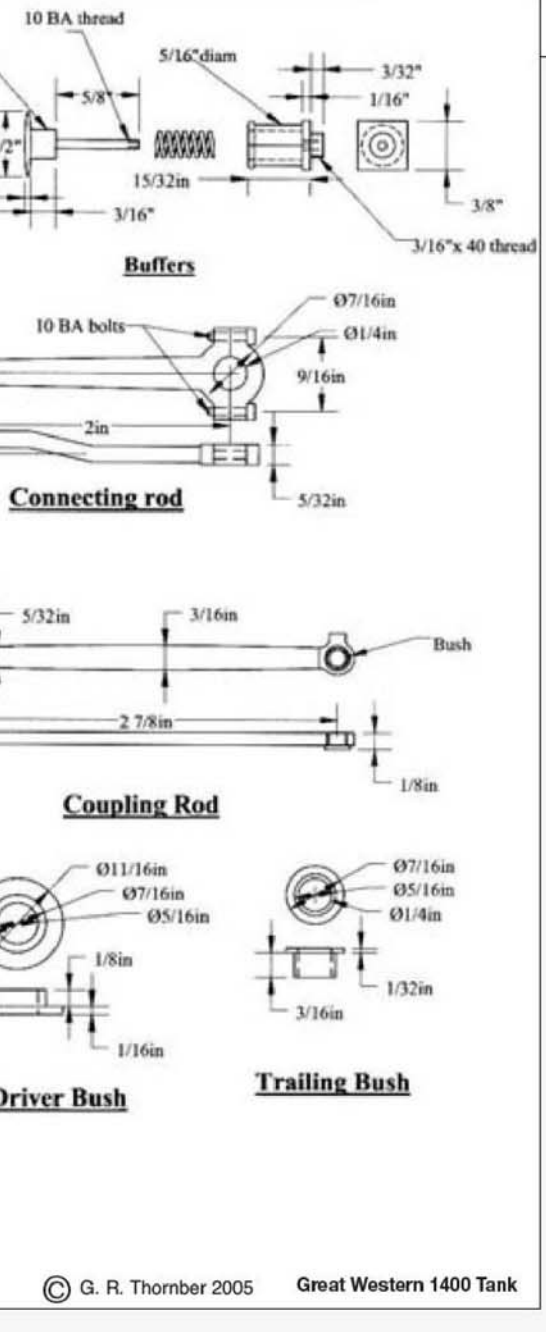
Do not put the wheels on yet. This is best left until the valve gear is assembled. It can then be tested either on air or steam.

Having had another look at this drawing I realise that some readers may be unfamiliar with the G1MRA wheel standards so I have included a sketch, which shows the current standards. There is some discussion going on about these standards, but the changes being discussed are relatively minor. The main one is to include a tolerance on the back to back wheel arrangement. This will be 40mm +0.5mm -0.0 millimetres. In other words the spacing should not be less then 40 millimetres. It is possible that the two 10deg. tapers on the rim may be changed to give one taper of 20deg. on the outside only - the back being flat.

●*To be continued.*

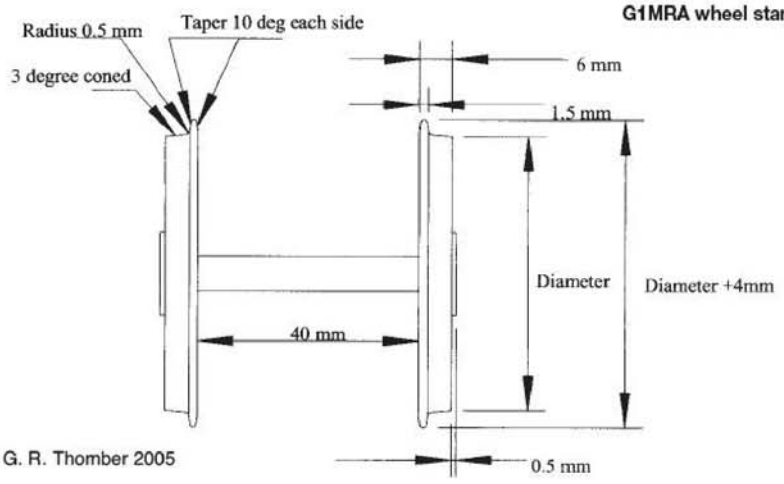
Exploded view of wheels assembed in chassis frame



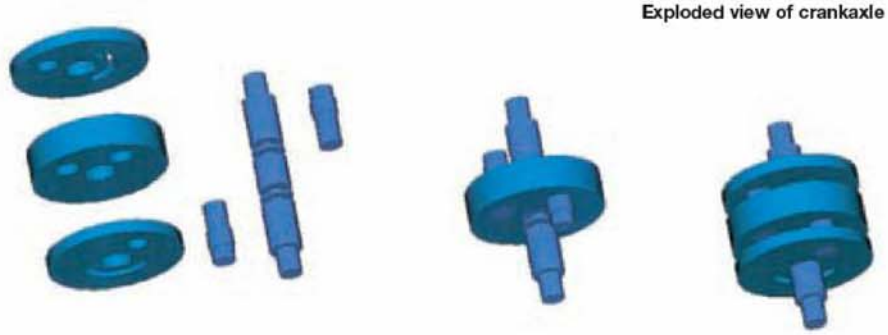


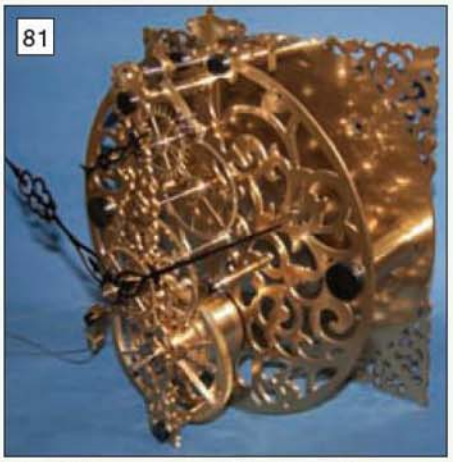
 Great Western 1400 Tank

G1MRA wheel standards



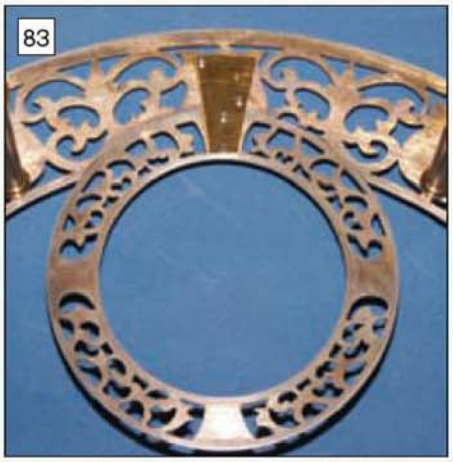
Exploded view of crankaxle





View of the movement at this stage with the hands and motion work fitted.

View showing how the seconds ring is let into the main ring.



Reverse view shows how the seconds ring is secured into position.

AN UPDATED CLAUDE REEVE EIGHT-DAY REGULATOR CLOCK

John Wilding FBHI
concludes this fascinating series with a description of how he made the dial.

●*Part VII continued from page 441 (M.E. 4258, 14 October 2005)*

A view of the movement at this stage with the hands and motion work fitted is shown in **photo 81**.

The skeletonised dial ring is recessed at the top to accommodate the seconds ring, this can be seen in **photo 82**. A back view shows the method of fixing (**photo 83**). A check must be made to see if the arbor of the escape wheel is in the centre of the seconds ring. On my clock I found a discrepancy here and I had to take the drawing of the seconds ring to a photocopying shop and have the drawing reduced to 96% in order that the second hand would be in the centre of the ring.

The drawing of the main dial ring should be cemented to a square sheet of compo brass. As before I used Spraymount for this. The back movement plate is laid on the dial ring and secured with clamps as shown in **photo 84** and the vertical and horizontal lines on both components correctly aligned. No. 55 holes are now drilled right through both components. The holes in the back plate are opened out to 1/4in. as shown on the drawing. Those in the dial ring are tapped 10BA.

It is now time to fret out the main dial ring and I did this on my Rexon powered machine, the blade used was a razor No. 2/0. This work is much quicker as the plate is only 1/16in.thick. The work in progress is shown in **photo 85**.

Leave the centre in place while the rough filing is carried out then the centre can be removed and I did this on the fret saw machine (**photo 86**). The ring can be held in wooden chops as shown in **photo 87** and **photo 88** for filing.

Seconds ring

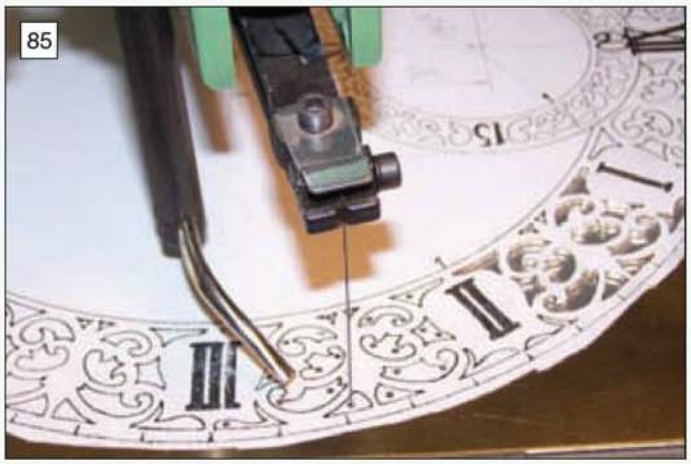
As already explained I had to reduce the diameter of this very slightly so that it was in correct alignment with the escape arbor. Again, the drawing was cemented onto a piece of 1/16in. brass sheet, a 1/8in. hole drilled in the centre and this was located on a similar sized pin in the centre of a wooden faceplate on the lathe. The outer diameter was turned to size and the inner diameter was trepanned as demonstrated in **photo 89**. **Photograph 90** shows the ring after the trepanning was completed.

The seconds ring was then pierced and I did this by hand. At this stage the movement plates were assembled with the escape arbor in position and a disc of thin card having a diameter equal to the inner diameter of the seconds ring was impaled on the escape arbor front pivot. The seconds ring was held firmly in contact with the main dial ring while a line was scribed round its edge. This arc was then cut out of the main ring and the small ring secured in position with the wedge shaped piece of brass illustrated in photo 83.

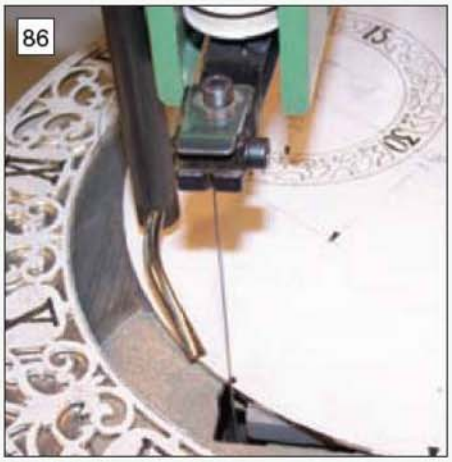
Numerals

The large roman numerals can be cut out from 1/32in. brass but these are readily available from

Method of clamping the back plate and the dial together while drilling the dial pillar holes.



Fretting out the dial ring on the author's Rexon powered fretsaw. Note the drawing is glued to the brass with Spraymount.



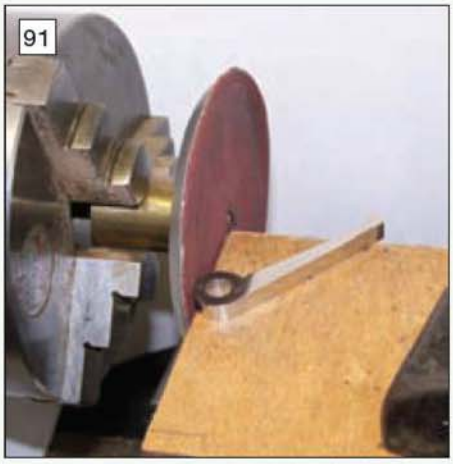
The dial centre was also removed using the powered fretsaw.

Curved vice chops were used to support the ring during filing.

The dial held in the instrument vice, a useful aid for delicate work.

Trepanning the centre from the seconds ring in the lathe.

The seconds ring after separation from its centre, which remains screwed to the backing board.



Using a homemade lap for finishing off the edges of a part.

Meadows & Passmore. They should be 20mm in height. Each one is secured with a single 14BA brass screw put in from the back. The Arabic numerals on the second ring I had painted by a professional after the ring had been silvered.

It will be noticed that the lower left dial pillar acts as a convenient limit stop for the pulley when winding the clock. Although Claude Reeve suggests that the dial pillars are secured with screws in the back plate, it is difficult to gain access with a screw driver here and I used 5BA bolts in this position. These are easily tightened with a spanner.

General Finishing

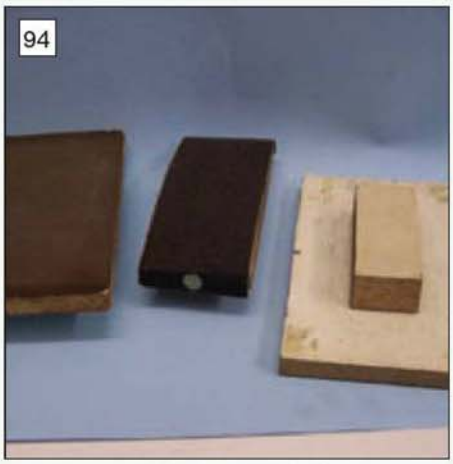
I have already mentioned the use of homemade laps, and these are very useful for the final shaping and polishing of many parts. In **photo 91** I show one of these being used for finishing the edges of the maintaining detent and in **photo 92** a group of various grits.

Although it is not obligatory to blue screws, it is generally done in good quality work. Large screws can be blued in the bluing salts but smaller ones are best blued in the set-up shown in **photo 93** where a scrap piece of brass is equipped with a number of different clearance holes for the normal BA sizes. The screw needs to be a loose fit in these holes so that it falls out easily when it is ready to be quenched. The source of heat is a spirit lamp and the brass has the effect of slowing up the bluing process giving more time to observe the colour changes.

Flat components are best polished on a polishing board. **Photograph 94** shows some of these, they have different grades of emery papers and cloths attached to them. The centre one here is not a polishing board, its upper surface is curved and the emery cloth is coarse; it is used for graining the burnisher, the latter being moved sideways over the surface. Emery papers go down to 4/0 grit and then you can move on to

Group of laps having different grades of grit shown with a backing plate.

Method used to blue small screws. The screw should be a loose fit in the hole.



Selection of polishing boards. That in the centre is for graining the burnisher.

The pillars were polished in the lathe after turning marks had been removed with a fine file.

crocus paper. For highly polished work the Micromesh cloths are very good. They extend from 1,200 grit to 12,000 grit. 8,000 grit is fine enough for most applications. In **photo 95** you can see a small sheet of this being used on a pillar, but great care must be taken in this situation not to overheat the cloth. Before any polishing is carried out it is essential to remove all turning marks. The best file that can be used for this is a No.8 cut and 4in. in length. Such a file needs to be cleaned with a brass scratch brush regularly otherwise it will clog.

Oil sinks can be polished with a miniature felt bob held in a hand drill (**photo 96**) or a small square of cloth dipped in metal polish and rotated on the end of a piece of pegwood.

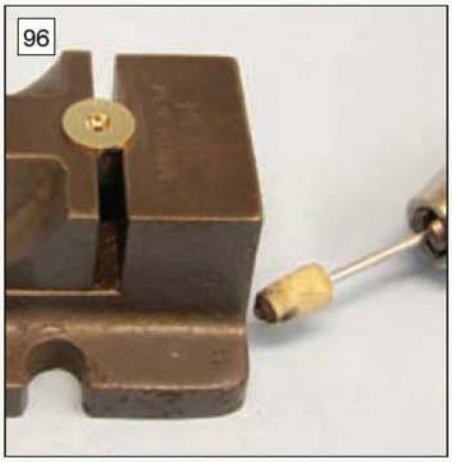
The large plates can be placed on a rubber mat on the bench and worked on with sheets of emery or wet and dry papers wrapped round a cork block. A very satisfactory polish can be obtained using the micromesh cloths finishing with the 8,000 grit.

Lacquering

I lacquered all the brass work, but I am not entirely happy with the result on the pierced plates. I suspended them in a spraying booth and used a lacquer from a spray can. It seems to me that whatever lacquer is used there is a tendency to dull the original polish. The small parts I lacquered using a cotton wool swab moistened with a shellac based colourless, clear lacquer.

At the time of writing my case has not been made but the movement is finished and has been on test on the workshop wall for months.

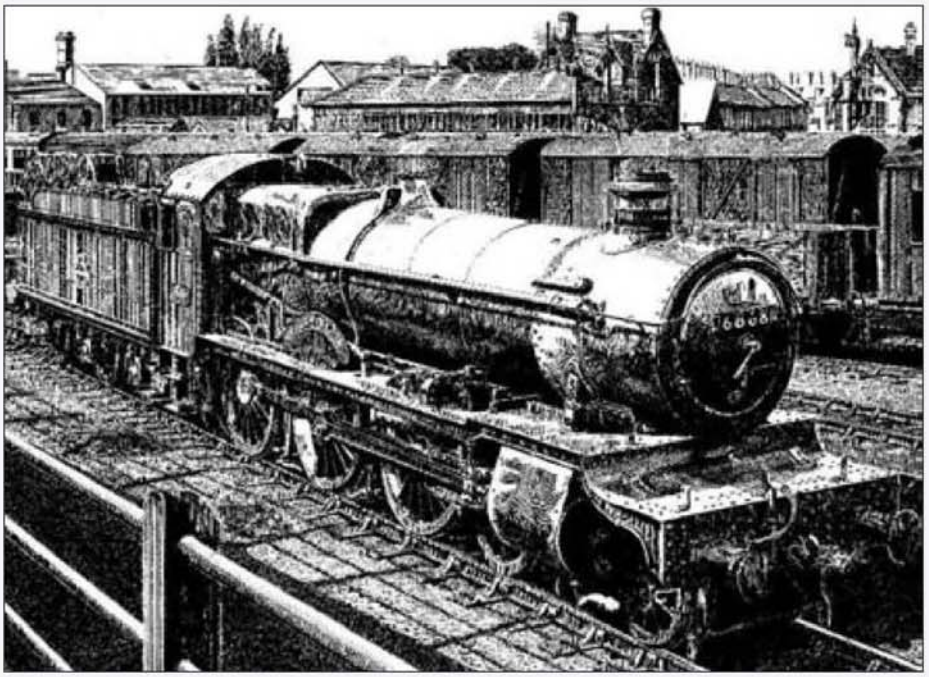
A detail which I forgot to mention in the chapter on lantern pinions. When assembling a train with lantern pinions great care must be



Oil sinks can be polished using a felt mop driven by a pistol drill.

taken when inserting the pivots in their holes because the lantern bobbins tend to get in the way of the meshing wheel. It is advisable to reduce the diameter of the bobbins after the pins have been inserted. This will make the assembly easier.

I knew Claude Reeve very well and I am pleased to have had the opportunity to revive interest in this particular design, and I hope we shall see many examples at the various exhibitions held up and down the country.



PENRHOS GRANGE

Neville Evans
continues the description of the 4,000 and 3,500 gallon tenders for this 5in. gauge locomotive

●*Part XXIV continued from page 448 (M.E. 4258, 14 October 2005)*

Or should it be 3,500 rivet bodies? Once again I must acknowledge the input of my friend David Aitkin in this design. I mentioned in the first of this Collet tender series that David had written two articles in *Engineering in Miniature* (February and March 2005), together with photos of what I consider to be the definitive models of these artefacts. As luck would have it my own design differs slightly in detail to that of Mr. Aitkin, so it cannot really be called a close copy. As we are, however, striving to model as closely as possible to scale there will undoubtedly be many similarities in the design as well as the content of the article.

Having got that off my chest, the first point to be made is that one of the greatest difficulties in scale modelling lies in material thickness. The full size tenders were made of 1/8in. sheet steel. In 5in. gauge that would equate to 0.011in., a little flimsy you must admit for a working model.

Before we start however, we should think about the material that we are going to use as well as its thickness. The obvious choices include brass, nickel silver, and tinplate. The best of these is probably nickel silver. This alloy possesses the advantages of being ductile and strong, which means that thinner sections can be used. It does not corrode; it solders easily and takes paint very well. The big snag is of course, that it is very expensive in 24 gauge sheet. It may be worth thinking about though for the superstructure generally if you can get hold of some at the right price. In fact, given the opportunity, I would never use anything else.

Tin plate has most of the above advantages, and is of course very cheap. I do not know that it is readily available in sheets of more than about 0.023in. thickness, which may mean that a tank side would need vertical bracing for added stiffness. The disadvantage is that it is only too easy to scratch through or otherwise degrade the protective coating of tin. This allows the underlying steel to corrode. As I mentioned a few months ago, this corrosion can be inhibited by coating the inside of the tank with a resin called 'Petseal' which can be obtained from any classic motorcycle shop (look in your Yellow Pages). Simply mix the two part resin in the approved proportions, pour it in, slosh it around inside the tank leave it to dry, and then paint the innards with gloss white enamel.

Peter Rich uses a splendid material called 'Zintak' which is a high quality ductile steel that is zinc coated on both sides. I have used it for locomotive footplates and find it to be excellent for this purpose.

Brass, the obvious alternative, has all the virtues but does not accept paint very readily. It is therefore necessary either to use a self-etching primer or to bead blast the surface to give a key before the first coat of paint. Pete Thomas uses 1mm (0.039in.) material for most of his sheet metal work in brass and finds that it combines the virtues of reasonable rigidity and appearance with ease of bending and soldering. I fully agree with Pete's choice of material, with the proviso that the sole plate is made of 1/16in. ▶

The new Grange cab photographed under construction at Llangollen. The other photos show a 4,000gal. tender (photos: Pete Thomas).

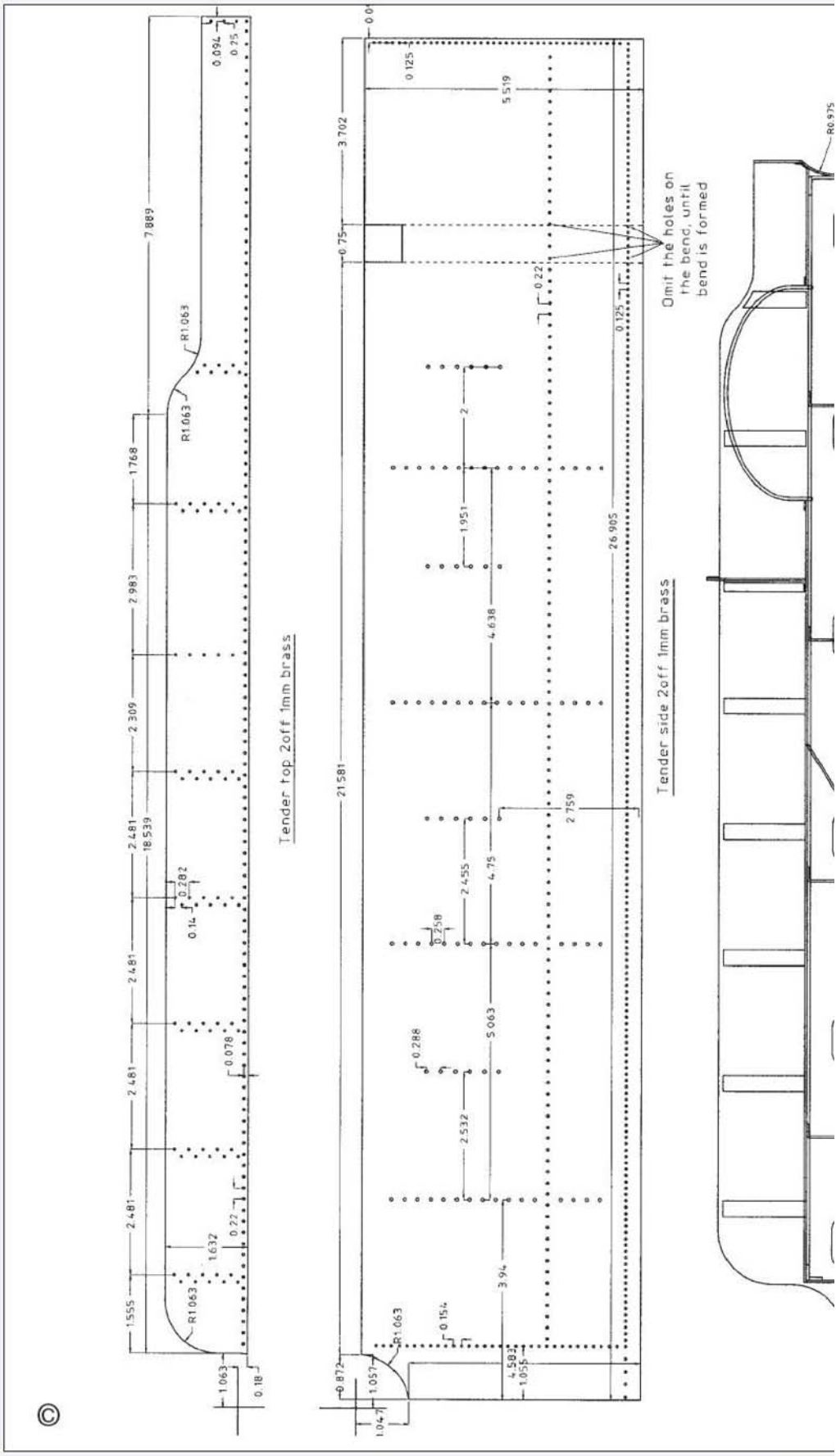
brass plate to add a little stiffness where it is most needed. The obviously over-thick sides of the soleplate can be judiciously trimmed with a file to give the appearance of scale thickness, as indeed can the rest of the plate work where the end of the plates is visible. The sides are braced, as is the prototype, by four large diaphragm bulkheads in the appropriate places.

The complete tender tank assembly will be obtainable from Bruce Engineering 'in the flat' so to speak, at little more than the price of the brass, which should save a huge amount of time and frustration. The first sheets are being cut out as I write, and I think that having thousands of rivet holes drilled to precision limits ready for assembly, should prove to be a welcome feature. Talking of rivets I have standardised on 3/64in. copper for these little items, so as to avoid deformation of the soft(ish) brass when the shank of the rivet is beaten down. I have measured a few of the heads in my workshop and find that they are approximately 0.08in. diameter, in other words near to a scale 1in. especially after a couple of coats of paint have been daubed on.

The 3,500gal. tank is similar to the 4,000gal. except in height. The smaller capacity tank is seven inches lower than the larger, this means that the rivet pattern is slightly changed, and the curvy bits on the front end are of a different shape, otherwise the two tanks are similar. The only real difference lies in the side sheets, which will be the subject of a separate drawing in the near future. The under-frames and running gear are interchangeable.

The GWR tender is similar to that of the Highland Railway in that the corners at the rear are rounded at 3/8in. external radius and the two sides are joined in the centre of the tender back. It is vitally important that these two rounded corners are absolutely vertical otherwise the whole job will look dreadful. The difficult part is the flared portion where the tank meets the coal rails. After months (literally) of agonising I have decided on a 1 x 3/8 x 1/16in. angle that fits into the space where the flare finishes and the vertical part begins. I do not think that it matters whether the angle faces in or out, the result will be the same. A glimpse at the drawing will show exactly what I mean. The angle has to be cut away in places so as to avoid trapping water between it and the sides. The tank top sits upon the angle and the sides are sealed along their edges. There is a continuous strip of thin angle rivetted along the join line and underneath on the outside there runs a length of elliptical sectioned beading.

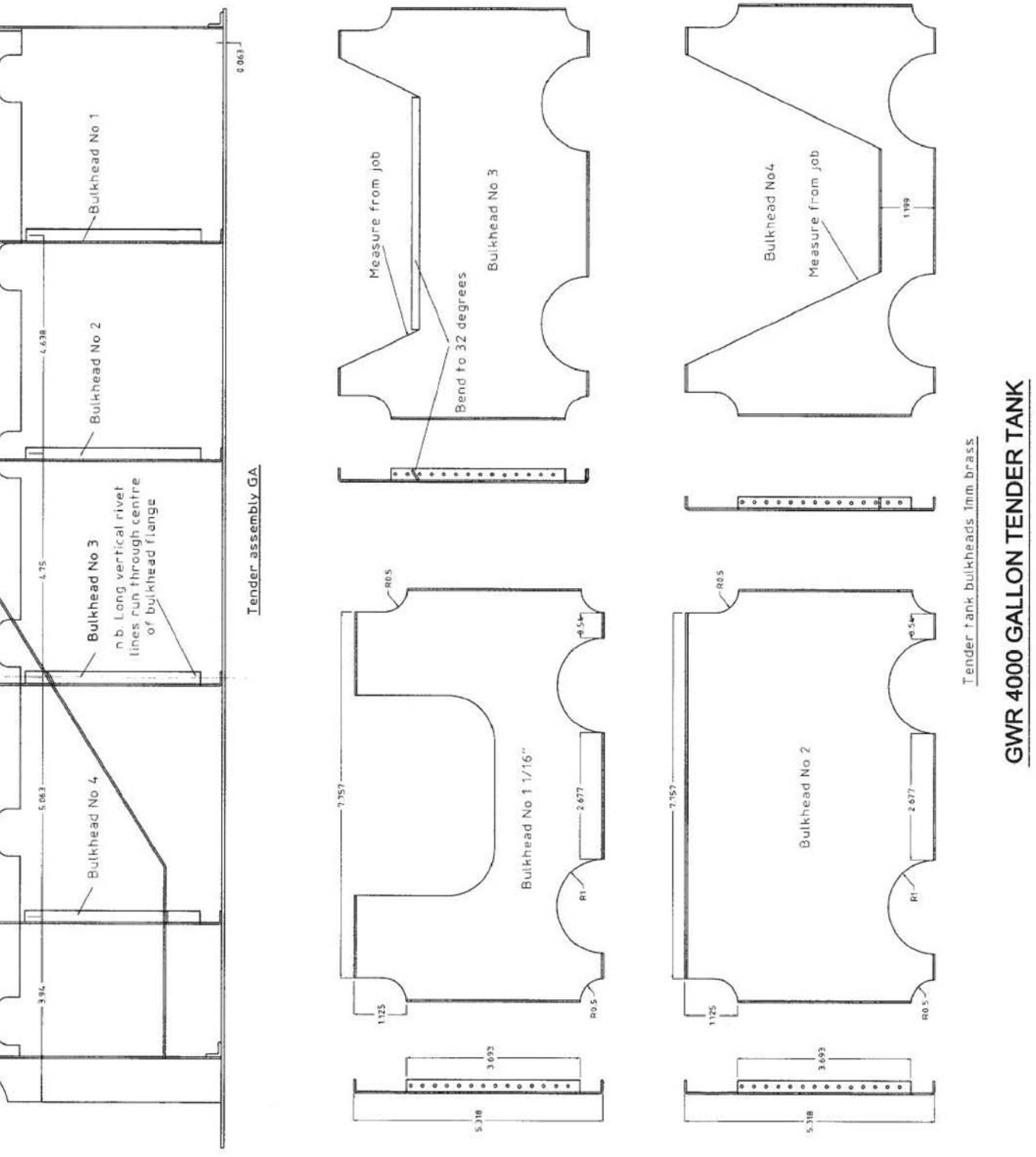
The forming of the flare in the tender sides may create some difficulty. David Aitken suggests that the sides are clamped to a length of suitably planed wood and the flare beaten over with a wooden mallet. I can see no other way of doing it other than the use of a folding press with a suitable former. If you've got one, or have the use of one then I trust that you'll need no further instruction from me. Remember that the metal is liable to spring back out to a larger radius after having been bent, depending on how soft it is. The curved parts at the top corner of the flares will be available as ready pressed items from Bruce engineering. They will need to be soft soldered into the corners and cleaned up.



Please note my comment on the drawing to the effect that it is inadvisable to drill the rivet holes that lie on the corner bends before actually bending the metal, as this may result in the bend assuming the shape of a 50 pence piece. Bend first and put those few holes in later.

Soleplate

This is the foundation of the whole tank, made from 16 gauge brass, so make sure that it is flat. The tender body is mounted on the soleplate with a rather obtrusive angle that is close riveted to the outside of the tank body, and bolted to the soleplate by 10BA round headed screws. As I mentioned when describing the locomotive



platforms which use the same screws to hold the hanging plate onto the footplate proper, these screws can be plain round headed, good but expensive (you get charged extra for not putting the slot in) or they can be made by screwing 1/16in. round headed brass rivets 10BA. A third alternative would be to use round-headed rivets and simply give them a bash underneath instead of countersinking them. Whichever method is used remember that the fixing has to be long enough to go through angle, soleplate and hanging plate. Note that I have increased the thickness of the angle to 1/16 inch. This means that we can use 5/16 x 1/16in. brass angle for this part. Either file it down 0.02in. or so to the correct dimension top and bottom, or leave it as bought. I doubt that anyone will notice. The same thing obtains with the hanging angle. The full size dimension is 6in. which scales out at 0.531 inch. You can either file or mill down from 9/16in. brass angle, if there is such an animal nowadays, or leave it at 1/2in. and ▶

a coat or two of paint. The two corner pieces will have to be turned from round bar and soft soldered into the appropriate places.

Start by drilling the necessary holes for mounting the various blobs and gadgets that go in the tender and on the sole plate. I think that it is best to then make up the sides and angles before assembling them onto the soleplate, prior to the final sweating up of the joints with soft solder. Incidentally, if you have to use countersunk brass screws in holding plate work together, try not to countersink deeper than the level of the slots in the screw head. You never need to take them out again, and when the screw heads are linished or filed off, the joint becomes practically invisible.

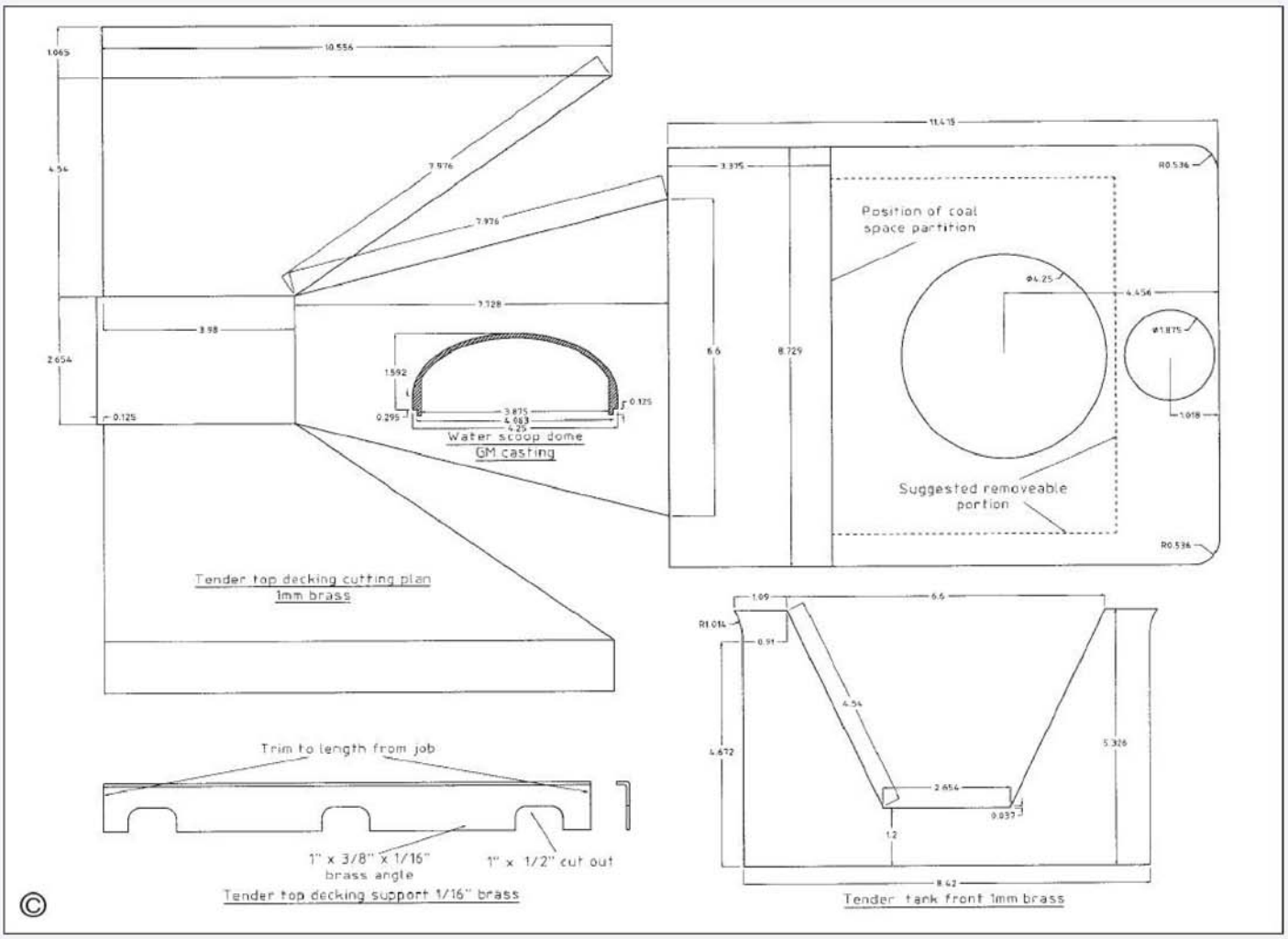
Soft soldering

To close this particular episode, a word or two on soft soldering may not come amiss. Soft solders are basically alloys of lead and tin. They have melting points below 200deg. C, dependant on the proportion of tin and lead in the alloy. Within certain limits the higher the tin content the higher the melting point and vice versa. Solder makes a joint by alloying with a thin layer of the surface of the metal to be joined. The remainder of the joint is a sandwich of solder before the alloying to the next piece of metal. It can be seen therefore, that as solder is not very strong, the thinner the layer of solder, the stronger will be the joint.

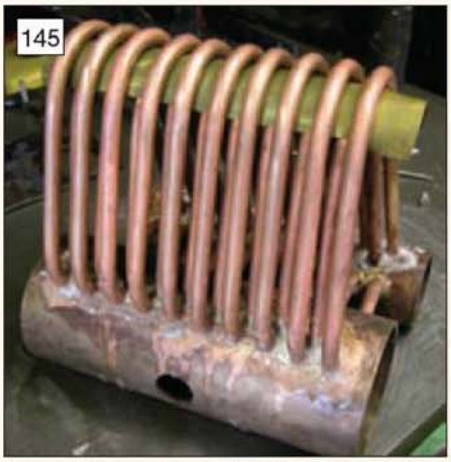
The essentials of making a good joint are having sufficient heat available and clean surfaces to be joined. The latter is achieved by using a degreasing agent provided of course that there is no rust or other obstruction on the surface. The joint is then fluxed to prevent oxidisation. Make sure that you have enough heat in the form of a small nozzled torch, or even a large soldering iron. With insufficient heat, simply heating a joint until the solder melts results in a part that is too hot to handle and a joint that may still be imperfect. With sufficient localised heat the solder melts and flows before the heat travels into the model and material an inch or so away will only feel warm. Distortion is also kept to a minimum. A liquid acid flux will run along by capillary action, as will paste flux when heated. A good joint will show by the solder obviously wetting the metal and there should be a thin concave fillet. The other basic method is to heat the whole area to be joined and to finish the whole 'shebang' in one heat. The starting point for this exercise is that you have to have a large enough torch to heat the entire area to the required temperature, which is the 'sizzling spit' point. In other words when you spit lightly on the surface, it forms a little dancing ball which evaporates quite quickly.

As we are concerned largely with the fixing together of the various bits of the tender tank and the sealing thereof, I shall confine my remarks to that aspect of the art. The basic technique is similar to that used in soldering up a footplate valance under a footplate (and where else). We can start by mechanically fixing the valance to the footplate by small screws or cramps. A good, stiff, small wire brush is a great asset in spreading flux and solder, so, beginning at one end heat the valance quickly, and apply a small tack of solder, allowing the hot metal to melt the solder and not the naked flame. When that end has hardened, go to the other end and apply a tack, then do the same in the middle and then tack between each of these tacks. Finally run the flame along judiciously adding a little more solder to give a continuous joint.

●*To be continued.*



John's fixture designed to keep the boiler components together during silver soldering.



A curved piece of brass sheet fits between the two tube banks.

The boiler in position in the fixture during silver soldering.

SAVAGE'S UNIVERSAL CARRIER

Stan Nipper and Martin Wallis discuss the silver soldering of the Musker, water tube boiler

●*Part XV continued from page 451 (M.E. 4258, 14 October 2005)*

The three obvious necessities for successful silver soldering are close fitting joints, making sure the metal is properly cleaned and fluxed, and enough heat to get it all hot enough to melt the solder in a reasonable time. In this case there might be a fourth necessity, and that would be making sure it is all held together properly so the tubes cannot become loose and slide out of position.

To hold the boiler parts securely and accurately John built the fixture shown in **photo 144**. Steel plates are used as they are cheap enough and will withstand the heat. In addition to the pair of holes to locate the two water drums a piece of steel tube spans the side plates to support the inner bank of tubes; a suitably radiused piece of brass plate then covers the inner tube bank and then supports the outer tube bank. In this way none of the tubes can inadvertently drop into the drums during soldering.

John's kindly offered the following sequence of events:

The assembly of the boiler was carried out in four stages:

1. Assembly of the main steam drums to the downers and inner water tubes.
2. Assembly of the outer water tubes.
3. Assembly of the flanged end plates.
4. Assembly of the steam drum.

After stage 2 the assembly was chemically cleaned and inspected to ensure that the silver solder had penetrated correctly, giving a clean fillet of material on both inside and outside of the drums.

A single heating was then carried out to install the front flanged plate, mainly to ensure that as this plate is fitted 'reversed', an adequate fillet of solder was built up on the inside of the drum.

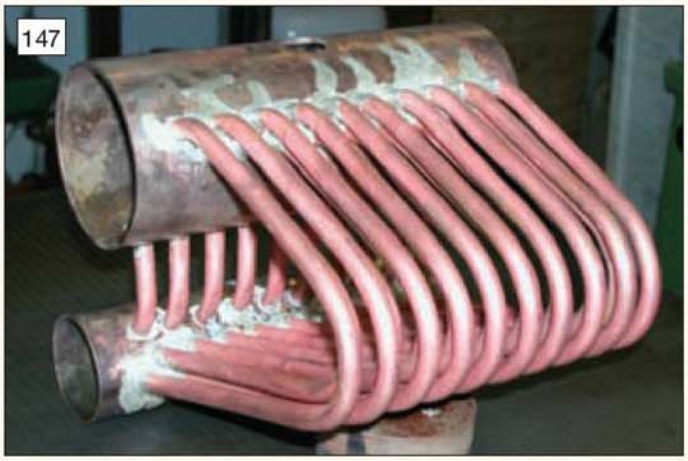
After the heating, it was found that end feeding from the outside of the drum gave a very acceptable fillet on the inside due to the capillary action. However, it is also still possible at this stage to actually feed the solder into the joint from inside the drum, while heating the outside. The remaining flanged plates were then assembled.

The steam drum was completed as an assembly before both parts of the boiler were connected. The original drawing called for a thick wall connecting bush to join the top water drum to the steam drum, however, on a trial assembly, it was very difficult to ensure that the drum stayed in the correct position whilst soldering, so a modified bush was employed which kept the drum square and easily aligned. This bush has a wall thickness of 0.25in., which was considered more than adequate to support the steam drum and protect it from the odd knock.

As this particular boiler was built to prove the strength of the design, only those bushes necessary for testing and inspection purposes were fitted.

Steam drum

A steam drum is fitted above the main water drum presumably, as mentioned, to separate the steam from the water and minimise priming. The rapid water circulation would result in much 'bad weather', if that is appropriate terminology, in the main drum. A thick wall piece of tubing, much as used for the fire holes on locomotive boilers, connects the two drums. Some thought was given to adding a copper stay or tab to teach end of the steam drum to secure the ends of it to the main ▶



The completed tube banks and water drums ready for the flanged end plates and steam drum.

The various components of the steam drum shown prior to silver soldering them together.

water drum. This was because annealed copper is very soft, but the visual 'independence' of the steam drum was felt to be such a noticeable feature of the prototype that it should be kept, and the thick wall tubing certainly ought to be adequate against all but the hardest knock.

The components of the steam drum assembly are shown in **photo 148**. John's clever way of incorporating both a bush in the end and longitudinal stay are shown in **photo 149**, and the CAD drawing has been revised to include them. As a reminder the bush material must be bronze and not brass; the stays may be either copper or bronze.

With a view to pressing the boiler to the higher than usual working pressure of 150psi to match the steel vertical and locomotive designs John kindly offered to undertake a rather more ambitious hydraulic test than usual. In John's own words:

"It took me over an hour to exercise the tubes to gain some decent amount of strength in them before applying the higher loads, this entailed pumping the boiler up gently at about 25psi at time, holding the pressure for about 10 minutes before releasing and pumping again.

The whole assembly is as solid as the proverbial brick outhouse (excellent job by Stan with the choice of material specifications and dimensioning), I deliberately carried out the test without the copper reinforcing (case side) between the upper and lower water drums to see how much distortion might arise. If there was any distortion I didn't see it.

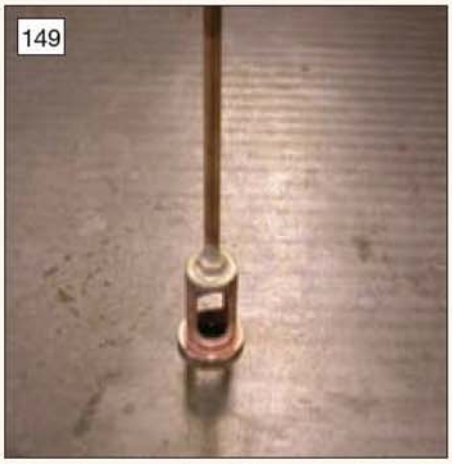
The test went up to the 150psi mark and held for 30 minutes with no problems, so the pressure was slowly built up to 300psi in stages, again with no distortion or nasty noises.

To prove a point I then carried on increasing the pressure to 400psi (the limit of my test set) and held it for a further 20 minutes before I ran out of courage and let it relax.

On the whole I would say a definite success with the design being easily able to cope with a working pressure of 150psi, with the initial test of 300psi and subsequent tests at 225psi."

All that said, and accepting the designs undoubted ability to withstand a 400psi hydraulic, does it follow that such a cold test validates a safe, hot working pressure of 150 pounds per square inch? 150 psi is about 10 bar, and tables give the boiler temperature at 10 bar as 184 degrees Celsius. Bearing in mind that the strength characteristics of copper are affected by temperature is 150psi a good idea?

If there is a metallurgist, or otherwise suitably knowledgeable reader, who would be kind enough to give us a reasoned resume, and a maximum safe working pressure for the boiler your authors would be very grateful. In the meanwhile we publish the boiler design written up for 125psi.



John's clever way of combining a threaded bush with a longitudinal stay.

Boiler casing

The boiler casing is assembled around the completed boiler and needs to be structural as it takes the weight of the boiler and fixes it to the chassis. The casing needs therefore to be of a robust construction. Consideration also has to be given to protecting the casing, as much as can be, from the heat of the fire. To this end refractory material/ fire clay/ fire brick or heat resistant tiles are needed to line the inside of the casing. The usual lagging material is applied over the casing which is, in turn, covered by thin sheet cladding.

Even with a firebrick lining the casing will inevitably get very hot in use and either copper or stainless steel sheet should probably be used. On the drawing the curved panels of the casing are silver soldered to the boiler, which is quick and practical. Two other alternatives are blind bushes for stainless or bronze fixings or copper tabs which may be drilled for similar fixings.

It is for each builder to decide themselves the best means of attaching the casing, but remember if the boiler is to be made commercially the position and frequency of any blind bushes must be detailed in advance of manufacture. The end plates are made from 3/16in. or 5mm thick mild steel or stainless steel and are held in place with 8BA round head screws (to simulate rivets) so they may be removed for inspection and maintenance purposes. The reason for the thick plate is so that it may be drilled and tapped into its thickness for the screws that secure it to casing plates and so it is more likely to remain flat in service.

The chimney base will be an interesting piece of beaten metalwork, best probably made from copper, and once one has been manufactured there will, with any luck, be some pictures which will be included in due course.

Drawings and castings

Drawings and castings for the Savage *Universal Carrier* are available from:

Little Samson Models, 38 Wheatsheaf Way, Linton, Cambridge CB1 6XD
website: www.littlesamson.co.uk
e-mail: edward@littlesamson.co.uk
Bell Boilers may be contacted on 01452 722211

Briggs boiler correspondence

Some readers will remember the *Little Samson* 'Briggs' locomotive boiler which has a dry firebox. Some recent Briggs correspondence from Australia, where this style of boiler is popular, may be of interest. The following extracts refer to some of my questions slipped into the correspondence regarding materials, insulation properties, and expectations relating to dry fireboxes.

"On the subject of firebox lining, I made some investigation of this some 10 or more years ago. With the demise in Australia of foundries, industrial steam, and industry in general, the refractory manufacturers have become few and far between. However, I remember discovering one interesting fact which makes some sense if you think about it. You would want to make your own enquiries in UK where a vast array of expertise in elsewhere defunct areas of

The completed, unusual water tube boiler undergoing its pressure test on the bench.

The flanged plates on the model boiler are reversed to receive dummy end plates.

knowledge seems to be on the increase if anything! I found that two distinctly different functions were addressed by refractory style products:

1. *Insulation - these are soft dense materials that trap air and prevent heat transfer. They generally fair poorly in the path of direct flame or in contact with the fire bed.*
2. *Refractory - material like firebrick, mixed and poured like concrete. These materials are porous and have less insulation properties but have the structural strength with which to build furnace walls, combustion chambers, brick arches etc. This is the stuff you need.*

The vexing dilemma is of course that you want a material that withstands the fire but you also want to stop the paint burning off the outside as much as possible. How to find the right compromise?

Pressure gauge recording 400psi with no sign of distress from the boiler.

To be of some help, the material I used in the Fowler locomotive (a Briggs boiler) was a cement like stuff, mixed with water and poured into the firebox with a wooden 'core' to provide the wall thickness and allowed to set for a few days. Finally firing it removed the moisture and left a hard concrete like lining. I cannot lay my hands on the data right now (we are renovating - like living in a quarry!) but I believe the stuff was rated for about 1,300 deg Celsius.

The lining so formed has lasted several years of punishment and certainly it has worn, melted, chunks fallen out, etc and paint burnt off so don't expect a perfect solution to this problem. Perhaps designing the boiler with a thought (of the) inevitable replacement of refractory is a more realistic approach. There are other fireclay/ mortar style products that are useful for patching up if required."

If any readers have any experiences or recommendations we should be very pleased to hear. The ideal material, so I have been advised, are the heat resistant Space Shuttle tiles - but I doubt if Reeves or Blackgates stock them and I have no idea what they are made of!

Many thanks to John Abbatt for all the pictures in this part, much of the wisdom, and for reading and checking these notes.

●*To be continued.*

A WINDERMERE STEAM KETTLE

Martin Wallis
describes an invaluable accessory for those traction engine enthusiasts who appreciate their creature comforts.

As far as accessories on traction engines go, lamps, wooden handled shovels, and the little galvanised buckets are the norm. Sadly, I never quite seem to find either the time or the motivation so my Fowler traction engine has had to do without any little extras- until now!

I have talked about making a Windermere Steam Kettle for some years, and accordingly have been keeping an eye out for a suitable piece of brass tube. Happily a friend bought a second hand lathe and in amongst several boxes of bits and bobs that apparently came with it was a fairly long length of brass tube. A start was finally to be made on project kettle!

A great deal of worry and discussion followed; just where on a traction engine do you fit a steam kettle? Under the tender foot step was considered, so was fixing it to a bracket off the horn plate at foot board height, likewise trying to squeeze it between the back wheel and the horn plate on the non-gearing side. As a practical accessory it must be easy to use yet not spoil the appearance of the engine. In addition a method of feeding steam to all the possible locations had to be worked out.

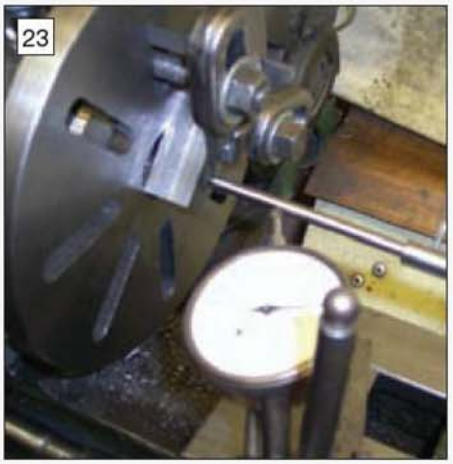
The final solution was to simply fit the kettle on to one of the front lamp brackets, no small part of the decision being the convenience of feeding it with steam from the blower valve (which is never used). I may have to rethink this position if the 'accessory bug' bites and I decide to make a set of lamps for my engine. Given my past record on accessories, this is most unlikely to happen but you never know.

The design is very simple, just a spiral of tubing inside the water container. Five turns of 8mm copper tubing was fitted, a further short piece of pipe directing the exhaust steam downwards onto the ground. When full the kettle will hold enough water to make five mugs of tea and with the engine at full working pressure it will boil the water in a second or two over half a minute. At a reduced pressure it takes noticeably longer.

The whole exercise has proved very successful, extending the 'smoke box cuisine' (an ever expanding speciality) into the beverages department. The photographs show the kettle fitted to my traction engine and the steam pipe run from the blower valve down to it. Although the cylinder has been painted and lined to match the engine the tap is as yet unpolished.

The neat steam kettle fitted to the author's Fowler road locomotive.

The location means that a minimum of pipe work is necessary to feed steam to the kettle.



Picking up a centre on the two crank webs prior to boring on the faceplate.

Boring holes in the crank webs. This method means the holes will be square to the faces.

Silver soldering the parts of the crankshaft together on the brazing hearth.

BUILDING THE RED WING MOTOR CO. AIR-COOLED ENGINE

Jim Service

continues his description of the building of this engine starting with the crankshaft.

●*Part III continued from page 444 (M.E. 4258, 14 October 2005)*

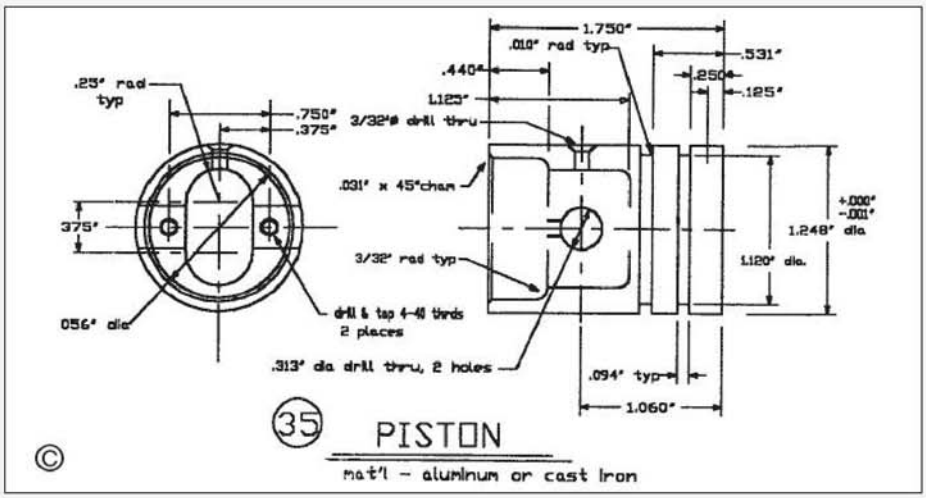
To make the crankshaft two 3/4 x 3/8 x 2 5/8in. long mild steel bars were prepared (the drawing shows the webs 5/8in. wide but I think 11/16in. looks better; so the 3/4in. width will be reduced to 11/16in. later). The bar stocks were clamped together and two 1/8in. dia. dowel holes drilled inside the extra 5/8in. at one end. The bars were doweled together and the sides machined to 11/16 inch. The end away from the dowels was squared off. It was then clamped parallel to the milling machine table and again, using the index dials, two dimples were drilled at hole centres as per drawing. It was then clamped to the face plate as in **photos 23** and **24**, the hole centred by using a wobbler and taken out to exactly 3/8in. and 1/2in. respectively. Using the faceplate rather than a 4-jaw, ensures that the holes are exactly 90deg. from the face, and is well worth the little additional effort.

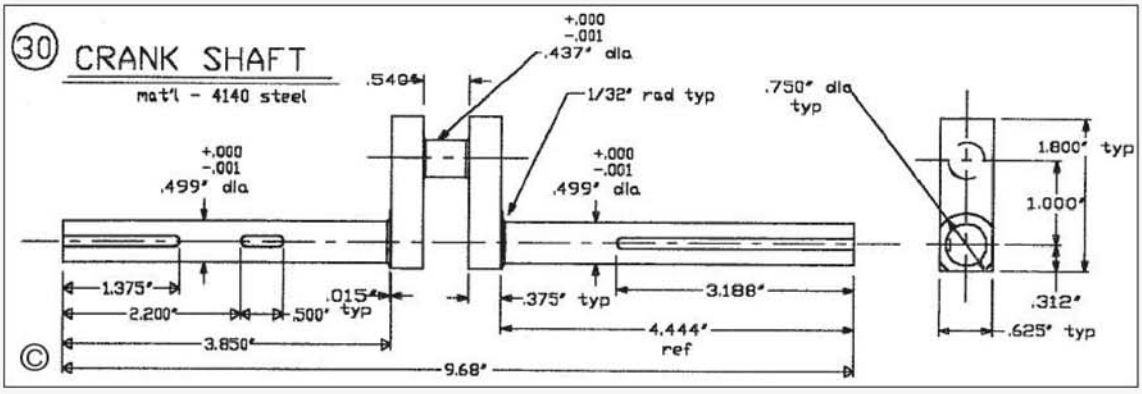
After the bores were complete, the webs were separated and the bores tapered 2 to 3deg. for 1/8in. length, the shaft holes done on the inside of the web and the crank pin holes on the outside. This provides a lead-in for the silver solder. I used 1/2in. precision ground mild steel rod for the shaft. In order to incorporate a starting 'dog' the gear end of the shaft was made 1/2in. longer than drawing. **Photograph 25** shows the whole crankshaft set-up on the brazing hearth for silver soldering. Lots of flux was applied at all joints - the white bits seen on the crank pin and on the outside of the main shaft are Tippex. This acts as a resist to prevent the silver solder from flowing where it is not wanted. Only the original type Tippex is effective; the new water-based sort is useless.

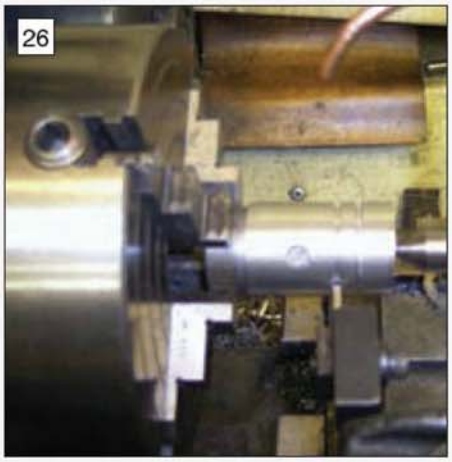
After everything had cooled down, the crankshaft was held between centres (previously drilled in the shaft) and checked that it ran true. On this occasion I was again lucky and did not need any adjustment. In the event of wobble, the shaft can be taken down a few thousandths of an inch to run true, and all bushes, flywheel, etc adjusted to the new diameter. The crankshaft was held in the milling vice and all key ways cut as per drawing using a 1/8in. dia. slot drill.

Piston

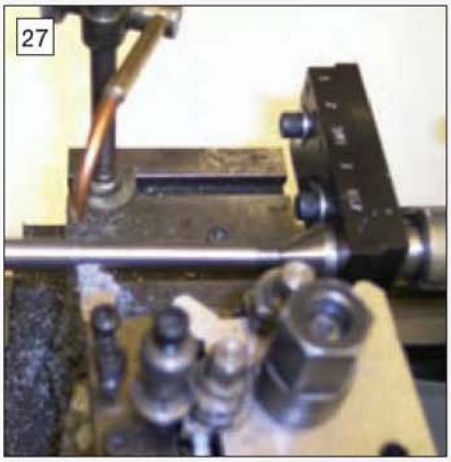
A 1 3/8in. dia. piece of aluminium alloy was held in the 4-jaw chuck and reduced to 1 5/16in. dia. for



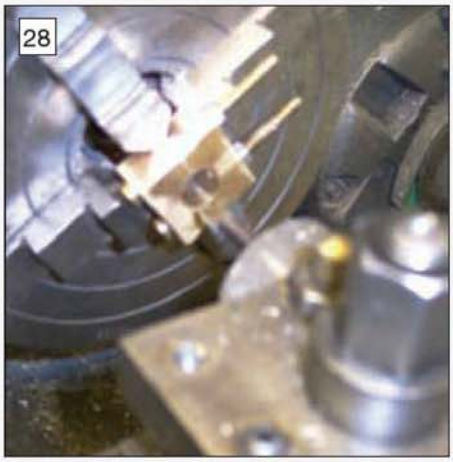




Machining the piston ring grooves in the piston with a narrow cutting tool.



Turning the taper on the connecting rod using an off-set centre.



Boring the big end bearing in the lathe. The outer dimension were subsequently machined to size.

2in. length. It was drilled out by stages to 1/2 x 1 1/8in. deep. Then it was taken out to 1.056in. for 0.44in. deep. It was then parted off at length 1 7/8 inch. It was then held horizontally in the milling vice, accurately centred by using the dial indices and the wrist-pin (gudgeon pin) hole drilled at 0.69in. from the front end. It was then turned 90deg. whilst maintaining the milling machine table at the same setting. It was raised on packing pieces, so that the wrist-pin hole was above the top of the vice. A length of 5/16in. rod was inserted in the wrist-pin hole and set square in the vice. A 1/2in. rod in the drill chuck located the centre of the piston length-wise. The stops on the milling machine table were set to 3/16in. on either side of the centre and the slot taken out as per drawing to 1 1/8in. deep.

A short length of 1 1/4in. diameter mild steel was machined for 1/8in. long with its diameter exactly equal to the inner diameter of the piston spigot. A 2BA hole was tapped in the centre of the mild steel. An eyelet was made consisting of a 1/2in. dia. x 7/16in. broad mild steel bush, drilled to just over 5/16in. clearance. A short length of 2BA studding was silver-soldered to the periphery of the boss. The piston was held on the spigot with this eyelet and a rod through the wrist-pin hole. The diameter of the piston was then machined to 0.01in. oversize. The additional 1/8in. length on the piston allows for tailstock support when cutting the grooves for the rings. Take in an additional 0.005in. deep to allow for the over-size diameter. It was then reduced to finished size and the extra length machined off. See **photo 26**.

Connecting rod

A piece of 7/16in. mild steel was machined at one end to 1/4in. dia. x 5/8in. long and the other end machined 1/4 x 1/4in. so that the distance between the spuds was 4.188 inches. Both ends were also centred drilled. I used a taper turning attachment as in **photo 27**, adjusted so that there was 0.057in. difference between the big end and the small end. This was done using feeler gauges. This can also be done using the top-slide set at an angle. A 1/4 x 1/2 x 1in. plate was prepared, drilled and tapped for the fixing holes. I moved the holes in to 5/32in. rather than 1/8in. so that 3BA nuts would come within the length. The centre hole was drilled out 1/4in. and silver-soldered to the rod, leaving the additional 1/2in. intact. It was then held between straight centres for machining the front end of the plate to finished size 0.2 inch.

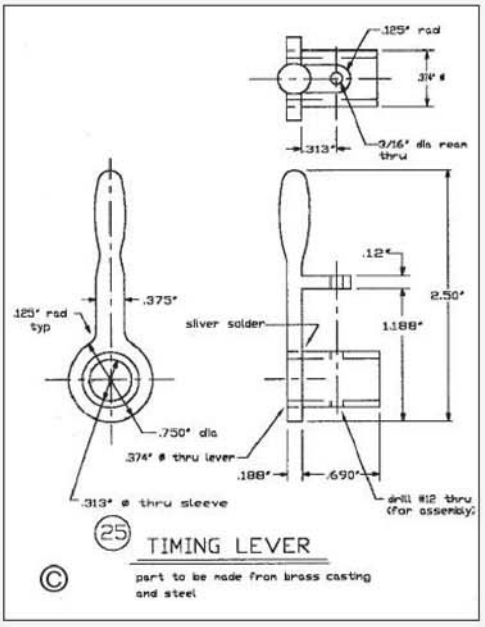
The crankshaft end (big end) bearing was machined to size plus 0.03in. on the length, and 0.02in. on the breadth. It was drilled same centres as the con-rod plate. It was cut in half using a slitting saw, then bolted together and bored out as in **photo 28**. It was then fitted to a mandrel and each side-face machined to finished size. The flutes were formed with a 1/4in. ball-nosed milling cutter. The small end boss was silver soldered to the rod and bored out to 3/8 inch. The drawing shows the small end running steel on steel, but I made a brass bush to fit into the boss and drilled 5/16in. for the wrist-pin.

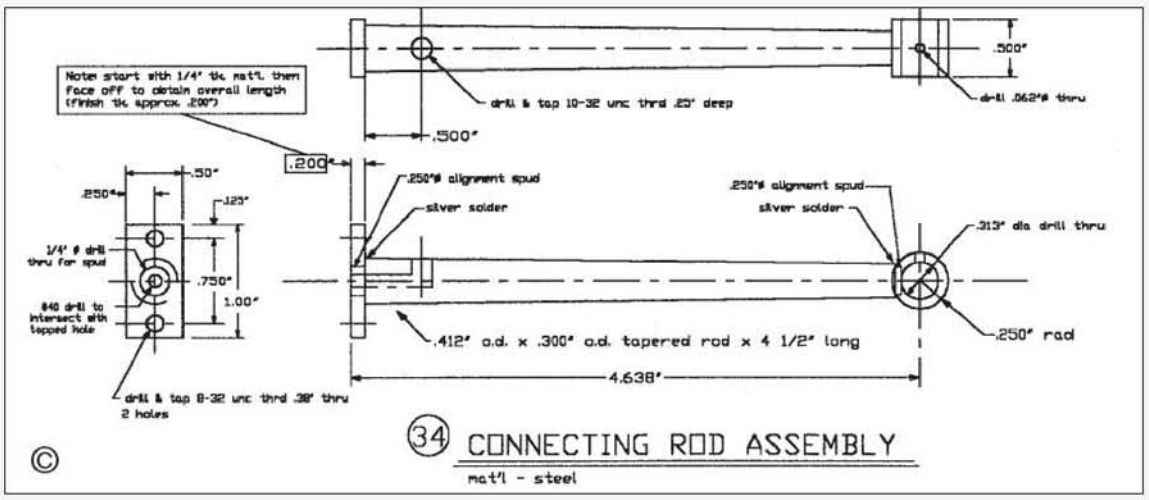
Timing Lever

The casting was held in the 4-jaw by the rear side boss, drilled and bored out exactly to 3/8 inch (**photo 29**). Using a boring tool, the inside face and terminal lug were then taken out to 0.813 inch radius. It was reversed and held in the 3-jaw and the rear face machined to just over 3/16in. width. The steel bush was made on a short length of 3/8in. precision ground mild steel to fit the timing lever, but was not parted off at this stage. It was silver soldered into the timing lever, held in a collet and the rear face of the lever machined to finish size. Then it was held in the milling vice by its additional length, down side up and using the index dials, the hole for the contact stud, drilled in the bush and through the brass lug of the timing lever to 3/16 inch. The bush was then cut off using a hacksaw.

Timing Gear

This item was held by its boss and the bore taken out to 1/2 inch. Reversed in the chuck, the boss was machined to 1/4in. width. Then it was held on a 1/2in. mandrel and the boss taken to 3/4in. diameter. ▶

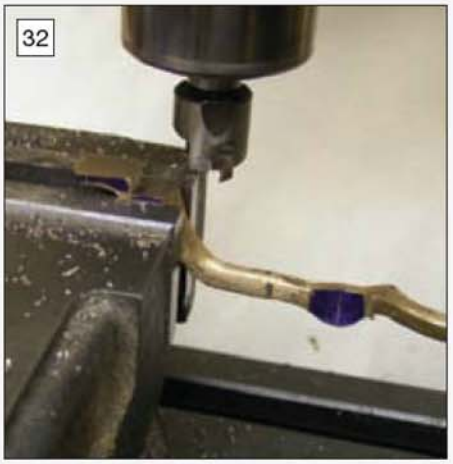




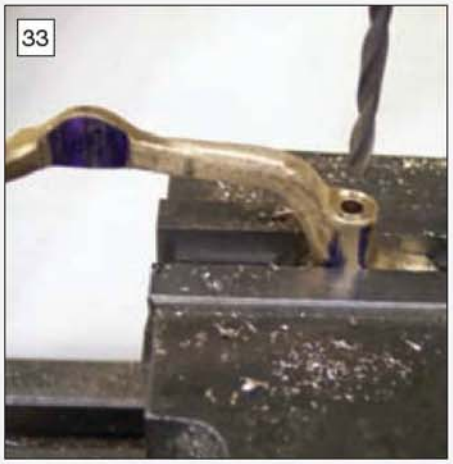
Boring the hole in the timing gear lever with the work in the 4-jaw chuck.

First operation on the latch-out bar is machining the flat on the central lug.

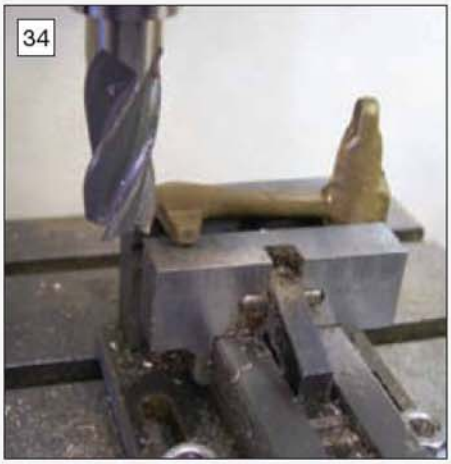
Further operations on the latch-out bar were facilitated by marking out on the milling machine.



After marking out a step was milled on the latch-out bar as shown.



Drilling the hole for the fine adjuster on the latch-out bar.

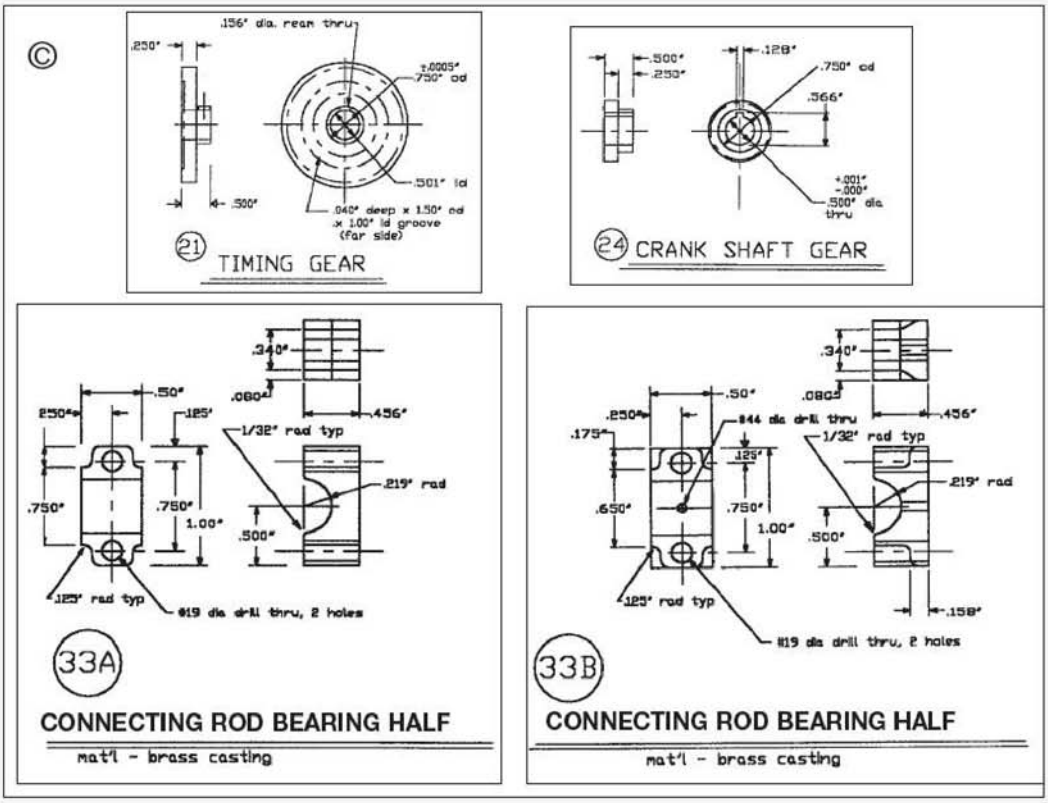


Milling the arms of the governor weights to 1/8in. thick on the milling machine.

An insulating collar was turned in the lathe as per drawing to be a push-fit on the boss of the gear wheel. The outside diameter (1in.) is nominal - a little less makes no difference. The timing lever bush was turned to drawing dimensions, making sure the O/D was a push-fit on item 21. It was grooved and secured by Loctite. The bush has to be a running fit on the steel bush of item 25, the timing lever.

Latch out bar

This is an awkward component to make. I determined roughly where the pivot hole should be and took a 1/2in. end mill across the top of the bar to reduce the thickness to 1/8 inch (**photo 30**). At the same setting, a scriber point was held in the chuck and, using the index dials, the dimensions were marked out on the castings (**photo 31**). I found that the dimension between the pivot hole and the fine speed setting screw has to be 1.75in., not 1.625 as in drawing (this was also the case on the Hopper version of this engine, built some years ago). The face of the bar and the step for the fine feed screw were machined as in **photo 32**. It was then held in the milling vice for drilling and tapping 2BA, the hole for the fine speed control screw (see photo 33). The end of the bar was then machined 0.68in. from this hole. The finger end is best done by grinding/ filing to size with the sliding collar (item 20) in place. There is some latitude for error on the bar as the catch plate on the valve rod is slotted for final adjustment. However, every effort should be made to get the speed control screw central to the boss on the casting, which carries the valve operating rod.



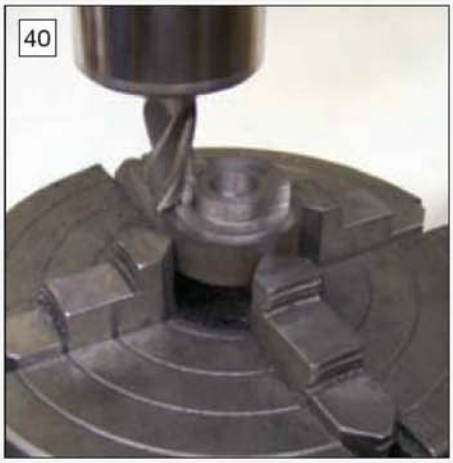
The method used to produce the beaks on the governor weights.

Turning the rear face and boring the governor weight bracket.

Machining the recessed face on the governor weight bracket.

Machining the slots in the governor weight bracket on the milling machine.

Drilling the weight pivot pin holes in the governor weight bracket.



Milling the large radius on the cam using a rotary table on the milling machine.

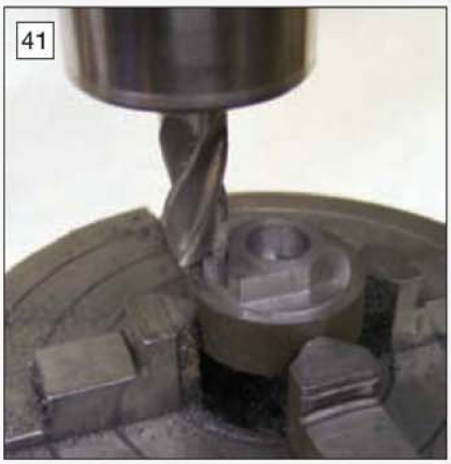
Weights

The weights are mainly a sawing and filing job **photo 34** shows a method for machining the arms to 1/8in. thickness. **Photograph 35** shows a method for producing the 'beaks' on the actual weights. Photographs **36, 37, 38** and **39** show methods for making the weight holding bracket.

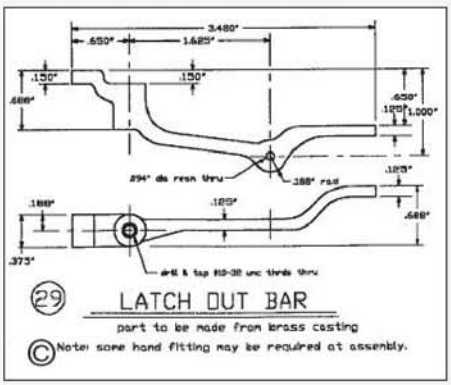
Cam

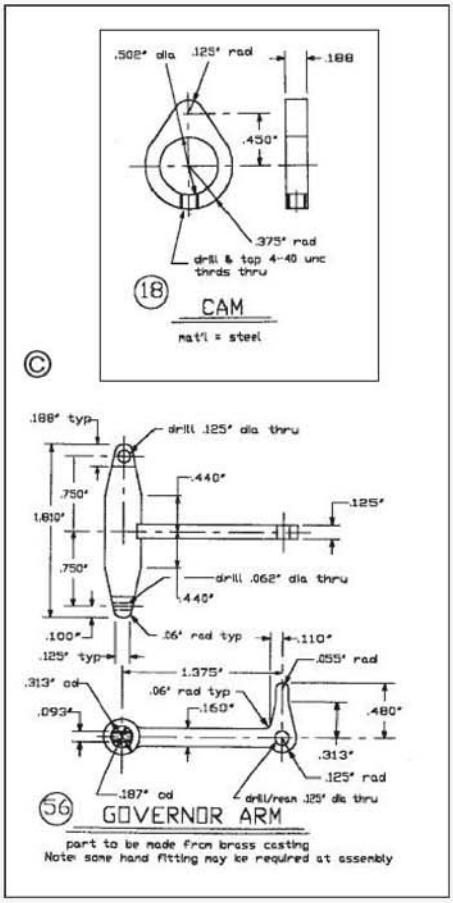
This is item 18 and **photos 40** and **41** refer. I used cast iron as I happened to have a suitable piece available, but mild steel or even brass will do. It was turned down to 1.15in. for a length of 7/32 inch. The chuck and work was then fitted to the rotary table on the mill, carefully centred and the table moved length-wise by 0.625 inch. Using a 1/2in. end mill, the heel of the cam was machined, starting at 355deg. and finishing 185deg. on the rotary table (see photo 40). The flanks were then formed, the first one by setting the rotary table at 325deg. locking the rotary table and traversing the milling machine table across the cutter. See photograph 41. The second flank was set on the rotary table at 250deg. and similarly machined. The chuck and work were returned to lathe and parted off to size. The contours were rounded off with a file. This seems a very elaborate method of making a simple component but it is the way I did it and as I said before, anything that can be done on a machine, gets done that way. Not everyone will have a rotary table, but I can tell you, a friend hacked a similar cam from solid, using a hacksaw and file. It works fine.

●*To be continued.*



Cutting the flanks of the cam. After parting off the final shape was obtained by filing.





PLAIN MAN'S GUIDE TO ORNAMENTAL TURNING

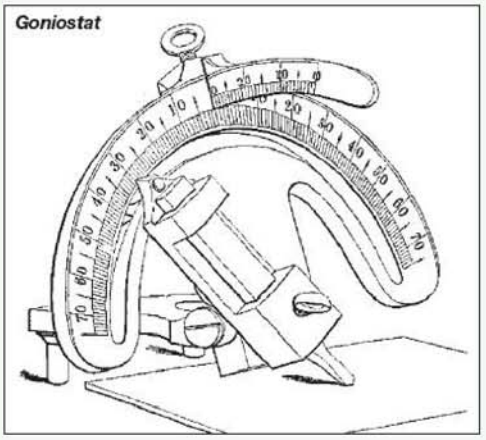
John Edwards

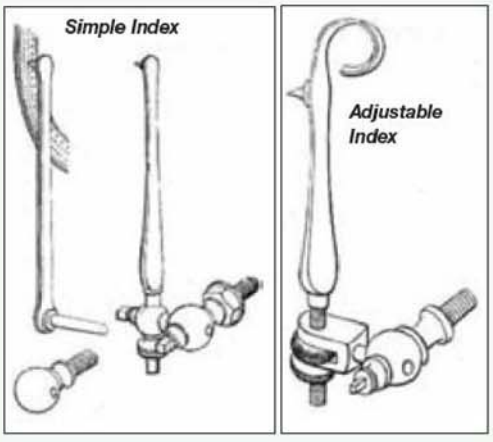
examines the Goniostat for sharpening cutters, the lathe headstock, its indexing and segmenting facilities and features of the slide rests.

●*Part V continued from page 453 (M.E. 4258, 14 October 2005)*

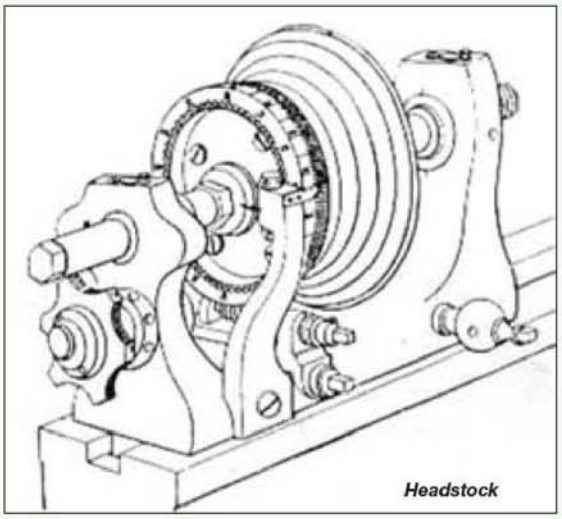
The Goniostat is an instrument for holding cutters at compound angles for grinding and honing. There is also a simple holder which rocks from side to side on a ball foot for honing round-nosed cutters.

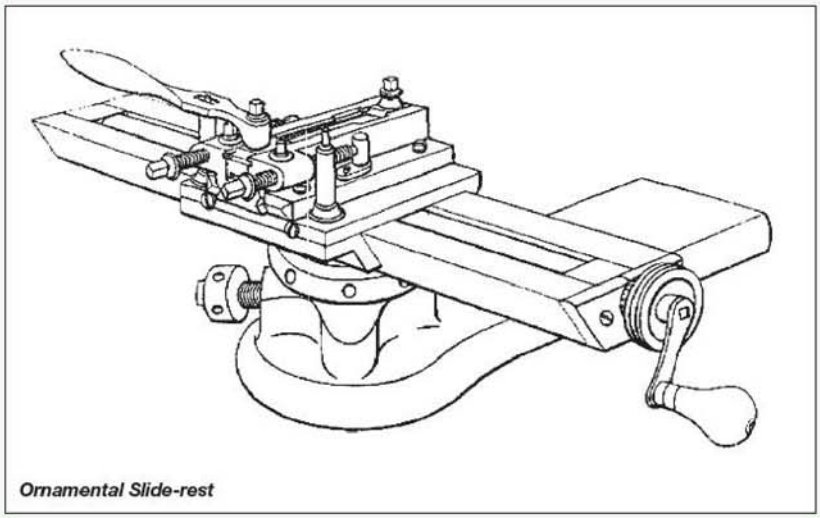
Ornamental cutters are sharpened as scrapers, with no top rake. These days, instead of the traditional emery, oilstone powder, pumice and crocus powder, more and more modern turners are now using diamond compounds for sharpening cutters.

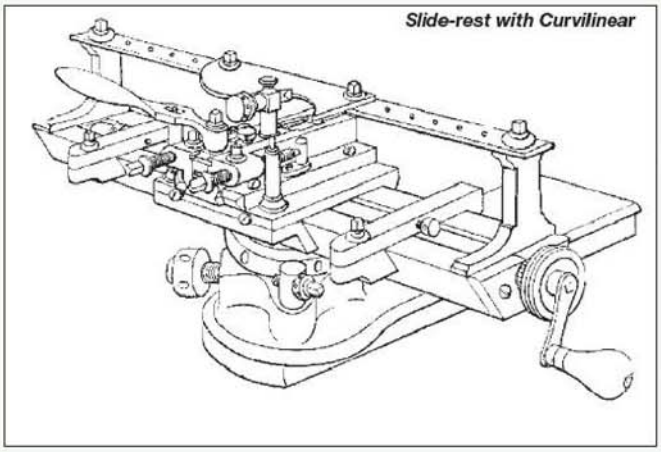




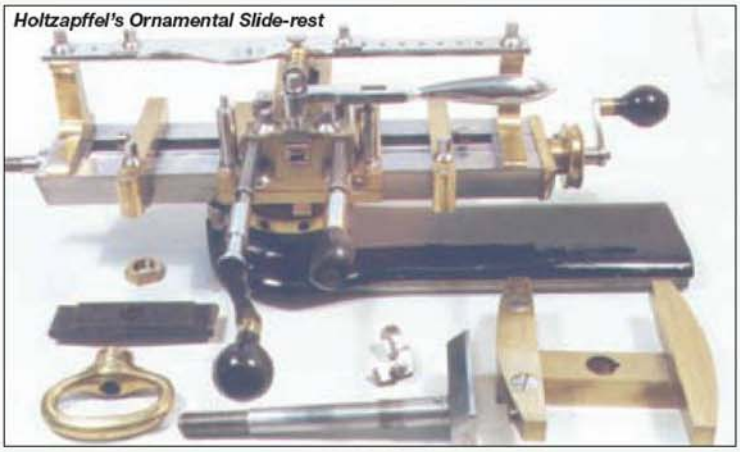
Indexing between cuts is effected by an index or detent and division plate that arrests the lathe spindle at any point in its rotation so that a cut, or a series of cuts, may be made with a cutting frame. The simple index is a pointed detent on a



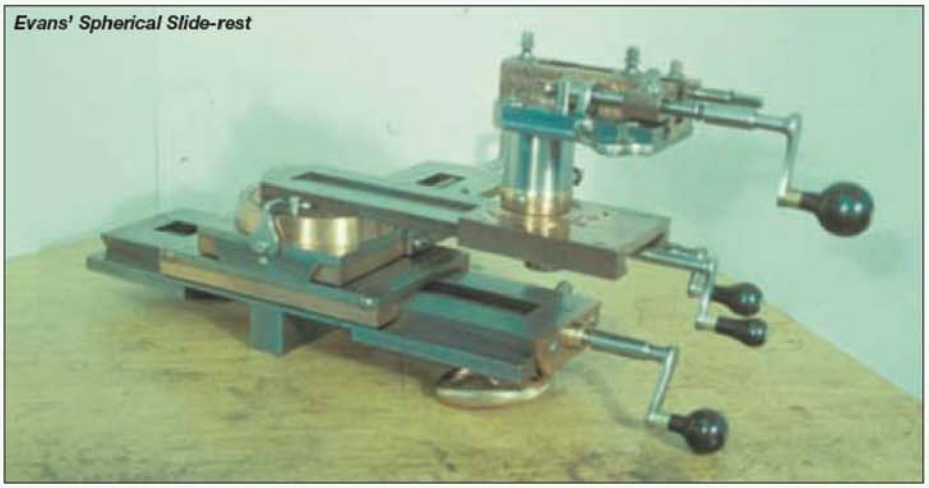




Slide-rest with Curvilinear



Holtzapffel's Ornamental Slide-rest



Evans' Spherical Slide-rest

spring-steel blade pivoting in a ball screwed into the headstock casting.

The adjustable index has the facility of being lengthened or shortened by the adjusting and locking screws and this is useful when it is required to place a cut in a position where the simple index cannot enter conveniently into a hole on the division plate.

Slow headstock drive: a tangent screw and worm-wheel may be engaged to drive the headstock slowly so that a cutting frame may cut a swathe on the work. The wormwheel, which has 180 teeth, provides an alternative means of indexing and the tangent screw also gives the facility of locking the lathe spindle more securely than is possible with the index and division plate.

Headstock Segment apparatus: so that swathe cuts may be constrained to a pre-determined segment or segments of a rotation, there is a pillar with adjustable stops next to the worm-wheel. Rotation of the spindle may be stopped within any segment by taper pins placed in any two the series of 72 holes drilled in the rim of the worm-wheel; fine adjustment is effected by stop screws.

The Ornamental Slide-Rest is like a compound slide but with angular adjustment to the main slide and an adjustable stop screw on the tool-slide for fast and accurate cutting of a series of cuts to a fixed depth. The tool-slide may be advanced by a guide screw or, the guide-screw may be released and the slide advanced by a hand-lever.

The Curvilinear apparatus is for profile copying. It comprises a pair of standards on which is mounted a template bar. The tool-slide guide screw is released and the slide is advanced and retracted by the hand-lever under the control of an adjustable follower or rubber which rubs along the profile of the template. The follower is positioned at a high spot on the template and the main leadscrew of the slide-rest is rotated by the winch handle so the carriage may pass back and forth while light pressure on the hand-lever causes the cutter to penetrate the work.

The Tazzae in Lignum Vitae and Mopane, illustrated, were made using the Spherical slide-rest. The double-curve flutes were cut with a long double quarter bead cutter cutting horizontally, one curve being the radius of the cutter and the second curve the radius of the slide-rest.

By cutting progressively 'down-hill' the work may be reduced to the same profile as the template. A final, finishing cut is taken after fine adjustment to the depth of the follower.

The Spherical Slide-rest has x and y axis slides, a main slide that rotates on a wormwheel, and a tool-slide that runs on the main slide. The x and y slides are used to position the centre of rotation (the centre of the wormwheel). When the tool-slide is positioned on the main slide so that the point of the cutter is behind the centre of rotation a convex curve will result; and when the point of the cutter is beyond the centre of rotation a concave curve will result. To turn a true hemisphere it is necessary to place the centre of rotation exactly on the axis of the lathe spindle.

●*To be continued*

The next article will examine the principal ornamental chucks and their uses.
If any reader wishes to know about the Society of Ornamental Turners or, indeed, anything about O T equipment and techniques not covered in this series, I can be contacted by telephone on 01732 355 479 or by email at johnf.edwards@virgin.net

GWR LOCOMOTIVE BAR FRAME EXTENSIONS AND CYLINDER ARRANGEMENTS

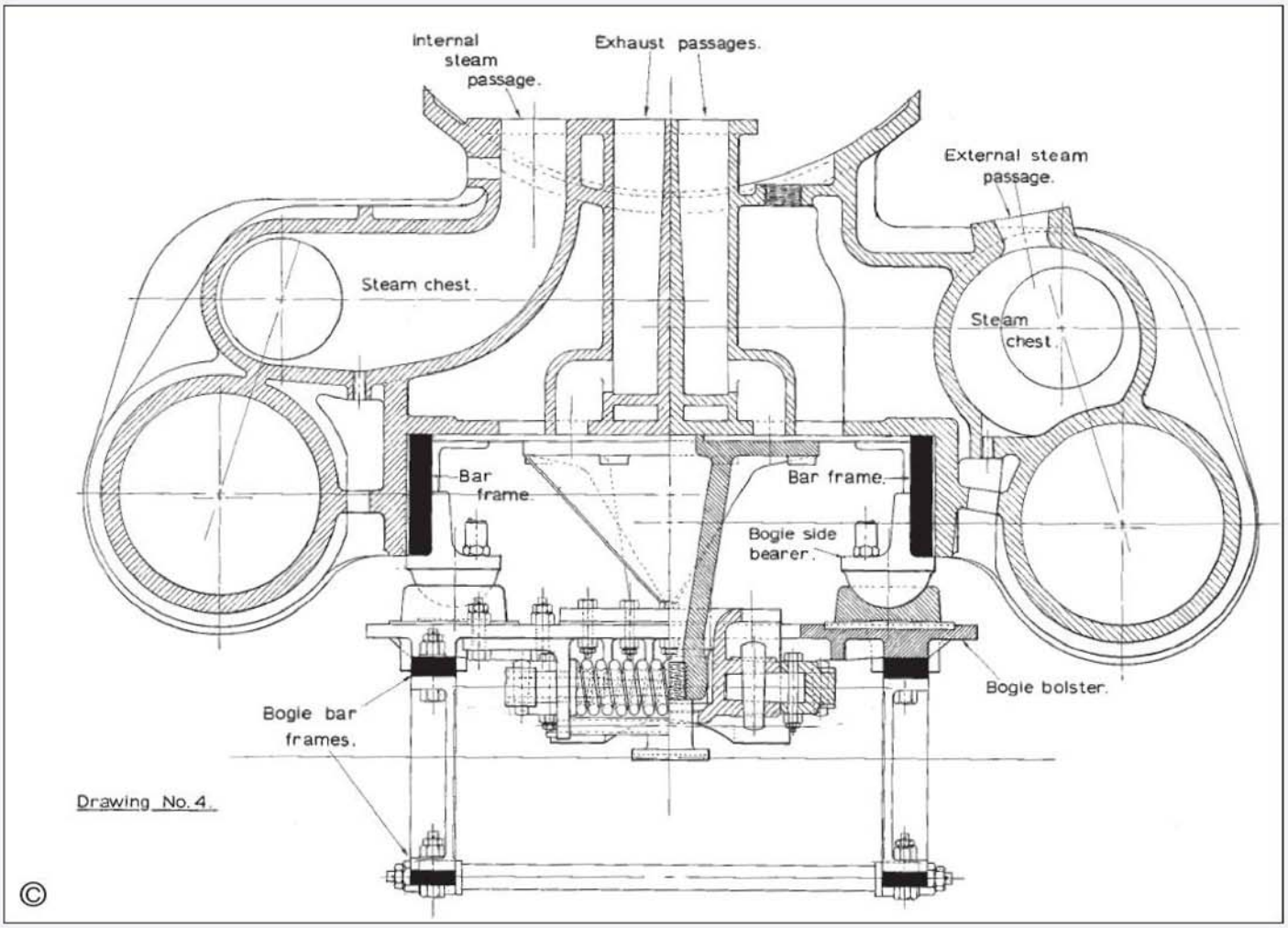
Peter Rich

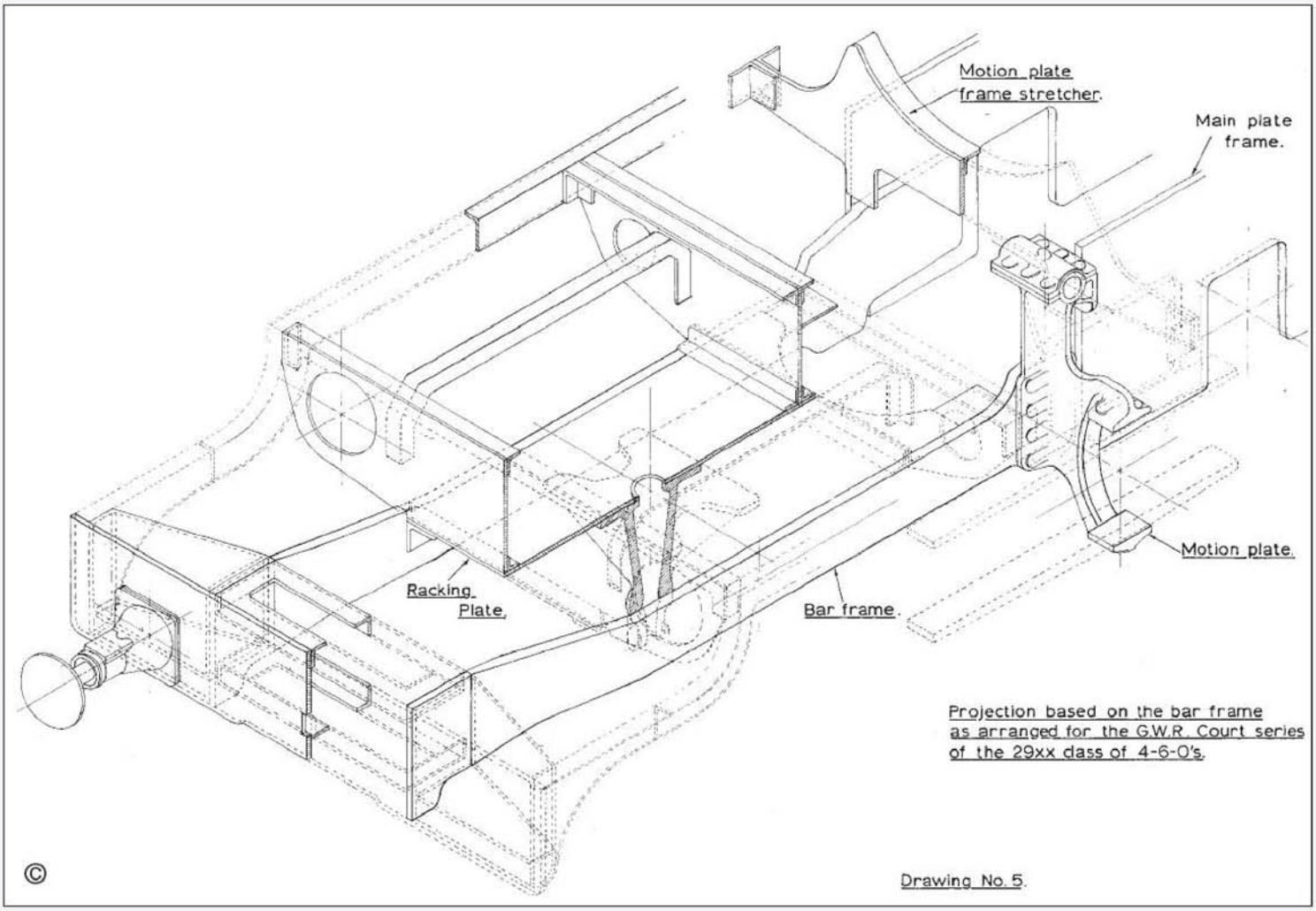
continues his discussion on this feature of GWR locomotives.

●*Part III continued from page 454 (M.E. 4258, 14 October 2005)*

In my experience making the bar frame adds very little extra work, if any, to the construction of the front end of this type of model. It almost certainly cuts out a lot of extra work required by the use of plate frames and the relevant alteration to the design of the bogie or pony truck frames, which is required to adopt plate frames. I suspect that some designers have shied away from bar frames to avoid showing scale cylinders with their integral cast-in exhaust and steam passageways, together with the smokebox saddle, possibly because they are under the impression that such cylinders cannot be accommodated in most model engineer's workshops. This may have been true years ago but in this day and age I am sure that quite a lot of model engineers have, or have access to, the capacity to deal with such cylinders especially if they are prepared to make up some jigs and props. When I first started in the model engineering game my tutor, my old friend Cyril Goulding, took me aside one day and made the following remark. *"Pete, sometimes in model engineering you will find that you have to make something this big"*, holding his hands a yard apart, *"in order to make something this big!"* holding his forefingers about a half inch apart. I have found this statement to be very true over my 45 years in the hobby.

A horizontal frame stretcher between the bar frame at its top edge, known as the racking plate, was fitted level with the top of the bar frame. This was from just ahead of the cylinders to a point to the rear of them. This arrangement of frames allowed the cylinders to be cast integral with the smokebox saddle as shown in my drawings and, with horizontal centre lines, two castings from the same pattern could be bolted back to back. Flanges were provided on the castings to allow them to be bolted to each other and to the outer faces of the bar frame, also to the top of the horizontal racking plate. The patterns for the cylinders were provided with a facility for changing the smokebox saddle to fit varying distances between cylinder centre lines and boiler centre lines and for varying diameters of smokebox. On those locomotives fitted with a front bogie the bar frame, with the exception of loco No. 4600, also supported the motion plate for the cylinder guide bars whereas this feature was omitted from pony truck locomotives. The racking plate,





together with the underside of the smokebox saddle, accommodated the bogie centre pin. On pony truck locomotives it supported the pivot bracket for the suspension equaliser beams from the pony truck to the leading driving wheel springs, the pony axlebox springs presumably not being regarded as sufficient.

Most pony truck fitted locomotives had a single spring equalising beam fitted from above the pony truck centre via the pivot bracket to a cross beam fitted between the front suspension points of the leading driving axle springs. The spring was adjusted normally via the hanger bolts and the single central bolt above the bogie, the end of which was covered by the dome shaped pressing seen above the footplate on these engines. One or two classes of the pony truck locomotives were fitted with two pivot brackets and two equalising beams from the pony suspension bolt. These were angled sideways to the rear, via the pivot brackets, and were directly connected to the leading driving wheel springs therefore without the need of a cross beam between the leading springs. In their early days the side control of the pony trucks was via swinging links but in 1916 this was altered to a system of Cartazzi slides. On the locomotives with bogies the bar frame also accommodated the dome shaped side bearers for supporting the front of the engine and transferring its weight to the bogie. My **drawing 4** shows a section through the cylinders and bogie bolster also showing the arrangement of the domed bearers. The left hand cylinder, as you look, shows the original inside steam pipe cylinder, with its internal steam passages, as fitted to the early 'Saints'. The right hand cylinder shows the 'Hall' class outside steam pipe cylinders as adapted to suit the 'Saints' when new cylinders were required from 1930 onwards. It was mainly problems concerning clearance over the bogie involving the spherical bearer which later caused the myth to be created that the steam chest of the cylinders on the 'Grange' and 'Manor' class locomotives were a lot bigger than on other GW locomotives. On these classes the steam chests are exactly the same size as on other two-cylinder locomotives that have outside steam pipes, a fact which became apparent to me when I made new cylinder drawings for the full size 'Betton Grange' project.

The largest steam chests in these designs of cylinders are in those of the original internal steam pipe type, as shown in the left hand side of my section drawing in the previous article, where the steam chest reaches back inside the casting and turns up under the smokebox saddle. Examples of these are still extant on some preserved locomotives. Calculation shows that these steam chests contain about a third more volume of steam than the later type.

My main isometric **drawing 5** shows the front end bar frame arrangement of a GWR 'Saint' class locomotive of the 'Court' series. Although there were differences between the classes, for the purposes of this article, it can be accepted as broadly the same for all GW locomotives of this type. Having said that I should point out that the 'Saints' were unique in one respect in that no other GW locomotive was fitted with the type of motion plate shown which, incidentally, makes up as a very nice lost wax casting. I have included **drawing 6**, which shows the motion plate to give a good idea what it looked like together with its combined rocker shaft bearing bracket. Examination of this small set of drawings will show that I have followed full size practice and the bolting holes for the slide bars are set opposite each other in order that, if necessary, the bottom and top slide bars can be swapped. As an aside on this aspect of fitting slide bars, full size practice was to fit predetermined sized spacers between the slide bars and the cylinder cover and motion plate landings. When adjustments had to be made, due to wear of the cross-head, whatever thickness was removed from the cylinder cover landing to raise or drop the slide bar then the equivalent thickness was added to or removed from the motion plate landing. This ensured that the slide bar remained parallel to the cylinder centre line. I do not know if standard thickness spacers were stocked at running depots for this purpose but I would not be surprised to find that this was the case.

Having mentioned the 'Court' series of 29s, I should make a further point. These locomotives, together with the later batches of the 4-4-0 'County' and 4-4-2 'County Tanks' and the single 4-4-2 tank No. 4600, differed from all other 'Churchward' engines in that their cylinder centre line was coincident with the driving wheel centre line. In all others it remained at $2^1/2$in. above the driving wheel centre line and remained the case until Collett started to redesign the type in the 1930s. In the 'Courts' this caused a small alteration to be made to both the bar frame and the quadrant link valve rod while on the other three classes the alteration was confined to the ▶

valve rod, which most authors seem to conveniently forget. When cylinder renewals were required on the 'Saints' after the outside steam pipe cylinders of the 'Hall' had been developed, these were fitted to most of the earlier 'Saints' and brought the cylinders coincident with the driving wheel centres. It is of notable interest that in 1924, when loco 2925 'Saint Martin' was rebuilt with 6ft. 0in. driving wheels to become the first 'Hall' class, it was fitted with new 'inside steam pipe' cylinders of the 'Court' pattern. This was despite 'outside steam pipe' cylinders having been developed three years before. I am of the opinion that this particular locomotive was chosen for this rebuild because its original cylinders had reached their reboring limit after 20 years work. It was easier and cheaper to fit the existing 'Court' type cylinders, which were probably in stock, rather than alter the pattern and cast new outside cylinders for it.

Some authors have stated that when the cylinders were lowered it was the whole bar frame which was lowered but that is rubbish. Bar frames were never lowered only raised, as it was still necessary to provide adequate clearance over the bogie otherwise the bogie would have to be redesigned with its frame set lower probably as per Martin Evans' redesign of the bogie top frame for his 'Torquay Manor' design. Much as I admired Martin as a designer of model locomotives, I have to say that this was one of those occasions when deviating from the full size design made model construction far more difficult. It is far easier to make a flat bogie top frame, as per full size, than one with a number of 90deg. 'sets' in it. Bearing in mind that adequate clearance both over and under the bogie had to be provided, the maximum this type of bogie frame could be lowered from the standard 'Churchward' height was one inch. This was accomplished with the introduction of the 'Hall' class in 1928 by quite a major alteration to the design of the bogie centre bolster together with reducing the bogie wheel diameter by two inches from 3ft. 2in. to 3ft. 0in., and cutting short by 1in. the guard irons which were attached to the top of its frame. Including the major re-design mentioned this design of bogie remained standard for all later 2-cylinder 4-6-0s until the 'Modified Hall' class was introduced in 1944 when its design was completely changed. As far as the cylinders were concerned what actually happened was that the smokebox saddle part of the pattern remained at its normal height but the cylinder part was lowered in relation to the bar frame.

Until the introduction of optical aligning equipment at Swindon in the 1920s a combined allowance of half an inch was provided between the cylinder side fixing flanges and the outer faces of the bar frames. This was in order to allow the cylinders to be correctly aligned and spacer plates were then fitted to make up any differences. The optical equipment allowed the cylinders and bar frames to be much more accurately set and machined for alignment so from that time both the right hand and left hand bar frame plates were made a quarter of an inch thicker on the outside at the cylinder bolting face.

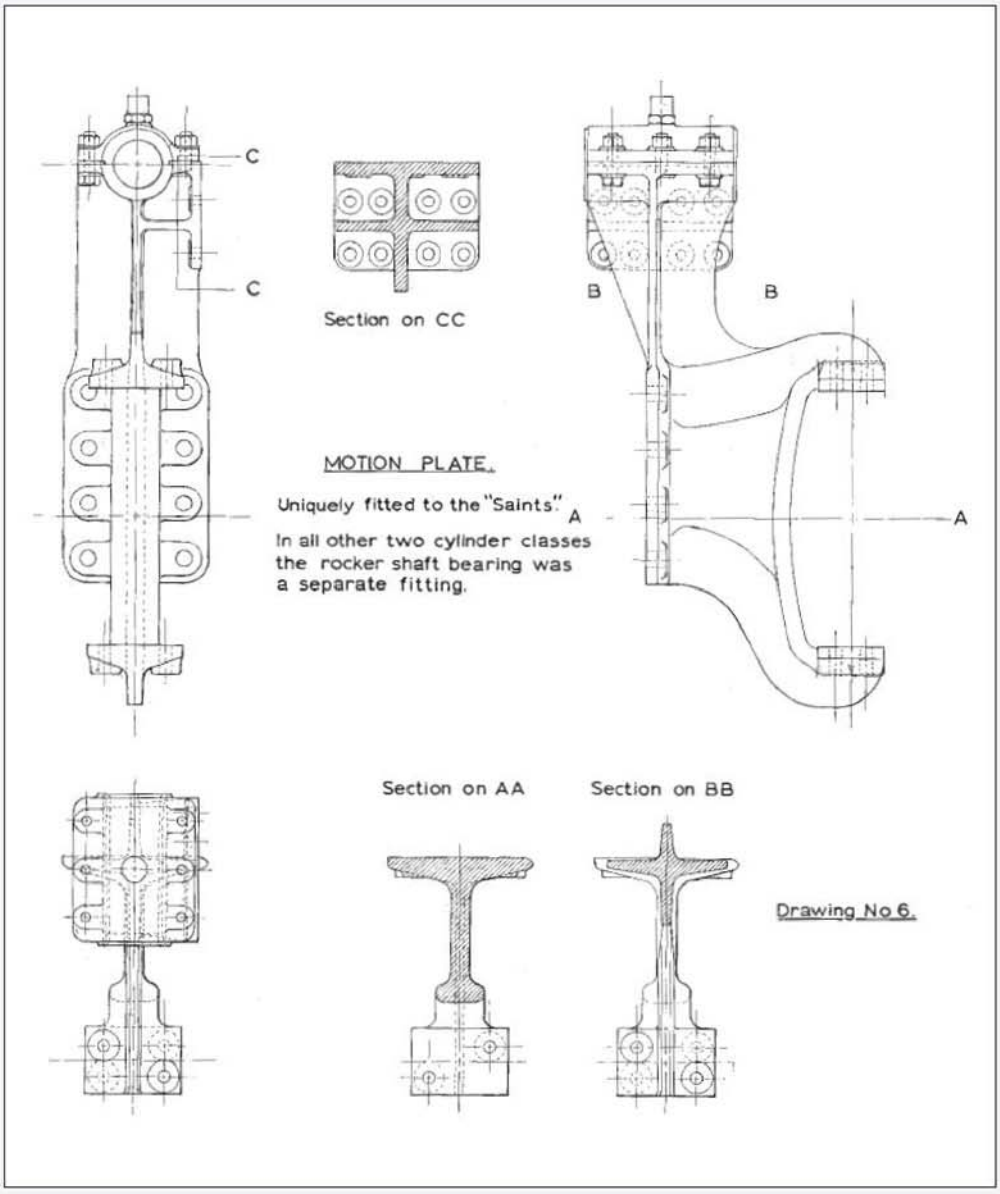
Bar frame extensions sometimes cracked, as do main plate frames, and after about twenty years and a number of rebores the cylinders also normally required renewing. On one 29xx class locomotive it was found that after 9 months in service with new cylinders the bar frame had cracked and also had to be renewed. This was investigated and it was found that the cost of also renewing the bar frames at the same time as renewing the cylinders only added an extra £10 to the total repair cost (1920/30's) so replacement bar frames became normal practice when new cylinders were fitted.

According to K.J. Cook, Works Manager, (Swindon Steam, 1921-1951) Swindon built up complete sets of bar frame assemblies for each class of its two-cylinder locomotives and held them in stock for immediate application when needed. They were actually constructed upside down in order to facilitate the fitting of the horizontal racking plate.

Having researched the main frames my impression is that it was far more likely that repairs would be needed on the plate frames from normal usage rather than any damage or weakness repair needed on the bar frame. This was because the plate frames were prone to cracking from the top corners of the horn cut outs, which required extensive welding and the plate frames are a much more difficult item to replace than the bar frame section. Main frame repairs due to cracking are becoming more apparent in the preservation movement as the preserved locomotives are getting older and such repairs have indeed been found necessary on the full size 4942 during its conversion to 2999.

I have followed the full size design exactly in my models and can quite easily remove the bar frame, in the event of damage, without even having to remove the cylinders from the engine or dismantling of any steam joints or valve rod joints. In point of fact, except for one fitted bolt (which I am considering leaving out and making it a dummy where visible), located behind the leading driving wheel tyre, I can remove the bar frame without dropping the leading driving axle. To this end I have made a template of the frame for the three 5in. gauge 'Saints' I have under construction should it ever be necessary to renew their bar frames. I am sure that readers will understand that in what I have written I am really talking about building a little closer to scale than is normally recommended. I hope that some of you will be encouraged to do just that because I can assure you that there is nothing like the confident feeling that having made and fitted something which is as per the full size. It is really worth another couple of whiskeys at night time!

●*To be continued.*



TRADE TOPICS

NEW OWNERS FOR MJ

MJ Engineering, well-known model engineering suppliers, is under new ownership. Malcolm Frost and John Steer, who have supplied castings and drawings for a range of excellent traction engine and locomotive models over the past 30 years, have decided that it is time to think about retirement. Alan and Helen Barsby have bought the company from them.

Alan and Helen have run a Bagnall (MJ design) for over eight years using it to carry passengers at their local track, Pinewood Miniature Railway, Crowthorne, Berkshire; and at fairs and fetes with 200ft. of portable track. The business will continue as normal with Malcolm and John providing their invaluable help and support. The current range of models will be continued; together with the full range of materials, fastenings, steam fittings and sundries which customers have come to expect from MJ Engineering.

Plans for the future include introducing new models and increasing the range of supplies, together with a re-vamped website which includes more information and photographs of all the stock.

For more information about MJ Engineering, and their products telephone +44(0) 1425-476234. Alternatively visit their website **www.mjeng.co.uk** or e-mail **sales@mjeng.co.uk**

Helen and Alan Barsby, the new faces behind MJ Engineering, seen here with their Bagnall locomotive.

NEW FROM MAXITRAK LTD.

Maxitrak Ltd., has announced some exciting new products. First is a Class 66 freight locomotive in 5in. gauge. The model is 24 volt with electronic control and is available in either four or six motor (80 watts each) versions. Gear drive is provided to each wheel and a full spring suspension system is incorporated. The all-steel body and chassis construction is complimented with moulded detailing. Prices for the locomotive are £2275 for the four motor version and £2525 for the six motor. A lighting set is now available which features high intensity LEDs.

Maxitrak has also released a new sound system for all diesel locomotives. This is recorded from full size engines and sound bites include start-up, engine revving up and down, horns and station announcements etc. The kit comes complete with sound card, amplifier, speaker and instructions and costs £250. A new controller hand set to work with sound and lighting systems, auto return speed control key switch etc. is also available to fit all diesel locomotives in the Maxitrak range and is built to individual requirements.

The next new engine is a vertical boilered De Winton in 5in. gauge. Used extensively in the Welsh slate industry, this model is based on the surviving locomotive *Chaloner* built in 1877 and now in regular use at the Leighton Buzzard Narrow Gauge Railway, Bedfordshire. The model uses a simplified gas-fired boiler which provides quick starting and easy boiler management. A battery powered electric water pump is fitted with automatic control to maintain water level. Priced at £2445, we are also told that coal-fired and 7¼in. gauge versions are to follow.

Good news for Maxitrak Ruston fans - a price cut.

The next subject, while not a new locomotive, is newsworthy because it's on special offer. Maxitrak's popular twin motor Ruston can now be had for £790 as a ready to run model or £750 as a painted kit. Colour choice is maroon or green and various extra cost options can be specified such as a lighting set, sound system and remote control.

A new water gauge sensor, which lights up and buzzes (optional) when there is no water in the gauge, is another new item available at £59. This 9 volt item fits 5mm glass only and comes complete with cable connection to sensor. Finally, there are some new powered wheel sets for use on all new generation 5in. gauge Maxitrak engines. The two types are; Ruston (3in. dia. wheel) at £150 and Warship (3½in. dia. wheel) at £155.

For more information about Maxitrak telephone +44(0) 1580-893030. Alternatively visit their website **www.maxitrak.co.uk** or e-mail **info@maxitrak.co.uk**

Maxitrak's new Class 66 Freight Locomotive in 5in. gauge.

Another new Maxitrak locomotive, the De Winton Chaloner *in 5in. gauge.*

CLUB PROFILE

Robert McLuckie introduces readers to his local model engineering club.

Triple gauge track from steaming bays to the running loops.

EDINBURGH - THE WORLD'S OLDEST M.E. SOCIETY

Founded in 1894, the Edinburgh Society of Model Engineers (ESME), as far as we know, has the distinction of being the oldest model engineering club in the world. We currently have around 70 members from beginners to experts, juniors to seniors, with a very wide range of interests. We meet each Tuesday evening in the clubroom throughout the year, and on the second and fourth Sundays of the month at our track. Our project group also meet each Thursday to undertake work ranging from track maintenance and grass cutting through specific engineering projects such as locomotive and rolling stock production.

We are always keen to encourage new members and pass on our skills and knowledge. Whether you are a beginner, unsure of how to start, or a skilled model engineer you will receive a very warm welcome. Membership costs £35 per annum, with reductions for junior and country members.

Location

The society is based in the grounds of a private estate a few miles to the west of Edinburgh. We are indebted to the estate owners who have allowed us to develop an excellent range of facilities for members.

Main interests of members

One of the most popular subjects is the building and operation of miniature locomotives. The club has a ground level track that caters for locomotive gauges of 3½in., 5in. and 7¼ inch.

Another popular subject is the construction and operation of steamboats. This is not strictly model engineering since the boats and steamplants are at a scale of 1:1. These models are full size working replicas of Edwardian steam launches! The Scottish canals and lochs provide ideal locations for gently steaming along recalling the elegance and engineering of a time long past. Our members involved in this hobby are also members of the Steam Boat Association of Great Britain. If you wish to learn more about this hobby please visit their website at **www.sba.co.uk**

Members' models on display at a local exhibition.

Other interests

Several members are interested in the construction and operation of steam-powered road vehicles such as traction engines. The society benefits from the use of the private roads on the estate where we are based, which provide quiet traffic-free operation for such machines.

Members also have a wide range of other interests such as the construction of machine tools, and the modelling of stationary engines, hot air engines, military vehicles and almost any type of steam plant you can imagine. One member is building a replica Bugatti from scratch.

Facilities

The society has the use of several basement rooms within the estate which include meeting rooms, storage facilities, a fully equipped machine shop and a general workshop.

Within the beautiful estate grounds we have a ground level track with raised steaming bays and turntable. The track consists of a double loop approximately one quarter mile long, the inner loop being a 3½in. and 5in. gauge track and the outer loop being a 7¼in. and 5in. gauge track. The loops are connected to a raised steaming bay and turntable over a triple gauge

Re-laid track in woods with spur to proposed goods yard.

View showing recently widened bridge across stream.

Tunnel on the 3 1/2/5in. gauge track.

track. The rail is of prototypical profile 3/4in. high, flat bottomed steel on timber sleepers set in ballast. A station area provides passing loops and watering points and the track passes through open country and woodland and crosses a substantial bridge. The track is not suitable for the largest 7 1/2in. gauge locomotives, but can handle most sizes up to about 350kg in weight. There is no limit to the size of 5in. or 3 1/2in. gauge locomotives that we can handle. Since we are on a private estate we do not in general steam for members of the public, however members can bring along family and friends for a ride.

The society also has a portable track, locomotive and rolling stock that can be taken to fetes and other such events to give rides to children, of all ages! This can be used to raise attendance or funds for your event.

Throughout the winter season the society arranges a programme of events such as talks, videos and visits on engineering subjects.

How to contact us:

If you would like to visit us to learn more about the society please contact one of our society officers:

Peter Rigby, Chairman; tel. 01506-890741.

John Clerk, Treasurer; tel. 0131-4495250.

Robert McLuckie, Secretary; tel. 01506-655270.

David Neale, Portable Track Manager; tel. 0131-6642449.

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.

NOVEMBER

11/13 **Furness MRC.** *Pendle Forest Nelson Exhibition.* Contact: Colin Burns 01229 837079.

12 **Cardiff MES.** *Steam-Up and Family Day.* Contact Trevor Jenkins: 029-2075-5568.

12 **Glasgow & S.W. Rly Ass'n.** *G. A. Davidson: Poor but Honest - aspects of the LNER.* Contact Bruce Steven: 0141-810-3871.

12/13 **Hutt Valley MES.** *Tauranga Open Weekend.* Contact Gavin McCabe: 567-4487.

12 **SM&EE.** *Training Seminar.* Contact David Boote: 01202-745862.

14 **Bedford MES.** *R101, the story of a disaster.* Contact Ted Jolliffe: 01234-327791.

14 **Saffron Walden DSME.** *Club Night.* Contact Jack Setterfield: 01843-596822.

15 **Chesterfield MES.** *P. Crawley: Settle & Carlisle.* Contact Mike Rhodes: 01623-648676.

15 **Nottingham SMEE.** *Noel Coates: The Lancashire & Yorkshire Railway.* Contact Graham Davenport: 0115-8496703.

15 **Taunton ME.** *Auction.* Contact Don Martin: 01460-63162.

16 **Andover DMES.** *John Berry: Coastal Engineering.* Contact John Berry: 01960-882616.

16 **Leeds SMEE.** *Jumble Sale.* Contact Colin Abrey: 01132-649630.

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

17 **Cardiff MES.** *Cyril Chandler: Film Night.* Contact Trevor Jenkins: 029-2075-5568.

17 **East Somerset SMEE.** *Meeting.* Contact Roger Davis: 01749-677195.

17 **Frimley & Ascot LC.** *AGM.* Contact Bob Dowman: 01252-835042.

17 **Isle of Wight MES.** *AGM.* Contact Ken Stratton: 01983-531384.

18 **Canvey R&MEC.** *Meeting.* Contact Brian Baker: 01702-512752.

18 **North London SME.** *Work in Progress.* Contact David Harris: 01707-326518.

18 **Romford MEC.** *Photo Talk.* Contact Colin Hunt: 01708-709302.

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

19 **Dublin SMEE Ltd.** *Mr. G. Drumm: Clock Wise!* Contact Colm de Br'n: (01) 868 2549.

19/20 **Furness MRC.** *Hazel Grove & New Mills Exhibition.* Contact Colin Burns: 01229 837079.

19/20 **Furness MRC.** *Alsager Exhibition.* Contact Fred Firth: 01229-821192 or Colin Burns 01229 837079.

19/20 **Kew Bridge Steam Museum.** *Live Steam Model Railway Show.* Information: 020-8568-4757.

19 **Oxford (City of) SME.** *COSME Golden Jubilee Dinner.* Contact Chris Kelland: 01235-770836.

19 **SM&EE.** *Rummage Sale.* Contact David Boote: 01202-745862.

19 **York City & DSME.** *Jack Dee: Vacuum Technology.* Contact Pat Martindale: 01262-676291.

20 **Frimley & Ascot LC.** *Club Running.* Contact Bob Dowman: 01252-835042.

20 **Furness MRC.** *North Turton O gauge test track in operation.* Contact Colin Burns: 01229 837079.

20 **N. W. Leicester SME.** *Public Running.* Contact John Elliott: 01455-847040.

21 **Model Steam Road Vehicle Soc.** *Quiz Night.* Contact Geoff Miles: 01869-247602.

21 **Peterborough SME.** *Talk Night.* Contact Tony Meek: 01778-345142.

23 **Hull DSME.** *Chairman's Evening.* Contact Tony Finn: 01482-898434.

23 **Staines SME.** *Auction.* Contact Stan Bishop: 01784-241891.

24 **Cardiff MES.** *Bits & Pieces.* Contact Trevor Jenkins: 029-2075-5568.

24 **Leyland SME.** *Quiz Night.* Contact A. P. Bibby: 01254-812049.

24 **Wimborne DSME.** *AGM.* Contact Eric Basire: 01202-897158.

25 **Chichester DSME.** *Club Auction.* Contact Brian Bird: 01243-536468.

25 **Malden DSME.** *Rummage Sale.* Contact John Mottram: 01483-473786.

26 **Hornsby ME.** *Family Day & Boiler Inspection.* Contact Ted Gray: 9484-7583.

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

27 **York City & DSME.** *Running Day.* Contact Pat Martindale: 01262-676291.

28 **Bedford MES.** *Discussion on lubricating work-pieces while cutting.* Contact Ted Jolliffe: 01234- 327791.

28 **Hornsby ME.** *Meeting.* Contact Ted Gray: 9484-7583.

30 **Andover DMES.** *Peter Donovan: Traction Engines.* Contact John Berry: 01960-882616.

DECEMBER

1 **Cardiff MES.** *Club Chat.* Contact Trevor Jenkins: 029-2075-5568.

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

2 **Canvey R&MEC.** *AGM.* Contact Brian Baker: 01702-512752.

2 **Chichester DSME.** *Christmas Dinner.* Contact Brian Bird: 01243-536468.

2 **Maidstone MES (UK).** *Bits & Pieces.* Contact Martin Parham: 01622-630298.

2 **North London SME.** *Anecdotes and Reminiscences with Seasonal Refreshments.* Contact David Harris: 01707-326518.

2 **North Norfolk MEC.** *Club Dinner.* Contact Gordon Ford: 01263-512350.

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

2 **Rochdale SMEE.** *Work in Progress.* Contact Mike Foster: 01706-360849.

2 **Romford MEC.** *Competition Night & Millennium & Rusty Titford Cup.* Contact Colin Hunt: 01708-709302.

3 **Dublin SMEE Ltd.** *Gauge 1 Topics.* Contact Colm de Br'n: (01) 868 2549.

3/4 **Furness MRC.** *Warley National Model Railway Exhibition.* Contact Colin Burns: 01229 837079.

3 **York City & DSME.** *Bits & Pieces.* Contact Pat Martindale: 01262-676291.

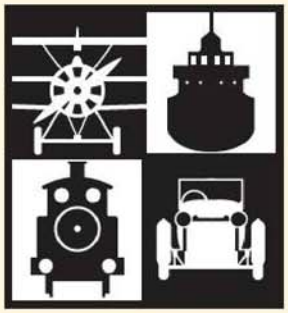
4 **Canvey R&MEC.** *Santa Specials.* Contact Brian Baker: 01702-512752.

4 **Cardiff MES.** *Santa Special Day.* Contact Trevor Jenkins: 029-2075-5568.

4 **Reading SME.** *Public Running.* Contact Brian Joslyn: 01491-873393.

4 **South Durham SME.** *Running Day.* Contact B. Owens: 01325-721503.

5 **Peterborough SME.** *Bits & Pieces.* Contact Tony Meek: 01778-345142.



THE MODEL ENGINEER EXHIBITION

Please return completed form to:
Model Engineer Competition, The Leys,
Church St., Twyford, Bucks. MK18 4EU

ENTRY NO.

OFFICE USE ONLY

CLASS	ENTRY NO.

ENTRY FORM - COMPETITION & LOAN MODELS

PERSONAL DETAILS (Please print)

Surname ..... Forename(s) ..... Age .....

Address .....

.....

.....

Post Code ..... Home Tel: ..... Daytime Tel: .....

Model Club or Association .....

Have you entered before? (Y/N) .....

Do you purchase or subscribe to a Highbury House Communications plc magazine? (Y/N) .....

How many years have you been a modeller? .....

Mail Order Protection - please tick this box if you would prefer not to receive mail from other companies which may be of interest to you ☐

MODEL DETAILS - PLEASE TICK BOX IF MODEL IS FOR LOAN ☐

Entry Class (competition entries only) .....

Model Title (to be used for catalogue and display card) .....

.....

Model Description .....

.....

.....

Model Scale ..... Length ..... Width ..... Height ..... Weight .....

Type of construction .....

.....

Parts not made by you and commercial items .....

.....

Have you supplied a photograph? (Y/N) .....

Are you supplying Judges Notes? (Y/N) .....

Value of model (Highbury House Communications plc will not insure the model unless a value is entered) £.....

Name and address of local newspaper .....

.....

NB Please make a copy of this form and any photographs enclosed for your own reference. Please note that Highbury House Communications plc will not accept liability for any loss of documents or photographs submitted with this form

TO HELP YOU GET THE BEST FROM THE MODEL ENGINEER EXHIBITION

These notes are written purely for guidance. Full information is contained in the Competitors' Information booklet which is sent to every entrant as part of the information package. If you have an item and are unsure as to the Class into which it should be entered, leave that section blank and we will take care of it. The Judges have the right to move any competition exhibit into another class if they feel that by doing so its chances of gaining higher marks or a more appropriate award are improved.

If the item is offered as a Loan exhibit please indicate this by writing Loan on the form in the box identifying the Class. Loan models are not judged but carry all other privileges associated with competition entries.

Part built models are particularly welcome in the Loan Section; visitors like to see work in progress, and entry does not preclude the item being entered in competition when completed.

The classes listed below are those associated with mainstream model engineering.

Club exhibits

Where a club is exhibiting, each model should be entered on a separate entry form and clearly identified as a club exhibit by entering Loan/Club in the class section box. This ensures that we have a full record of all models on display during the show and facilitates matters of administration and insurance.

Additional forms

If you do not wish to deface your copy of the magazine we are happy to receive photocopies of the entry form, one for each model. We will be pleased to send out extra forms if required, so if you know of a modeller who is not a reader of one of our magazines but who you think may wish to participate, please advise them to contact our Exhibitions Office , or simply photocopy the entry form for them.

The success of the show depends largely on the number of models on display. Your work could well be the stimulus which inspires someone else to start in the hobby. There can be no doubt that this event is our showcase on the world of modelling in all its aspects. Every modelling discipline needs more and more participants, and it is by displaying not only the crème-de-la-crème, but also examples of work of a more achievable standard, that people are encouraged to join into the wonderful world of modelling, in whatever aspect.

We look forward to seeing a sample of your work at the show!

COMPETITION CLASSES

Engineering Section

- A1 Hot air engines.
- A2 General engineering models (including stationary and marine engines).
- A3 Internal combustion engines.
- A4 Mechanical propelled road vehicles (including tractors).
- A5 Tools and workshop appliances.
- A6 Horological, scientific and optical apparatus.
- A7 General engineering exhibits — not covered by the above

Railway Section

- BI Working steam locomotives 1in scale and over.
- B2 Working steam locomotives under 1in scale.
- B3 Locomotives of any scale, experimental, freelance or based on any published design and not necessarily replicas of full size prototypes, intended for track duties.
- B4 Scratchbuilt model locomotives of any scale, not covered by classes BI, B2, B3, including working models of non-steam, electrically or clockwork powered steam prototypes.
- B5 Scratchbuilt model locomotives gauge 1 (10mm scale) and under.
- B6 Kitbuilt model locomotives gauge 1 (10mm scale) and under.
- B7 Scratchbuilt rolling stock, gauge 1 (10mm scale) and under.
- B8 Kitbuilt rolling stock, gauge 1 (10mm scale) and under.
- B9 Passenger or goods rolling stock, above 1in scale.
- B10 Passenger or goods rolling stock, under 1in scale.
- B11 Railway buildings and lineside accessories to any recognised model railway scale.
- B12 Tramway vehicles.

Marine Models

- C1 Working scale models of powered vessels (from any period). Scale 1:1 to 1:48
- C2 Working scale models of powered vessels (from any period). Scale 1:49 to 1:384
- C3 Non-working scale models (from any period). Scale 1:1 to 1:48
- C4 Non-working scale models (from any period). Scale 1:49 to 1:384
- C5 Sailing ships and oared vessels of any period - working.
- C6 Sailing ships and oared vessels of any period - non-working.
- C7 Non-scale powered functional models including hydroplanes.
- C8 Miniatures. Length of hull not to exceed 15in for 1:32 scale; 12in for 1:25 scale; 10in for 1:16 scale; 9in for 1:8 scale. No limit for smaller scales.
- C9 For any model boat built from a commercial kit. Before acceptance in this class the kit must have been readily available for at least 3 months prior to the opening date of the exhibition and at least 20 kits must have been sold either by mail order or through the retail trade.

Scale Aircraft Section

- D1 Scale radio control flying models
- D2 Scale flying control-line and free flight
- D3 Scale non-flying models, including kit and scratch-built
- D4 Scale flying radio controlled helicopters

Model Horse Drawn Vehicle Section

- G1 Carriages & other sprung vehicles. (Omnibuses, trade vans etc.) Wagons, carts and farm implements. Caravans.

Junior Section

- J1 For any type of model, mechanical or engineering work, by an under 14 year old.
- J2 For any type of model, mechanical or engineering work, by an under 16 year old.
- J3 For any type of model, mechanical or engineering work, by an under 18 year old.

All entries will be judged for standard of craftsmanship, regardless of the modelling discipline, i.e. a boat will not be competing against a military figure. Providing a model attains sufficient marks it will be awarded a gold, silver or bronze medals

Model Vehicle Section

- K1 Non-working cars, including small commercial vehicles (e.g. Ford Transit) all scales down to 1/42.
- K2 Non-working trucks, articulated tractor and trailer units, plus other large commercial vehicles based on truck-type chassis, all scales down to 1/42.
- K3 Non-working motor bikes, including push bikes, all scales down to 1/42.
- K4 Non-working emergency vehicles, fire, police and ambulance, all scales down to 1/42.
- K5 Non-working vehicles including small commercial vehicles (e.g. Ford Transit). Scale from 1/43 or smaller.
- K6 Any available body shells including Concours, in any scale or material, to be judged on appearance only.
- K7 Functional model cars/vehicles which must be able to move under its own power of any type. Can be either free-running, tethered radio controlled or slot car, but must represent a reasonable full size replica

DUKE OF EDINBURGH CHALLENGE TROPHY

Rules and Particulars

1. The Duke of Edinburgh Challenge Trophy is awarded to the winner of the Championship Award at the Model Engineer Exhibition.
2. The trophy remains at all times the property of HIGHBURY HOUSE COMMUNICATIONS PLC.
3. The name of the winner and the date of the year in which the award is made will be engraved on the trophy, which may remain, at the discretion of HIGHBURY HOUSE COMMUNICATIONS PLC in his/her possession until required for renovation and display at the following Model Engineer Exhibition.
4. Any piece of model engineering work will be eligible for this Championship Award after it has been awarded, at The Model Engineer Exhibition, a Gold or Silver medal by HIGHBURY HOUSE COMMUNICATIONS PLC.
5. No model may be entered more than once.
6. Entry shall be free. Competitors must state on the entry form:
   (a) That exhibits are their own bona-fide work.
   (b) Any parts or kits that were purchased or were not the outcome of their own work.
   (c) That the model has not been structurally altered since winning the qualifying award.
7. HIGHBURY HOUSE COMMUNICATIONS PLC. may at their sole discretion vary the conditions of entry without notice.

COMPETITION RULES

1. Each entry shall be made separately on the official form and every question must be answered.
2. Competition Application Forms must be received by the stated closing date.

LATE ENTRIES WILL ONLY BE ACCEPTED AT THE DISCRETION OF THE ORGANISERS.

3. Competitors must state on their form the following:
   (a) Insured value of their model.
   (b) The exhibit is their own work and property.
   (c) Parts or kits purchased.
   (d) Parts not the outcome of their own work.
   (e) The origin of the design, in the case of a model that has been made by more than one person.

NOTE: Entry in the competition can only be made by one of the parties and only their work will be eligible for judging.

4. Models will be insured for the period during which they are in the custody of HIGHBURY HOUSE COMMUNICATIONS PLC
5. A junior shall mean a person under 18 years of age on December 31st in the year of entry.
6. Past Gold and Silver medal award winners at any of the exhibitions promoted by HIGHBURY HOUSE COMMUNICATIONS PLC. are eligible to re-enter their model for the 'Duke of Edinburgh Challenge Trophy.'

Past winners at any of the exhibitions promoted by HIGHBURY HOUSE COMMUNICATIONS PLC. will not be eligible for re-entry into the competition unless it has been substantially altered in any way.

7. HIGHBURY HOUSE COMMUNICATIONS PLC. reserve the right to:
   (a) Transfer an entry to a more appropriate class.
   (b) Describe and photograph any models entered for competition or display and to make use of any such photographs or descriptions in any way they may think fit.
   (c) Refuse any entry or model on arrival at the exhibition and shall not be required to furnish a reason for doing so.
8. Entry into the competition sections is not permitted by:
   (a) Professional model makers.
   (b) Anyone who has a financial interest in the direct supply of materials and designs to the public.

NOTE: If unsure, please contact the Competition organisers, prior to the show.

9. The judges' decision is final. All awards are at the discretion of the judges and no correspondence regarding the awards will be entered into.
10. Exhibitors must present their model receipt for all models collected at the end of the exhibition and sign as retrieved.
11. The signed release for each model must be presented to security staff when leaving the exhibition complex with display model(s) after the close of the exhibition.

IMPORTANT NOTE PLEASE MAKE COPIES, INCLUDING PHOTOGRAPHS, OF ALL INFORMATION RELATING TO YOUR MODEL, AS HIGHBURY HOUSE COMMUNICATIONS PLC *WILL NOT ACCEPT LIABILITY FOR ANY LOSS.*

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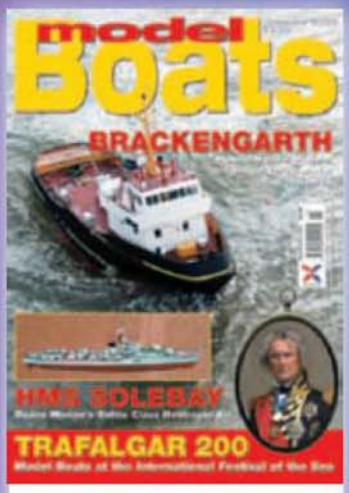

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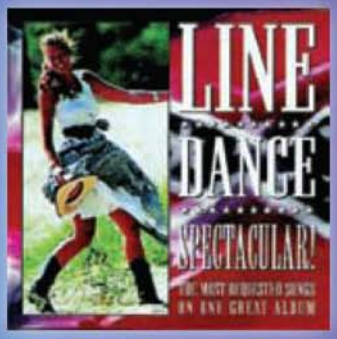

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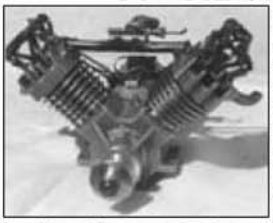

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205TE Turbo*	30-185	£329.95	£387.69

*Turbo fan cooled for longer welding at full output

Clarke BENCH GRINDER STAND

BGS1 Complete with bolt mountings & feet anchor holes

ONLY £24.99 EX VAT £29.36 INC VAT

Clarke BENCH GRINDERS

CBG8W (wet) features 8" wetstone & 6" drystone.

FROM ONLY £12.75 EX VAT £14.98 INC VAT

MODEL	DUTY	WHEEL DIA.	EX VAT	INC VAT
CBG6RP	DIY	150mm	£12.75	£14.98
CBG6RZ	PRO	150mm	£18.95	£22.27
CBG6RSC	HD	150mm	£25.49	£29.95
CBG6RWC*	HD	150mm	£29.95	£35.19
CBG8RSC	HD	200mm	£33.95	£39.89
CBG8W (wet)	HD	150mm/200mm	£33.95	£39.89

Clarke MICRO MILLING & DRILLING MACHINE

CMD10

ONLY £239.95 EX VAT £281.94 INC VAT

- 150w/230v motor
- Variable speed 1000-2000rpm
- MT2 Spindle Taper
- Face mill capacity 20mm, end mill 10mm
- Table cross travel 90mm, longitudal travel 180mm

Clarke VARIABLE SPEED LATHE & SEPARATE MILL DRILL HEAD

CL250M & CL251MH

REDUCED £269.95 EX VAT £317.19 INC VAT WAS £328.94 INC VAT

MASSIVE PRICE CUTS

CL251MH (ATTACHMENT)

- 250mm between centres
- 153mm swing over bed
- Power feed
- Screw cutting facility
- Transforms the CL250M into a superb Lathe/Mill
- 10mm max drill capacity
- Variable 30mm travel for drilling spindle

SAVE £11.75

REDUCED! NOW ONLY £149.95 EX VAT £176.19 INC VAT WAS £187.94 INC VAT

Clarke MECHANICS TOOL CHESTS & CABINETS

- Robust steel construction
- 1 piece roll formed friction slide drawer runners

FROM ONLY £39.95 EX VAT £46.94 INC VAT

MODEL	DESC.	DR LOAD	EX VAT	INC VAT
CTC600	6 Drawer chest	19Kg	£39.95	£46.94
CTC900	9 Drawer chest	19Kg	£49.95	£58.69
CTC500	5 Dr. cabinet	35Kg	£84.95	£99.82
CTC800	5 Dr. Chest/cab	19Kg	£84.95	£99.82
CTC700	7 Dr. cabinet	35Kg	£99.95	£117.44
CTC1300	13 Dr. Chest/cab set	19Kg	£139.95	£164.44

Clarke ANGLE GRINDERS

Inc. disc & handle

MASSIVE PRICE CUTS

FROM ONLY £12.95 EX VAT £15.22 INC VAT

MODEL	DISC mm	MOTOR	WAS INC VAT	NOW EX VAT	NOW INC VAT
CAG1218	115	500w	-	£12.95	£15.22
CAG115C	115	720w	£29.37	£22.95	£26.97
CAG115	115	500w	£30.49	£23.95	£28.14
CON115*	115	1010w	£35.19	£24.95	£29.32
CAG232	230	2000w	£25.19	£25.95	£30.49

REDUCED

*CON115 is Heavy Duty contractor model

Clarke SWING ARM & MAGNIFYING LAMPS

FROM ONLY £7.95 EX VAT £9.34 INC VAT

- Features clamp
- Lamp Only

Ideal for fine detail work

MODEL	LENS (MM)	EX VAT	INC VAT
SAL100*	-	£7.95	£9.34
SAM75	89	£14.95	£17.57
SAM100	120	£34.95	£41.07

Clarke 12 SPD MILL/DRILL

CMD1225C

ONLY £599.00 EX VAT £703.83 INC VAT

Precision engineered with cast iron head, base & column

- Spindle speeds 100-2150rpm
- ¾ Hp, 230v, 1 Ph motor
- Accessories available
- 63mm milling cutter
- 16mm chuck
- Table size 585x190

Clarke TAP & DIE SETS

FROM ONLY £12.95 EX VAT £15.22 INC VAT

- High quality tungsten steel
- Supplied in metal storage case, except 16pce

TYPE	EX VAT	INC VAT
16pce Metric	£12.95	£15.22
19pce UNF	£14.95	£17.57
24pce UNC/UNF/NPT	£19.95	£23.44
28pce#‡ Metric	£19.95	£23.41
33pce# Metric/UNF/BSP	£29.95	£35.19

#28pce Best Budget Buy, 33pce Recommended: Practical Classics

Clarke DRILL PRESSES

- Tables tilt 0-45° left and right
- Depth gauge
- Chuck guards

FROM ONLY £29.95 EX VAT £35.19 INC VAT

MODEL	WATTS/SPEEDS	EX VAT	INC VAT
CDP5DD	245/5	£29.95	£35.19
CDP101B	245/5	£49.95	£58.69
CDP151B	300/5	£79.95	£93.94
CDP-10B	370/12	£89.95	£105.69
CDP201B	370/12	£99.95	£117.44
CDP-15F	370/12	£114.95	£135.07
CDP301B	510/12	£134.95	£158.57
CDP351F	510/12	£149.95	£176.19
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FULL RANGE OF AIR TOOLS & SPRAY GUNS AVAILABLE

- 7 cfm displacement
- 1.5Hp • 24Ltr

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OTHER MODELS IN THE RANGE

MODEL	MOTOR	CFM	TANK	EX VAT	INC VAT
8/45 o/f	1.5Hp	6.3	24ltr	£84.95	£99.82
Panther 25	2Hp	8.2	24ltr	£129.95	£152.69
Panther 50	2Hp	8.2	50ltr	£169.95	£199.69
10/70t	2.0Hp	9	50ltr	£254.95	£299.57
15/55	3.0Hp	14	50ltr	£259.95	£305.44
15/65t	3.0Hp	14	50ltr	£359.95	£422.94

Clarke AIRBRUSH KITS

FROM ONLY £7.99 EX VAT £9.39 INC VAT

DIY KIT - CAB1H

- Spray pattern adjustable

ONLY £7.99 EX VAT £9.39 INC VAT

PRO KIT - CAB2P (pictured)

- Double action trigger for accurate air/paint control
- Precision machined nozzle • Special lightweight hose

ONLY £23.95 EX VAT £28.14 INC VAT

Clarke TURBO FAN GAS HEATERS

- Ideal for low cost, highly efficient heating in workshops, garages etc

MODEL	OUTPUT BTU/hr	WAS INC VAT	EX VAT	INC VAT
LITTLE DEVIL	35,000	£93.94	£76.95	£90.42
DEVIL 650	51,600	-	£109.95	£129.19
DEVIL 850	107,000	£176.19	£139.95	£164.44
DEVIL 1250	149,000	-	£179.95	£211.44
DEVIL 1850	200,000	£328.94	£274.95	£323.07

REDUCED

STAINLESS STEEL MODELS ALSO AVAILABLE

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- 95% of input energy is converted into heat output

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Kit includes:

- Rotary tool
- 1m flexible drive
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- 40x accessories/consumables

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MULTI-PURPOSE CHV125

ONLY £37.95 EX VAT £44.59 INC VAT

- Jaw width 127mm
- Jaw opening 120mm
- Jaw depth 75mm
- 360° rotating vice head
- 360° double locking swivel base

Clarke MEASURING INSTRUMENTS

MODEL	DESCRIPTION	EX VAT	INC VAT
CM100	150mm/6" Vernier Caliper	£8.49	£9.98
CMT80	0-25mm Micrometer	£9.95	£11.69
CM145	150mm/6" Digital Vernier	£19.95	£23.44

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Elliot powered suface grinder "as good as it looks"

A selection of tinmans stakes

Boxford AUD MK111 5" x 22" gearbox, power cross feed

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Marlco notch broaching fixture	from £425 to £200
Elliot Surface grinder	from £2250 to £1950
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Loads of machines and parts 'in house to callers only' including steel stock

Harrison 140, 5 1/2" x 24", gearbox, power feeds, gap bed and almost immaculate

We have a good selection of bench vices from £12.50 including the Record No.23 at £75 each

BCA jig borer/ milling/ drilling machine complete with collets & cabinet stand

Colchester Chipmaster 5" x 20", a very nice example with dual dials

Harrison vertical milling machine, 30 INT head + 30" x 8" powered table & coolant

Flamefast PB250 power burner crucible furnace

Boxford VM30 milling machine, 30 INT head + 3 Way DIGITAL READ OUT

BCA 12" rotary table

Tom Senior 'E' type milling machine, extremely rare and sought after

Jones and Shipman bench centres 4" x 24" between centres

LO-D14 + 3 collets

Easi Blaster (sand) cabinet + 2HP compressor

Henry Milns 6 1/2" x 48" geared head, gearbox and gap bed + tooling just in off the lorry

Elliot 8" pedestal grinder

Boxford 1130, 5 1/2" x 30"

Boxford CUD Mk III centre lathe 5" x 22" in very nice order

Harrison M250 lathe complete with 3 and 4 jaw chucks, extra gears, with the high 2000rpm top speed almost as new

Presto BSP set off taps and dies 1/2" - 1" boxed

Viceroy vertical milling machine, 30 INT head + 34" x 8" powered table

Viceroy pedestal buffing machine

Mercer dial gauge imperial reads to .0005" Ex Mod complete still boxed (last few available)

Boxford pedestal drill

Small tooling! at 'Home & Workshop Machinery'

Rapidor 6" hacksaw

Lorch precision lathe complete with collets

Tom Senior 'S' Type milling machine table 28" x 6"

Myford Super 7B precision (gearbox) screwcutting lathe + power crossfeed, cabinet stand, drip tray & blocks and rare Hardened Bed

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Myford ML7R 3 1/2" x 19" + clutch / lever tailstock

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Centurion 3in1 Long Bed

Standard Accessories
125mm, 3-Jaw Chuck
1-13mm Drill Chuck & MT3 Arbor
Set of 5 Carbide Lathe Tools
Combined Vice/Compound Slide

Specifications

Centre Height	210mm
Distance Between Centres	800mm
Spindle Taper	MT4
Milling Table Size	475x160mm
Lathe Motor	¾ hp
Milling Power	¾ hp
Net Weight	300kgs
Dimensions	1570x480x955mm

£936.17
+VAT & delivery

(shown with optional tray)

Centurion 3in1

Standard Accessories
125mm, 3-Jaw Chuck
1-13mm Drill Chuck & MT3 Arbor
Set of 5 Carbide Lathe Tools
Combined Vice/Compound Slide

Specifications

Centre Height	210mm
Distance Between Centres	520mm
Spindle Taper	MT4
Milling Table Size	475x160mm
Lathe Motor	¾ hp
Milling Power	¾ hp
Net Weight	250kgs
Dimensions	1270x480x955mm

£548.94
+VAT & delivery

(shown with optional tray)

Model B Super 3in1

Standard Accessories
3-Jaw Chuck
1-13mm Drill Chuck & Arbor
Dual Purpose Compound Slide/Machine Vice
Set of 5 Carbide Lathe Tools

Specifications

Centre Height	210mm
Distance Between Centres	520mm
Spindle Taper	MT3
Milling Table Size	300x150mm
Motor	¾ hp
Net Weight	155kg
Dimensions (HxWxL)	930x690x1090mm

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