

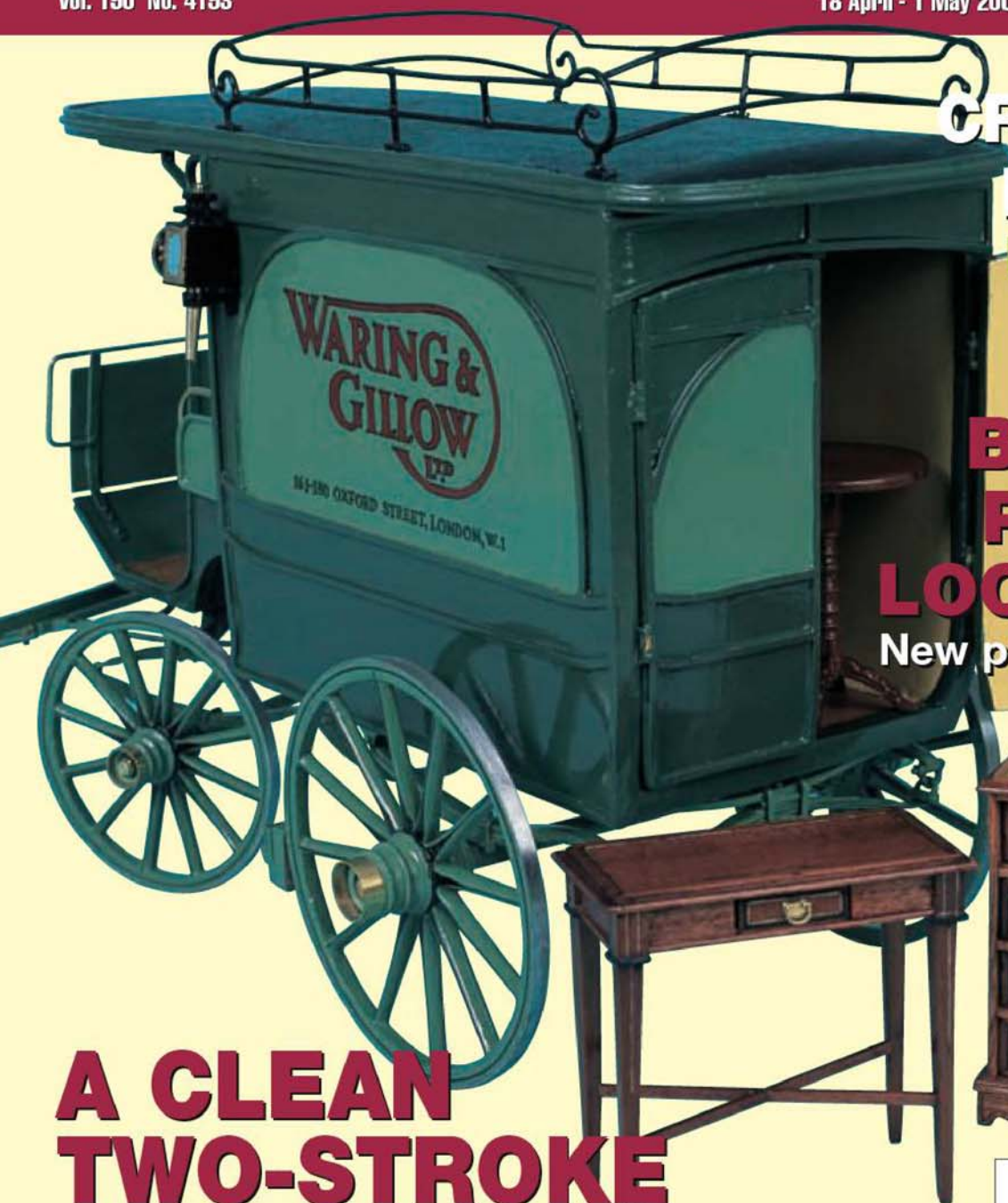
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Vol. 190 No. 4193

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Model Engineer is published by
Highbury Nexus Special Interests Limited
Nexus House, Azalea Drive, Swanley, Kent BR8 8HU
Tel: 01322 660070 Fax: 01322 616319
www.hhc.co.uk/modeng
Highbury Nexus Special Interests Limited is a
subsidiary of Highbury House Communications plc.

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Origination by
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SUBSCRIPTIONS & BACK ISSUES

Direct Subscriptions and Back Issues are available from
Highbury Nexus Subscription Services, Link House,
8 Bartholomew's Walk, Ely, Cambs CB7 4ZD
Phone: 01353 654422; Fax: 01353 654400
Email: nexus@wyvernpress.co.uk
Rates for 26 issues (annual), 13 issues (six months):
UK: £58.00 (annual), £29.00 (six months);
Europe: £73.00 (annual), £36.50 (six months);
RoW Surface: £74.50 (annual), £37.25 (six months);
RoW Airmail: £79.00 (annual), £39.50 (six months);
US Surface: \$104.00 (annual), \$52.00 (six months);
US Airmail: \$121.00 (annual), \$60.50 (six months).
Cheques payable to Highbury Nexus Special Interests Ltd.
Second class postage paid at Rahway NJ USA.
Postmaster, please send address corrections to
Model Engineer c/o Mercury Airfreight International Inc,
2323 Randolph Avenue, Avenel, NJ 07001. Usps 0011099.
US Subscription Agents: Wise Owl Worldwide Publications,
6150 Candlewood Street, Suite #1
Lakewood, CA 90712-1900, USA
Phone: 562-461-7574; Fax: 562-461-7212.
Email: info@wiseowlmagazines.com
Website: www.wiseowlmagazines.com
Visa/MC/Discover accepted.
Canadian Distribution by Gordon & Gotch Periodicals
(Toll free 1-800-435-5005).
Model Engineer is published fortnightly.



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ISSN 0026-7325

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Steam chest covers, cylinder liners
and guidebars plus a little Greek
sagacity. Part XVI.
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72nd MODEL ENGINEER EXHIBITION
More superb Competition Class entries

On the cover ...

Reminiscent of a bygone age when
furniture was delivered by a horse drawn
van, this 1:8 scale miniature delivery
vehicle is modelled on a design in use at
the beginning of the twentieth century.
Built by Timothy Smith, it gained for him
a Silver Medal in Class G1 at the
72nd Model Engineer Exhibition.
Turn to page 420 in this issue for a full
report on this and other superb entries.

(Photograph by Gary Sinfield)

AERONCA E113 AERO ENGINE in 1:4 scale

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Some Good Reading



R. J. Mitchell, Schooldays to SPITFIRE [Mitchell]

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The bulk of this book is a biography of R.J. Mitchell, designer of the legendary Supermarine *Spitfire* fighter aircraft and linked to this, Britain's earlier winning of the Schneider Trophy outright. Arguably one of the greatest aircraft designers, in an era when there many good ones, Mitchell died in 1937 aged just 42, but left his country with one of the most important tools for its resistance and eventual triumph over Hitler. The second, but still major part of this book is a 'biography' of the *Spitfire* itself, how it came to be, its development and service. Written by R. J. Mitchell's son Gordon, this is a highly readable book which should be on the shelves of anyone with an interest in aviation history and is a fitting tribute to a gifted and brave man. 319 pages, well illustrated, mainly with B & W photographs. Paperback.

Henry Maudslay & the Pioneers of the Machine Age

[Cantrell, Cookson et al]

£19.39

Excellent mixture of biography, and history of engineering which tells the story of Henry Maudslay, one of the great pioneers of industrial machine making, the firm he started, *Maudslay, Sons & Field* and a number of other pioneers in the same field who worked with, and were influenced by Maudslay, namely Richard Roberts, David Napier, Joseph Clement, Joseph Whitworth, James Nasmyth and William Muir. Erudite, but highly readable, and recommended. Well produced 192 page paperback with numerous B & W illustrations and drawings.

Steam Shovels [Manktelow]

£ 4.50

Small, but good introductory book on steam shovels, covering the *Otis Crane Excavator*, the railroad shovel, the revolving shovel, the long-range shovel, the dragline and the grab or clamshell. Good explanations and drawings or diagrams, as well as photos, show how each variant works. Given that, curiously, there seems to be nothing else around on these fascinating machines, make the most of this! 32 pages. 46 illustrations. Softcover.

Practical Clock Escapements [Penman]

£ 29.34

The escapement is really the heart of a clock, and a good escapement is essential for a good time-keeper. This book deals in detail with the five escapements most usually found: crownwheel and verge, recoil anchor, Graham deadbeat, Brocot and platform, and a number of other types of escapements are also considered. The action and geometry of each type is described and there is practical information on how to design and make both pallets and escapewheels. There is practical advice on assessing faults and repairing the escapement for the repairer and restorer. This really is an extremely good, well written and produced practical clock book. 248 pages. 400 diagrams.



Machine Shop Methods {1950} [Milne]

£ 18.05

Dave Gingery, whose books will be known to many, reckons this is the best beginner's machine work book he has seen, and it certainly is good. The majority of the chapters are concerned with using the lathe, but others cover the drilling machine, the shaper, the milling machine and the grinder. And there are other chapters on holding the workpiece, useful tools and fixtures - full drawings for a large number of items, gears and gear cutting, cutting speed and finish, accuracy and materials. The illustrations (all drawings) are very clear and the text is concise and to the point - Lorus J. Milne really knew his onions. 376 very heavily illustrated pages. Paperback.

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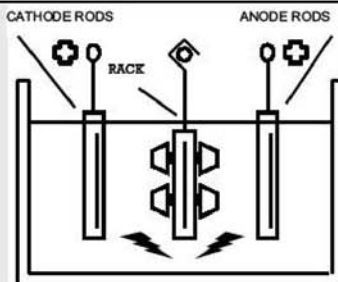
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5" 0-4-0 Marie E Tender Loco
5" 0-4-0 Railmotor 1 Tank Loco
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5" 0-4-0 Railmotor 3 Tank Loco
5" 0-4-0 Scamp Tank Loco
5" 0-4-0 Swiss Molly Tank Loco
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5" 0-4-2 Titfield Thunderbolt Loco
5" 0-4-2 Tom Rolt Tank Loco
5" 0-4-4 Fishbourne Tank Loco
5" 0-6-0 Achilles Tank Loco
5" 0-6-0 Aspinall Tender Loco
5" 0-6-0 Boxhill Tank Loco
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5" 0-6-0 Jinty Tank Loco
5" 0-6-0 Nechells Tank Loco
5" 0-6-0 Pansy Tank Loco
5" 0-6-0 Pom Pom Tender Loco
5" 0-6-0 Sallie Tank Loco
5" 0-6-0 Simplex Tank Loco
5" 0-6-0 Speedy Tank Loco
5" 0-6-2 Barnet Tank Loco
5" 0-8-0 Netta Tender Loco
5" 0-8-0 No. 136 Tender Loco
5" 2-4-0 Asia Tender Loco
5" 2-4-0 Metro Tank Loco
5" 2-4-2 Lanky Tank Loco
5" 2-6-0 BR Class 2 Tender Loco
5" 2-6-0 Horwich Crab Tender Loco
5" 2-6-0 Macailin Mor Tender Loco
5" 2-6-2 BR Class 84000 Tank Loco
5" 2-6-2 GW 51XX Tank Loco
5" 2-8-0 Nigel Gresley Tender Loco
5" 2-8-0 R.O.D. Tender Loco
5" 4-2-2 Princess of Wales Loco
5" 4-2-2 Sterling Single Loco
5" 4-4-0 Bulldog Tender Loco
5" 4-4-0 Dukedog Tender Loco
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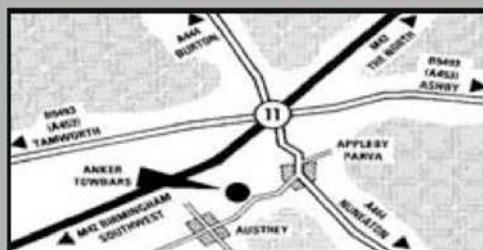
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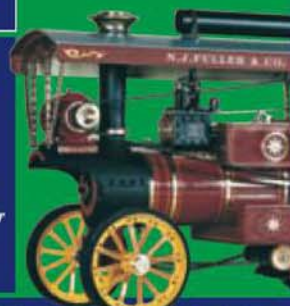
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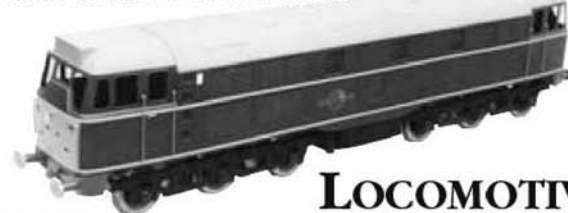
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SMOKE RINGS

With the Editors

Adjustable spanners

The letter written by Peter King in New Zealand (*Postbag*, M.E. 4175, 9 August 2002) about the origins of the term Monkey (or Moncky) wrench jogged Neil's memory about an incident which happened to him many years ago. He was in Germany preparing a machine tool for run off and was working alongside a German fitter. During the course of their work one of the fitter's colleagues strolled over and, in German of course, asked if he could borrow his English man. Neil's German is not particularly good but he managed to pick up the German words for 'borrow' and 'English man' (Engländer) and so politely enquired what he was to be borrowed for. At this both Germans dissolved into peals of laughter. When they had regained control of themselves it was explained that Germans call an adjustable spanner an Engländer but neither of them knew the reason. It was just something everyone did.

This intrigued Neil and so he got into the habit of always asking German engineers and fitters what the origin of the term was. At the back of his mind was the nagging thought that Germans tended to associate British engineering with adjustable spanners — an item of tooling that his engineering training had always steered him clear of. Indeed, former RAF servicemen have told him that the use of an adjustable spanner on an aircraft could result in them being on a charge. He had therefore always reserved these tools for dealing with non-standard or damaged nuts or undoing the large gland nuts as encountered in plumbing work.

Only many years later did the full story of the German connection come out. It seems that before Germany was fully industrialised, most of their machinery and steam engines were purchased from the UK. Each piece of equipment sent out was supplied with a tool kit for erection and maintenance purposes and in each tool kit was included an adjustable spanner — most likely of the Moncky wrench type. The Germans had never seen a tool like this before and did not have a name for it so it became known as 'the English tool' or Engländer for short.

Perhaps some of our German readers could comment on the accuracy of this story. If nothing else it does tend to demonstrate that our European neighbours have a sense of humour not unlike our own.

Tangmere

Following 20 years of meticulous restoration, Battle of Britain Class locomotive *Tangmere* returned to service on 1 March between Preston and Carlisle as part of an inaugural run from Bristol.

Owner Brian Pickett, Director of Wessex Trains, saw it being built as a boy, found it languishing in a scrapyard, has devoted these last 20 years restoring the locomotive to its former glory and 40 years on from its last journey in revenue earning service has just cause for personal celebration.

Much of the restoration work has been completed by Riley & Son (E) Ltd. at their Bury locomotive works in Lancashire. It is therefore fitting that Wessex Trains started the renewed life of the locomotive with a series of excursions in

the north of England before it set off for its new base at Old Oak Common.

Built in the Southern Railway's Brighton Works in 1947, Bulleid Pacific No. 34067 *Tangmere* will be used to re-launch the famous *Golden Arrow* service on 17 May along with two new Saturday services, the *Excalibur Express* and the *Royal Wessex*.

Further details and a timetable appear on page

447 in this issue; more information can also be obtained by visiting www.wessex-trains.com

Drummond Bros. Ltd.

We are sure that many readers will wish to visit an exhibition of photographs, literature, early machine tools and other curiosities associated with Drummond Brothers machine tool company of Rydes Hill, Guildford.

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CHUCK the MUDDLE ENGINEER

by B. TERRY ASPIN



POST BAG

Sulphuric acid

SIRS, - Further to D. A. G. Brown's pertinent letter (*Postbag*, M.E. 4183, 29 November 2002), there is a particular problem with sulphuric acid, even in the dilute condition. Unlike nitric and hydrochloric acids, pure sulphuric acid is a liquid, not a gas. Thus, as the water in the dilute acid evaporates, you are left with a viscous (and vicious!) concentrate, hence the 'holey' trouser syndrome.

All sulphuric acid spills should be neutralised, but even copious rinsing is likely to leave traces that will concentrate over time. Washing soda (sodium carbonate) is okay. Do not use caustic soda (sodium hydroxide). If you have an excess of it, the cure is as bad as the disease. For skin spills, copious rinsing to deal with immediate effects, then neutralising is the usual recommendation.

In spite of that, I do use the concentrated acid for making up pickles for removing brazing fluxes. Care (make that *great care*), goggles, surgical gloves, old clothes and a warehouse coat suffice. (I keep the surgical gloves for handling other noxious fluids, including old sump oil. They are cheap and effective.)

Like Mr. Brown, I find that citric acid is cheap and remarkably effective, as well as safe, for copper work. A tip (for skinflints like me) is to buy it from brewing suppliers, rather than chemists. The former will supply large quantities at very reasonable prices per kilo.

Bob Margolis, Hampshire.

Yorkshire Engine Co. 0-6-0ST locomotive

SIRS, - I am trying to discover further information about an old model locomotive. Information has recently come to light that an article on this model locomotive, named *Wendy*, may have been prepared and submitted circa 1937 by a Douglas Blackburn, accompanied by a drawing (copy alongside). I would be most grateful to hear from any reader(s) who recognise the engine and can locate the article for me.

David Atkinson, Cambridgeshire.

Equivalent oil specifications

SIRS, - With reference to the discussion about oils in *Postbag* (M.E. 4186, 10 January 2003) the following may be of help.

Esso Nuto H32, Castrol AWS32, Elf Hydelf 32 and Texaco Rando

HD32, are all equivalents. They are used widely in agricultural equipment, in hydraulically driven plant, and in machine tools. There are many more equivalents and they can be obtained in 5 or 25 litre drums.

Eddie Kingston, Kent.

Simple tools

SIRS, - For the possible benefit of newcomers to model engineering, I enclose a photograph (right) of four of my most frequently used tools. Clockwise from the top, the first is a modified 'Spam' can with a soldered-on handle for the purpose of scooping up swarf in the lathe tray.

Next is a rake made from half the lid of a dried milk container, a 15in. length of 1/4in. dia. rod and a length of rubber hose for the handle.

After many experiments with drip cans, etc. I settled on a 1/2in. paint brush for the purpose of applying cutting lubricant to work in both the lathe and milling machine. The container shown is ideal; folded up from tinned steel sheet, it is 5in. long x 1 1/4in. deep x 1 1/2in. wide and soldered to seal the corners. The shape shown is very suitable for placing at the end of the lathe bed or milling machine table.

Finally, the key for the clamping screws in my (proprietary) four-way tool post is shown on the left. This key is simply turned up from mild steel and drilled marginally larger than the across-flats dimension of a short length of hexagon wrench broken off a commercial Allen key after weakening by careful notching on the corner of an offhand grinding wheel.

Each of the items shown is easily made and makes the use of workshop equipment that much more of a pleasure.

Neil Heppenstall, Cheshire.

Mr. Heppenstall's simple tools for good 'workshop housekeeping'. (Photo: Emyr Williams)



Gnome rotary engine

SIRS, - In my previous letter, which appeared in M.E. 4174, 26 July 2002, I referred to my intention to build a 2:5 scale model of the Gnome rotary engine then being described in 1:5 scale by the late Roland Lowe. At the time it was suggested that it would be helpful if I kept a record of any drawing errors that I came across, which could then be published to assist future builders.

I have now reached a stage in the construction where most of the major components have been made, assembled and checked, and feel I can now release the list. Some of the points on the list are minor and of little consequence, some are not.

I have not indicated any solutions since this is not a 'how to do it article' just a 'be careful list' and I assume a builder of this model would wish to find his or her own solutions anyway. However, if any builders of this model care to learn how I resolved the problems, I would be pleased to assist via the editor.

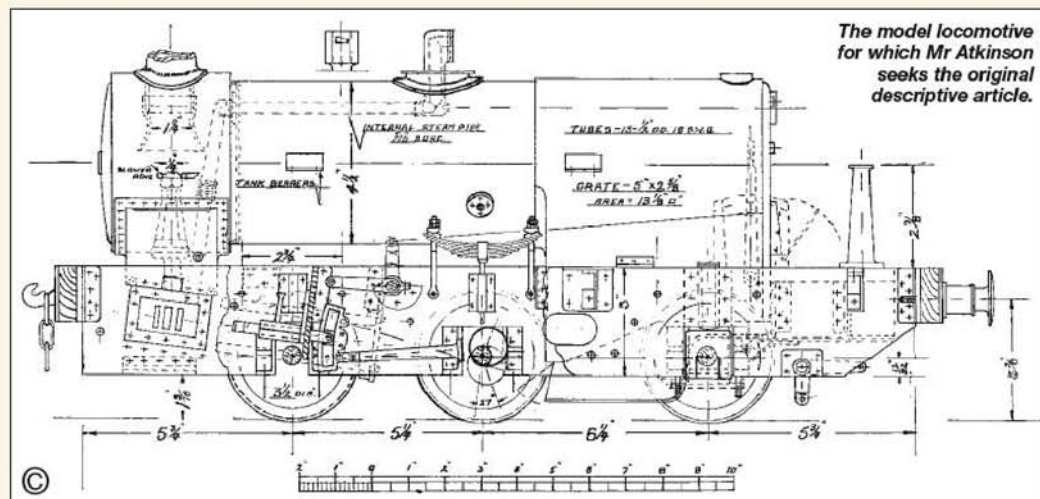
Drawing Errors

on Gnome Aero Engine:

- 1: The centre line of the crankpin is not in line with the cylinder centre line in the fore-to-aft direction.
- 2: The front crank bush (item 50) interferes with the propeller boss (item 53).
- 3: The tappet guide (item 38) will not assemble onto the front tappet rod housing (item 14). Due to

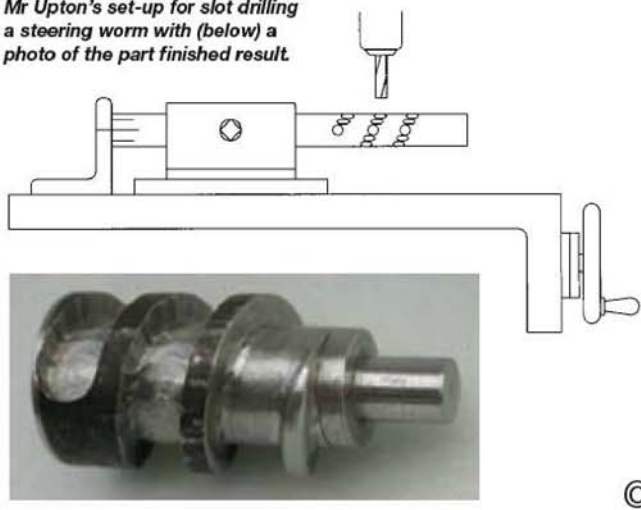
interference with the tappet rod housing, the guide nut (item 39) will not screw on to the tappet guide in the first tappet position. The centre lines of the cam followers are not in line with the centre of the cams.

- 4: The shape of the valve rocker is incorrect.
- 5: The rocker bracket (item 31) interferes with the valve guide locking ring (item 59).
- 6: The commutator brush holder (item 62) is too large and interferes with the crankshaft seal ring (item 7).
- 7: The connecting rod (item 8) interferes with the master rod (item 10).
- 8: The 0.062 wide x 0.200in. deep slot in the tappet guide (item 38) encroaches onto the 1/4in. x 40tpi thread.
- 9: There is no provision for lubrication of the front crankshaft bush (item 50).
- 10: The 1.40in. dia. on the front gear housing (item 47) should be reduced, with a similar propeller boss change (item 53), to make more room for the 6 bolts which hold it onto the front gear housing.
- 11: The taper on the piston crown is stated as 20deg. inclusive but should be 20deg. per side.
- 12: On the cylinder head the centre line dimension for the spark plug is missing.



The model locomotive for which Mr Atkinson seeks the original descriptive article.

Mr Upton's set-up for slot drilling a steering worm with (below) a photo of the part finished result.



13: When the engine is rotated, the connecting rods on some cylinder positions foul with the lower edge of their respective cylinder liners.
Jim Winrow, Yorkshire.

Steering worm

SIRS, - My interest was caught by your item in *Smoke Rings* (M.E. 4189, 21 February 2003) in which you drew our attention to Mr. van Ryn's problem concerning the production of the steering drum for his 2in. scale Aveling & Porter Class AM tandem roller.

One way to do it could be by roughing out the helix by what could be called chain drilling in a vertical milling machine, followed by filing to profile.

The design calls for a coarse helix of $9/16$ in. pitch cut on $1/8$ in. bar. It happens that the feed screws on my little milling machine are 16tpi., so nine turns of the handle advances the workpiece by one pitch. It follows that if the workpiece is held in the vice and rotated one ninth of a turn for each $1/16$ in. advance, a series of holes along the required helix can be drilled by the use of a slot drill — $3/8$ in. in this case.

The first step is to mark nine divisions at the far end of the bar, readily done in the lathe using a 45 tooth change wheel and traversing with a pointed tool. The work is then put in the milling vice with a back stop to the rear to maintain position and to give a datum mark against which to align the workpiece divisions. With the work centred under the slot drill, the first hole is drilled to depth. The work is then advanced one turn of the feed screw and rotated in the vice by one division, the next hole drilled and so on. I hope my sketch (above) helps.

On the sketch I have indicated a few holes drilled following the helix. In practice I have found it easier to drill the complete longitudinal row by advancing the full pitch each time before rotating the work in the vice to the next division.

The first set of drillings leaves quite a lot of material between the holes. This can be much reduced by repeating the whole procedure for the half and quarter spaces between the original nine divisions.

A trick which I find useful is to put a turn of white insulating tape around the bar end, marking across from the scribed lines with a ball point pen. It's very easy to read and to put in the half and quarter points.

I enclose my trial specimen (photo above — Ed.) to show the result. This is 1in. diameter because that was what I had to hand, but obviously the procedure would work for $1/8$ in. material.

David Upton, Surrey.

SIRS, - I had the same problem with the wormshaft as Mr. van Ryn. I overcame it by marking the pitch on the rod and then winding $1/8$ in. wide tape to represent the thread.

I set it up in a dividing head on my milling machine and, using the tape as a guide, cut the thread freehand by rotating the dividing head and winding the table along at the same time.

I wish Mr. van Ryn all the very best with his.

D. Hersey, Kent.

Sharpening small drills

SIRS, - Your continuing efforts to upgrade *Model Engineer* are noted and are much appreciated. Reading issues from the war years and shortly afterwards, it has struck me that the Editor today has a much more difficult task with respect to magazine content. In those far-off days, without their own specific titles, boats and workshop items were featured along with motor cycles and model planes, providing a much greater scope for the variety of articles presented.

In M.E. 4136 (29 December 2000) there was the first of a two-part series by John Wilding entitled *A Honing Jig for Small Drills*. I have been studying the design and suggest that

if the rollers were widened and bevelled to the correct angle, a more consistent and accurate back-off angle would be achieved. Would other readers, or Mr. Wilding himself, care to comment as I believe that this is the best design so far published?

I intend to construct the unit using an 'Eclipse' pin chuck but plan to make a new body for it so as to avoid the need to drill into it as Mr. Wilding suggests.

I await any response with interest.

**Peter Brown,
New South Wales, Australia.**

More about mils

SIRS, - In his letter concerning the 'mil' as a unit of angle (M.E. 4189, 21 February 2003) Mr. H. D. Turner is very nearly there. It is indeed derived from radian measure and is correctly $1/1000$ of a radian.

If we take a circle of radius 1000 units, the angle subtended by an arc of this circle one metre in length is one mil. The angle subtended by this arc is therefore $1/(1000 \times 2\pi)$ radians or $1/6283.18$ part of a circle.

The true derivation of the mil has been subverted by its military use since dividing something into or by 6283.18 is not easy at the best of times, let alone out in the field when someone is shooting at you.

The issue was further complicated by the fact that, at one stage, both 'infantry mils' and 'artillery mils' were in use at the same time. In a full circle, the infantry had 6280 mils and the artillery had 6400 mils respectively. The resulting confusion and probability of dropping shells on your own side eventually led to standardisation on 6400 mils to the circle with the added bonus that this was an easily divisible number.

**John Bloomfield,
Nottinghamshire.**

SIRS, - In his letter, Mr. H. D. Turner states, and I quote: "I have no idea why radians should be used; while they are very suited for use in mathematics they are not suited for practical purposes."

Such a bold statement should be qualified by something like 'unless you know better' because there is a very practical use of radians. They have a very ready application to the

making of Belpaire type fireboxes, especially in the larger gauges including $7\frac{1}{4}$ in. where the copper is thick, i.e. $3/16$ inch. Such material should only be bent once for ease of operation. Taking Martin Evans' boiler for *Highlander*, the outer firebox wrapper has two straight sides, a radius at each of the top corners and a curved top section. The top corner radius on each side should blend smoothly into the top section curve. This can only occur when the large radius of the top section curve passes through the centre of the small corner radius giving each curve a common tangent.

By the application of a little trigonometry and using radians, the length of each section of curvature can be calculated. Working from the vertical centre line of the boiler and taking the length of half the top section curve plus half the length of the corner radius the exact point of application of the corner radius bending bar can be found. Without the use of radian measure this would be very difficult to accomplish and would probably need some guesswork. The radian method is mathematically exact.

Marking a line from front to back of the outer wrapper at the point of application identifies the position where the copper must be bent for each corner radius. Using a hydraulic bending machine such as that shown in Alec Farmer's excellent book *Model Locomotive Boilermaking*, each radius can be bent quite easily giving an accurate bend at each corner which will then fit the throat plate and back plate easily with little need for adjustment.

Hugh Castellan, Staffordshire.

Power hacksaw

SIRS, - David Richmond's splendid small power hacksaw (M.E. 4191, 21 March 2003, p 302) seems to me to be a useful piece of workshop equipment to build.

I have been unable to locate the N. Mole of Watford mentioned as supplier of the necessary castings and would be pleased to hear from any fellow reader(s) who may be able to advise me concerning the castings I require.

Arthur Woodcock, Cheshire.

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Correspondence may also be sent to the Editor at PO Box 310, Hemel Hempstead, Hertfordshire, HP3 8AX; fax: 01442-269366; email: mike.chrisp@virgin.net or neil.read@nexusmedia.com or scalemodels@compuserve.com

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Eric Best's 1:12 scale LBSCR H1 4-4-2 locomotive, Beachy Head.



Eric Best's 1:12 scale LBSCR A1 0-6-0 locomotive, Brighton.

COMPETITION CLASSES

AT THE 72nd MODEL ENGINEER EXHIBITION

Class F: General Craftsmanship not Otherwise Classified

Neil Read, David Fenner
and Dennis Monk report

In its traditional red paint finish, Stephen Atkinson's 1:8 scale Ferrari 360 Modena made an eye catching exhibit. This model was largely built from wood, the main body being in utile (with a polystyrene roof) with details in sycamore, walnut, avodire, ebony, stainless steel and aluminium alloy. The windows were made from clear acrylic. Mr. Atkinson is clearly an accomplished wood carver and much care had been taken in shaping the body to match the curves of the prototype. It had then been carefully filled and painted. Details including the seats, wheels and engine had also been carefully reproduced in various woods and left unpainted so that the colour and texture of the different materials could be seen.

For this reason it was considered unfair to judge this model as a non-working model car (Class K1) and it was transferred to Class F2 (General Craftsmanship) where it could be judged as a piece of craftsmanship in its own right rather than a representation of an actual vehicle. Even so some marks were deducted because no attempt had been made to reproduce the sealing elements that would be apparent between the windows and the bodywork and



Stephen Atkinson's 1:8 scale
Ferrari 360 Modena.

some of the brake details which would be visible through the spokes of the alloy wheels were absent. The model was awarded a Bronze Medal.

The judges were quite bemused with two locomotive models, originally entered in Class B, when it was found that they were not the live steam models they appeared to be, but were constructed from cardboard, wood and plastic with MDF wheels. As a result and in consultation with the Chief Judge, it was decided to transfer them into Class F.

The first of these two models entered by Eric Best was a 1:12 scale model of LBSCR H1 Class 4-4-2, S.R. No. 2424, *Beachy Head*. Made from drawings supplied by the National Railway Museum, York it was modelled in the condition the

original locomotive was running between 1935 and 1938. It was extremely well detailed both externally and inside the smokebox. The plastic coupling and connecting rods were fluted at front and back, with strap and cotttered big end brasses. A prototypical backhead was also depicted. Well painted and lined in Southern Railway livery, it was awarded a Bronze Medal.

The second of these two models entered by Eric Best was a 1:12 scale LBSCR Class A1 0-6-0 Terrier tank engine No. 40 *Brighton*. The model was depicted as the engine was running in 1878, and the method of construction was similar to that used for *Beachy Head*. This engine was also very well detailed, including the smokebox interior and carried route indicator boards. Well painted and lined in Stroudley's deep yellow and green livery, introduced in 1872, this model was also awarded a Bronze Medal.

Class G: Carriages and Other Sprung Vehicles

Barré Funnell reports

Five models were submitted for competition this year, which was a better showing than last year. The standard of the models was high. The Judges for the Model Engineer Exhibition are not



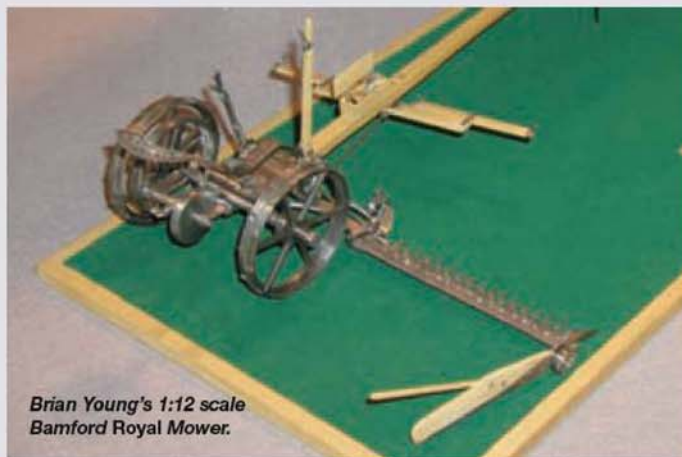
Roger Morgan's
1:8 scale Bull Wagon.



Ralph Kitching's
1:12 scale Garden Seat Omnibus.



*Timothy Smith's 1:8 scale
Waring & Gillow
Furniture Van
with furniture.*



*Brian Young's 1:12 scale
Bamford Royal Mower.*

looking for a 'winner' as such, but mark to a standard. In other words, to score full marks (in this case 600) the model must be absolutely perfect, in fact the best in the world! I do not believe I saw that this time. However, there were some interesting and worthy models on show.

Roger Morgan had found a Bristol Wagon Works, 1900s Bull Wagon to measure, photograph and reproduce in 1:8 scale. A fascinating vehicle it is too. First it was equipped with four-wheel steering achieved by a clever inter-linking of two swivelling axles and secondly, it was a 'walk-on, walk-off' vehicle. Horses can usually be loaded into a horsebox and persuaded to back out again, but one is highly unlikely to be able to coax a grumpy bull to emulate his equine counterpart! This bull wagon therefore had a loading (or unloading) ramp at both ends; in fact it appears that the shafts and the roof-mounted driver's seat could be mounted either end, so that the vehicle can go either way. Roger Morgan's model of this most interesting vehicle achieved Bronze Medal status.

Ralph Kitching brought along a 1:12 scale Garden Seat Omnibus built to a plan by the late John Thompson; this earned him a Bronze Medal.

Timothy Smith had built a Waring & Gillow Furniture Van to 1:8 scale which was accompanied by some furniture. His hand-painted sign writing was particularly noteworthy, although the lining was a little erratic in places. Nevertheless, it still managed to attain a Silver Medal.

Brian Young submitted two models of agricultural machines in steel and ramin, the Bamford Royal Mower, and a horse-drawn Tedding Machine which were awarded a Silver and Gold Medal respectively. For those interested, the full size Nicholson's Hay Tedder machine can be found at the Westfield Country Bygones Collection in Wiltshire.

One of the reasons why none of these models could be adjudged the best in the world was that not all the wheels were round and true! Models are very often secured to their baseboards, so the judge cannot give them an experimental spin; this year all but one were not fixed down, so spin them I did.

Another comment, which I know would have been endorsed by the late and dear old John Thompson, is that components which were originally of cast iron should look like cast iron and not appear to be made of bent wire and formed

sheet metal. Generally speaking, items originally made of wrought iron fared somewhat better. These can be made from round wire or square bar but should be made to look as if hand wrought.

And last, paint finish! If the wood grain can be seen through the paint, then it is not right. A severe but fair test is to take a good look at the finish in a light which shows reflections. That way any unevenness can be spotted quite easily. Come on fellows, take a look at the finish some of the locomotive modellers achieve; now, that's the way to do it!



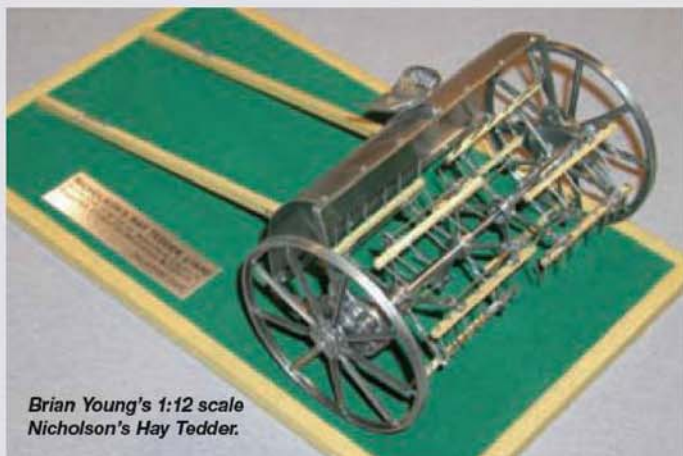
*James Finch's
Wimshurst Machine.*

Class J: Any Type of Work Made by an Under 18 Year Old Mike Chrisp reports:

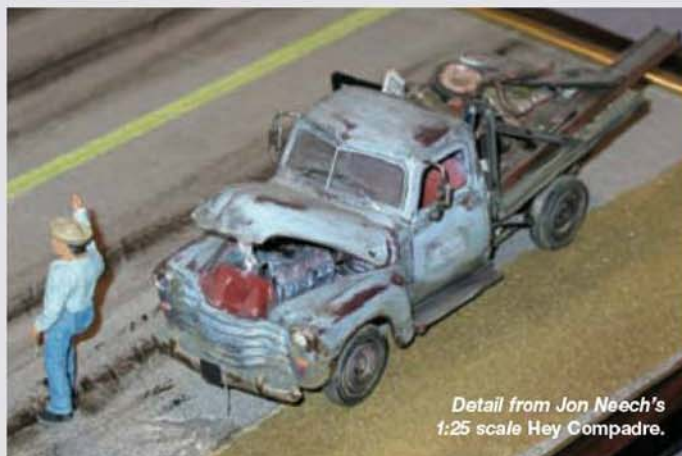
In years gone by, Judges and visitors to the Model Engineer Exhibition have been able to enjoy and admire a good display of work presented by young modellers. The world moves on and perceptions change; matters which were once of interest to young people may have been displaced by others with perhaps a more immediate appeal, and we are very aware that there now seem to be fewer opportunities to engender, encourage and nurture interest in traditional craft skills and craftsmanship in the young than ever before.

There was but a single entry in the Junior competition classes at this year's exhibition — but what an entry it was! I first saw James Finch's Wimshurst Machine in competition at the recent Guildford MES Rally and Exhibition, and it was a matter of great pleasure to have another and more leisurely opportunity to study this young man's workmanship. Now 18, James built his static electricity generator as a GCE A-Level Design and Technology project when he was 17.

The details of James' design came about from research of articles describing James Wimshurst's



*Brian Young's 1:12 scale
Nicholson's Hay Tedder.*



*Detail from Jon Neech's
1:25 scale Hey Compadre.*



Detail from Jon Neech's
1:25 scale Monte Carlo or Bust.



Jon Neech's mixed scale
Mad Max 2 - The Road Warrior.

original machine, developed in the 1880s, and information about contemporary machines which he obtained from the Internet; truly a blend of the old and the new. The base, support frames and pulleys are made of hardwood, the sectors on the acrylic discs were hand cut from 0.4mm aluminium alloy lithographic printing plate and glued in place. Clear acrylic tubing was used for the Leyden accumulators and acrylic rod for the charge collector supports.

The Wimshurst machine generates static electricity by contra-rotation of two large discs. The charge collects on sectors on the discs and is transferred to the Leyden jars where it is stored until sufficient has accumulated to ionise the air between the two large brass discharge balls and jump the gap. James' machine is apparently capable of developing about 45,000 volts!

The Judges were very impressed by the quality of workmanship displayed in both the construction and finish of this entry and were particularly pleased that the marks accrued led to the award of a well-deserved Gold Medal.

Class K1: Non Working Cars

David Fenner and Neil Read report:

Mr. Jon Neech entered two dioramas in this class. Both were great fun and packed with detail. The first, entitled *Hey Compadre* depicted a broken down Chevrolet truck with the driver flagging down a fellow driver in a Ford truck. This was constructed mainly around commercially available items and had been very well painted. It was a little let down by the rather poor road scene used to depict the trucks and figures. No award was made for this entry.

The second entry by Mr. Neech was entitled *Monte Carlo or Bust* and depicted two vehicles in a winter landscape all housed in a discarded television cabinet. The two vehicles portrayed a Lea

Francis half-track and a Triple X sports car, the latter overhanging a precipice. The vehicles were partly scratch-built and the whole scene was very well presented. The tree and snow were particularly well done and looked very authentic. This entry was awarded a Highly Commended Certificate.

Mr. Alan Mallinson's model of the Bentley 'Speed Six' Le Mans racing car that won the famous 24-hour race in 1929 and 1930 was scratch built in 1:15 scale. This vehicle differed significantly from the production versions of this car and much research was necessary before a start could be made on construction of the model. The detail incorporated into this model was extraordinary and appeared to adhere very closely to the prototype. The tonneau cover over the rear part of the cockpit was particularly well done and, although made from 0.005in. thick lead sheet, looked very much like the original fabric. The cockpit boasted a full set of instruments and features including the rear view mirror and aero screen were all present. Pit signals painted on the inside of the passenger's door indicated the intended purpose of the prototype. This model was awarded a Gold Medal.

We plan to publish more details of this excellent model in a future issue.

Class K2: Non Working Trucks

Mike Chrisp reports:

There were two entries in this class. The first was 1:8 scale Panther tank by Peter Mealing, who provided very comprehensive notes describing the construction of his model. Having served for 25 years as an officer in the Regular Army and having driven all sorts of armoured vehicles from Chieftain tanks to the Russian T34, Peter is fascinated by armour! This report is not the vehicle for a detailed account of the 22 months work required to produce the finished superb

model from the imported kit originally purchased. It is evident that a great deal of research, much patience and considerable skill had been necessary to convert an inferior kit into the very fine model presented for competition and which was awarded a very well deserved Silver Medal.

The second, by Jon Neech was entitled *Mad Max 2 - The Road Warrior*, a mixed scale diorama presented in a box designed for eye-level viewing to give the impression that the scene depicted recedes some quarter of a mile into the distance. Like his entry in Class K1, the diorama was imaginative and full of detail.

Built using basic commercial models modified and augmented to suit the scene, the final result was produced using resin, plastic, wood, card, brass, anything in fact appropriate to the application and which gave the desired effect. The 'bent' panels on the crashed Chevelle were formed with alloy foil over the original panels, the door being fitted with an inner frame made from a paper clip. The sand buggy and scattered cargo boxes were built from scratch.

The model was Highly Commended.

Class K7:

Functional Model Cars/Vehicles

David Fenner and Neil Read report

Only one entry was received in this class but there can be no doubt that the Russian T34-85 Tank built by Peter Mealing was memorable both for its finish and attention to detail. The starting point for this model was a commercial Volgograd Russia glass reinforced plastic kit obtained from the Russian Republic. However, Mr. Mealing was dissatisfied by the poor quality of some of the moulding and the lack of detail prominent on the prototype. He therefore carried out a research programme at several museums and measured actual examples of this formidable weapon that



Alan Mallinson's
1:15 scale Bentley
'Speed Six' Le Mans racing car.



Peter Mealing's 1:8 scale
PzKpfw IV Panther Ausf A tank.



Peter Mealing's 1:8 scale Russian T34-85 tank.



Michael Matthews' 1:6 scale N.A. P-51 Mustang.

have reached the west. Armed with this data he set out to re-model the components in the kit and added features where appropriate.

One of the most challenging items to model was the very crude welding which held together the various parts. Apparently it was difficult to produce something that accurately reflected just how bad the original welding was! Items like the tracks also received attention being stripped down, cleaned up and re-pinned using bicycle spokes as pivot pins.

The model is fully functioning and is radio controlled using two receivers. One receiver is mounted in the hull and controls the drive, turret turning, lights, horn, the machine gun, working smoke canisters, camera and taped music. The other receiver is in the turret and controls gun elevation, main gun firing and machine gun firing. Both receivers have their own power supply. The turret is constructed to rotate at the rate of the prototype and is fitted with a main gun built around a starting pistol. This is apparently very effective at scaring off unwanted visitors — whether human or of the animal variety.

The paint finish and colour were also carefully researched and applied. The aim was to get a finish representative of a tank, which though not quite factory fresh, was fully prepared for, and about to take part in, a battle. The figure in the turret was moulded from a professionally made sculpture commissioned for the purpose.

The award to be made to Mr. Mealing for this model was the subject of much debate among the judges, the discussion going on well into the evening of Judging Day. The amount of research and the care taken in the finishing of this model made it almost 'museum quality' and earned high marks. However, it was based around a commercially available GRP kit and used many bought-in components. This naturally earned the

builder fewer marks than a scratch built model made from materials similar to those used for the prototype. Eventual agreement was reached, the marks added up, and it was decided to award this fine exhibit a Bronze Medal.

Class L: Scale Model Aircraft Ron Moulton reports

After the slim participation last year, it was a relief for the Judges to find nine R/C scale models entered in the 2002 Model Engineer Exhibition at the now palatial conference centre within the Sandown Park racecourse. Ranging in size from a 1:9 scale PBY Catalina to a pair of heavyweight 1:4 scale Fokker Triplanes which had their own impressively independent display, this was a great improvement, and will we hope bring back the aircraft section to the standards seen in years before.

No Gold Medals this time, but Michael Matthews' deceptively perfect N.A. P-51 Mustang was awarded the sole Silver Medal. Made to commercial plans by the respected scale aircraft specialist Brian Taylor for a completely enclosed MDS148 24cc two-stroke using scale exhaust stacks, it had a well detailed, specially made scale undercarriage and realistic surface finish with all the tiny markings to a scale of just under 1:6.

A pair of Bronze medallists offered complete contrast, though each was a Fokker. John Stevens had modified the American kit by Proctor for the Fokker Eindekker E-III with extra detail for a Laser 200 four-stroke. Using a more powerful servo than usual, it has warp control on the wings and is yet to be tested. Weighing 20lb., this Fokker was finished in Antique Solartex for a natural linen effect and could not be more distinguished from the other Bronze award model of a funeral all black Dr.1 Triplane in the colours of Josef Jacob.

Members of the Large Model Association will know this one well, also its twin in streaky camouflage green, each in the 30lb. range and powered by the big OS BGX motor from Japan. Irrepressible Dave Horton who designed, made and has regularly displayed both these models at the air shows is now, we understand, making his own full-scale Fokker Triplane, taking flying lessons too! Watch out for Dave as the Black Baron when it all comes together. Dave is an accomplished showman, as his unique display confirmed at Sandown Park.

Dave's second Fokker Dr.1 was Very Highly Commended, so too was Ian Redman for his quarter scale Sopwith Pup, most modified from a DB Models kit for a sport flyer and using an OS 120. At a 'mere' 13lb. for its large wing area, it should go as well as it looks. The dummy rotary is made to spin on the shaft housing, and the wing sections are revised to true scale.

Also Very Highly Commended was Alan Lincoln's PBY Catalina which is destined for a couple of Aveox brushless electric motors when the cash comes in. Alan is a pensioner in his 70s, is there anyone out there able to help? The Cat is obviously his favourite aircraft, as the wealth of detail in Alan's documentation proved. Overcoming the mechanics of that tricycle landing gear to 1:9 scale and adding thousands of glue-drop rivets would have taxed many younger and perhaps less adroit aeromodellers.

Commended awards were made to two other entries, an obviously well flown Henschel Hs-126 was neatly crewed with the observer hanging out of the open rear cockpit, and a well worn BE2c which had been resuscitated from storage after its original creation in 1979 were both the work of Colin Agate who clearly favours the 'used' look in models.

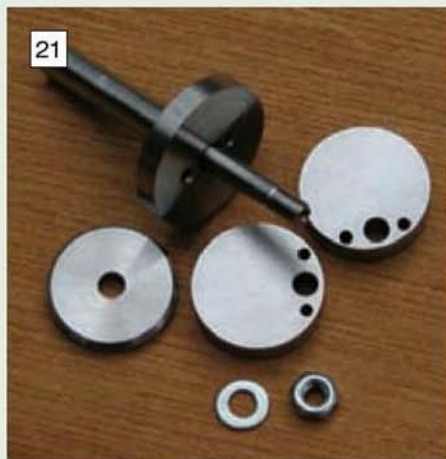
●To be continued.



John Stevens' 1:4 scale Fokker Eindekker E-111.



Dave Horton's 1:4 scale Fokker Dr.1 Triplane.



Components of the straight line crankshaft devised for the V-twin engine.



Assembled straight line crankshaft shown with its two piston assemblies.



Completed V-four engine shown standing in front of a mirror.

OSCILLATING ENGINES SOME REFLECTIONS

Colin Pape

completes the description of his penultimate engine and introduces his 'well-behaved' ultimate design.

●Part IV continued from page 313
(M.E.4191, 21 March 2003)

The previous instalment of this series closed with a discussion of the internal plumbing and the double ports and mirrors of dream engine No. 1, which I chose to call the Penultimate engine. We continue now with the straight line crankshaft and the reversing valve and throttle.

3: Straight line crankshaft

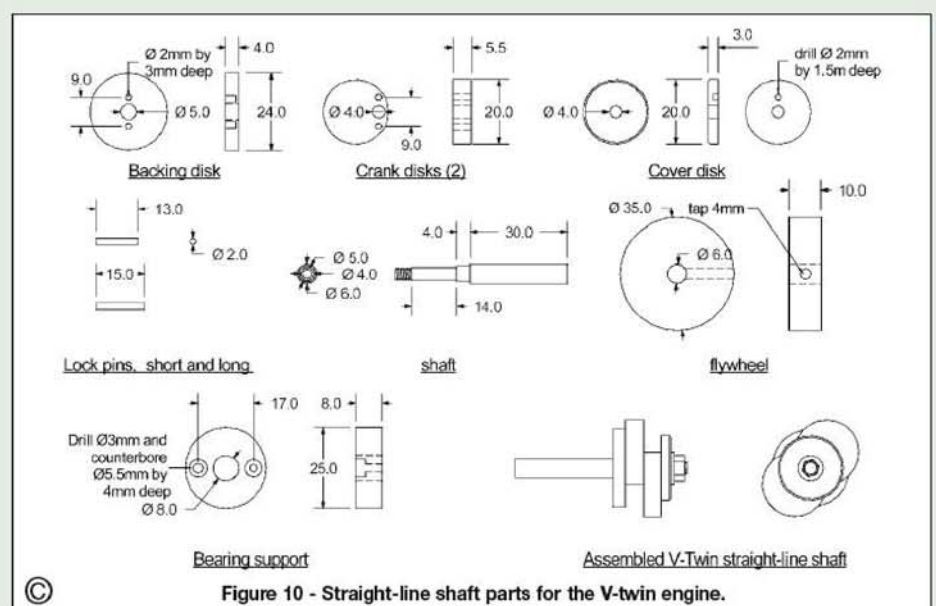
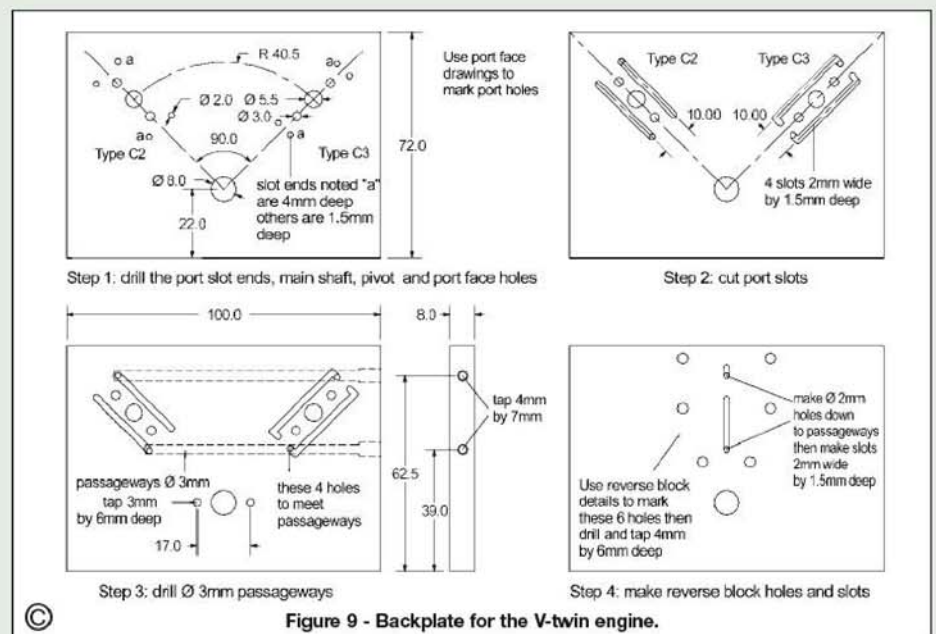
One main shaft bearing is used. A flywheel is mounted behind the backplate. Power take-off can be from either end of the shaft. One cylinder has to be mounted further away from the backplate than the other because the two big ends need two discs.

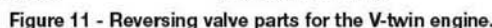
A conventional crankshaft cannot be used in this design because there is only one bearing and it would mean that one cylinder had to be even further away from the backplate due to the crankshaft web. Photograph 21 shows the V-twin straight-line shaft in pieces and photo 22 shows it assembled.

4: Reversing valve and throttle

This engine uses the same basic reverse valve/throttle which I have used since the re-work of the first test engine. The valve body shape and fixing hole positions have changed from time to time but the main dimensions and layout of the ports have remained constant. I think that better designs exist. My design is gas tight but is fairly stiff and its throttle application is somewhat basic. It is not really suitable for a radio control application where a design requiring less operating power would be better.

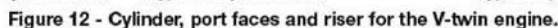
If required, the unit could be installed on the edge of the backplate and connected directly to the ends of the two passageways. I have left the two drilled passageways unplugged. In my implementation they are closed off with 4mm socket head screws which could be removed to





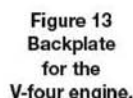
Specific items for the V-twin are limited to the base plate, the mainshaft, the second variety of double port design and a riser block for the second cylinder. The main dimensions of this engine are the same as for T4. The drawings for the key parts of this engine are shown here in **figs 9, 10, 11 and 12.**

Construction was quite simple and less complicated than the V-twin. The result is shown in **photo 23**. Like the V-twin, this is not a model engine since it is not a model of any engine of which I am aware. One of the things I like most about steam-type engines is their speed range and ability to just tick over quietly. This engine and the V-twin are a delight to watch, especially at low speeds. Some new pieces were required.



This idea did not work: there were always leaks between the components. In the end, I cut the common pivots in two and joined the pieces together with an internal screw. The two pivot pieces could then be screwed up tightly together, a technique which applied pressure to the port faces. The springs only provide the pressure to keep the cylinder against the port face.

Because the angular movement is small, it was not possible to have completely overlapping port holes, so the radial slots were required to increase



MODEL ENGINEER 18 APRIL 2003

SELF STEERING WHEEL SETS and SWING LINK SUSPENSION

David Hudson

discusses adhesion and derailling as an introduction to his design for a wheelset suspension system, and then reviews brakes and a vacuum braking system.

●Part III continued from page 307
(M.E. 4191, 21 March 2003)

Allow me to recap on what I have said previously. If wheel bounce or slip occurs for whatever reason, the wheel is not in control. It follows that if good traction and braking are required, then the wheel must remain in contact with the rail at all times. At first sight this would appear to be difficult to obtain. On the other hand we all know that the suspension systems employed on modern cars can be superb. So we ought to be able to do something about it.

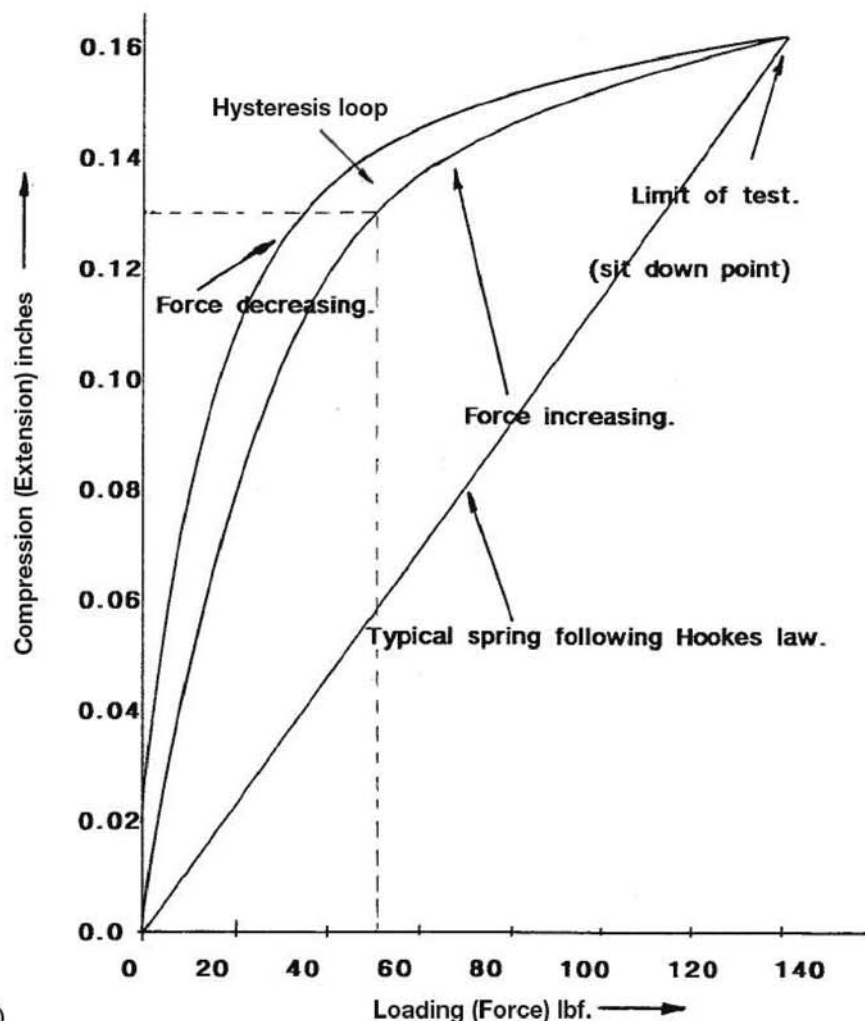
I have been able to obtain substantial improvements in adhesion on some of our scale locomotives by using softer springs and balanced wheel loadings so that rail sags and lumps do not change the loadings by very much. Other improvements can also be made, including axial 'slop' in the leading and trailing wheelset axleboxes. This enables all wheels to roll on their correct diameters when curving. It is not quite as simple as that, because a degree of yaw relaxation is also required. I have found that improved adhesion results from allowing a small clearance between the axlebox and the horns, say 0.01in. in the leading and trailing wheelsets (but not in the wheelset controlling the valve events).

This axlebox clearance does not appear to result in axlebox hammer; the moving masses and their velocities in our models are so low. Also, there are kinematic constraints operating. Contact between wheels and rail is one, coupling of wheels by the coupling rods is another and of course, the constraint of axleboxes in their horns is the third. Any increase or decrease in dimensional spacing of any one of these will cause increased stresses (fighting) to occur, and one of these constraints will have to yield. It is usually the contact between wheel and rail that yields first and, as wheel-treads and rail-heads bed-in (conform to one another), it is the coupling rod bushes that suffer next. The axlebox bearings and slides rarely give way because the surfaces are large and the stresses (not the forces) are lowest.

It seems to me that the kinematic constraint imposed by tight axlebox to horn clearances, where the stresses are lowest, might be the best one to relax. This would be achieved by increased clearance, and would prevent undue stresses arising at the other two points of constraint.

Some of you may not agree with this proposal, but think about it this way. When a locomotive is new and has close tolerances, adhesion is generally a problem and axlebox jamming sometimes occurs. As soon as adequate 'slop' occurs, the adhesion improves.

Figure 6 Actual test curve of Load/Extension for swing link suspension unit rubber (using natural rubber to E.D.S. spec. (60 I.R.H.D.))



It is much better to keep the relaxation (clearance) at a point where the stresses are lowest and there is an appreciable mass acting as a buffer to the cyclic acceleration force between the piston and the rail head.

Causes of derailling

Let us now examine some of the causes of wheel derailment in our driving and passenger cars. It seems possible that the intense lateral impacts caused by lurching may last longer than the time required for the wheel to climb the rail. This is partly due to the very small diameter and high rotational speeds of the wheels in common use. Also, there is often inadequate suspension and poor wheel profiles.

There is another factor that should be taken into account. The human body possesses mass. Due to the body's flexible nature, energy can be absorbed due to, say lurching, whereupon the body

will be given delayed momentum. This delayed momentum may extend the time the lateral forces exerted by the wheel flanges against the rail, exist. This is especially true if the mass of the passenger is large when compared with the mass of the passenger car.

Another cause of derailment is the likelihood of completely unloading a wheel due to the momentary shift of the centre of gravity outside the rail. This momentary unloading follows a combination of the lateral and vertical forces causing the passenger car and passengers to tilt. The natural passenger reaction tends to exacerbate this. The natural reaction forces applied by the passengers in trying to stabilise themselves may cause the cars to tilt excessively. This is especially so if passenger cars are light in weight, and it may result in a wheel dropping off the rail.

There is another cause of derailling, and that is due to passengers leaning out in order to observe

As long as the forces being transmitted to the passengers are fairly small, they should not feel too uncomfortable. However large track excursions, especially at speed, can cause passengers to produce strong reaction forces in order to regain a stable attitude. So how can we keep these forces within acceptable limits?

Wheel unloading should never be allowed to occur. Some miniature railway tracks are equipped with guard rails to prevent wheels completely unloading. However, this does not always happen if the axlebox travel or the spring extension rate is insufficient.

The job of the suspension system is to support the load and buffer the wheelsets from the inertial effects of this load. It is also necessary to keep the wheel-treads in contact with the rail-head at all times, so wheel bounce also has to be controlled. Some form of damping is therefore required, otherwise the wheelsets are not in control. It is well known that suspension systems should provide adequate travel without bottoming. They should be soft enough to absorb small shock loads and to provide for passenger comfort, and yet stiff enough to prevent bottoming. The same requirements are also necessary to accommodate lateral impact forces that manifest themselves as lurching.

Today, public passenger carrying appears to be the norm, a far cry from early days. The question of safety standards relating to passenger-carrying vehicles has come to the fore. I believe that attention should be paid to passenger car performance and the need to establish reasonable standards that can be upheld for the benefit of us all without undue restrictions.

My specification for a suspension system therefore, was to have a non-linear characteristic and the ability to absorb large lateral forces. It also had to be simple, robust, and maintenance free. Rather a tall order, but I had to try.

In the 1960s, rubber was being promoted as a good medium for car suspension systems, so there appeared to be possibilities here. A great many sketches of possible swing-link configurations were made and scrapped as being too cumbersome. It was only when I looked at the suspension of an Austin Mini, and I discovered that the rubber was doughnut shaped, with a hole in the middle, that the penny dropped. It ought to be possible to have a rod-type of link. So, some time and lots of scrap paper later, a design evolved that appeared to have possibilities. The

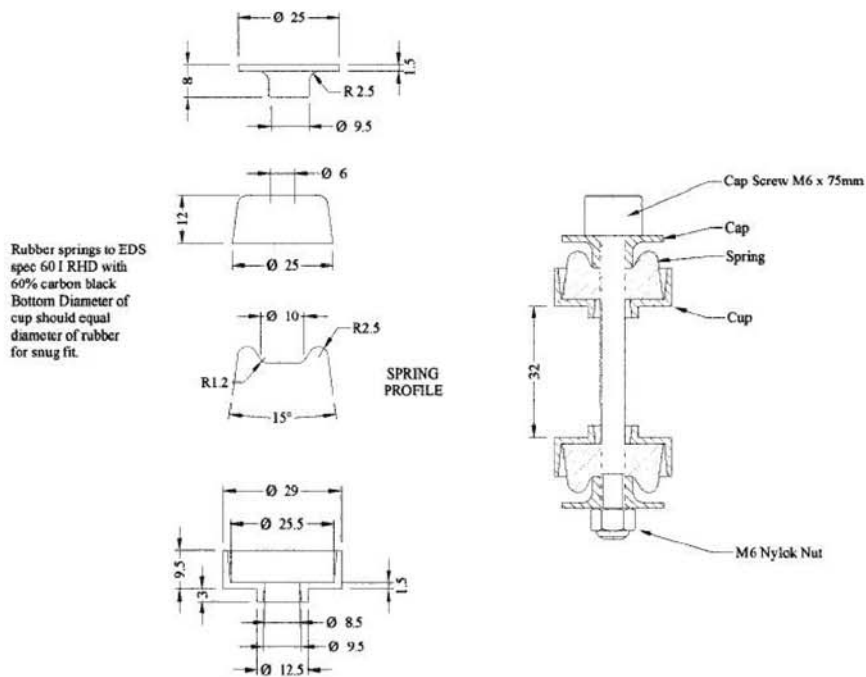


Figure 7 Swing link rubber suspension unit for 5in. gauge driving and passenger cars.

I spoke to rubber technologists at both Goodyear and the Malaysian Rubber Producers Association, and they advised me to use a natural rubber having an IRHD hardness of 60% and containing 60% carbon black. I learned that rubber did not like ultra-violet light, oxygen, or oils and greases. So, keep it away from these, and everything should be okay.

Every sample made had to be tested, and the load/extension curve plotted. I used my drill press with the bathroom scales, and a dial-type indicator. I logged all of the results in small increments. This was the easy part. After many samples, it looked as if I was wasting my time, because I could not get the right exponential curve. It was only when I placed the rubber dome in a restraining cup that I began to get any meaningful results. The shape or slope of the cup walls also plays a significant part in determining the correct load/extension curve.

Reference to the actual test results indicates that as the load is being removed, the curve does not follow the same path as that when the load is being applied. In fact, it does not immediately return to zero. This is because some of the energy absorbed during loading is converted to heat, and raises the temperature of the rubber. The rubber will not return to its original shape until this heat has been dissipated. The faster the rubber is distorted (loaded), the greater the energy absorbed, and the slower its return to its original shape. This energy loss is often referred to as 'hysteresis loss', and is one of the reasons why rubber is used in suspension systems. It means that rubber possesses an in-built damping capability.

I made a further visit to the rubber emporium, and came away with a bag of possible rubber shapes. Many more tests later, and *Hey Presto!* a rather nice-looking swing-link appeared. Over the years this has not been found wanting and I feel that it could become a standard unit. Many drivers who have built their driving cars to my design have used it.

I now had some wheelsets with the new wheel tyre profile and some swing-link suspension units. A simple sub-frame was constructed to support the wheelset bearings and upper suspension cups. The bottom suspension cups were anchored to the chassis which was designed to represent (in the broadest sense) a well-wagon. Thus, the embryo of a new generation of driving cars was born.

I just had to try it out at this stage, in secret of course, but it did not work! Horrible squealing noises emanated from the region of the wheel-treads. Closer examination revealed that the treads were trying to climb to a larger diameter when curving, and then slipping back to a smaller diameter. Longer swing-links were tried, so as to ease the yaw relaxation; this improved matters somewhat, but it was not the answer. I next tried it out on a different track when it worked perfectly, as it was supposed to do. The difference was that the radius of curvature of the first track was 26ft. whereas the radius of the second track was 50 feet.

Obviously there was a minimum radius below which self-steering would not take place. Later I discovered that this phenomenon existed in full size. I looked at ways to overcome this, and considered using forced steering (similar to BR's experimental bogies). However, on a four-wheel, long-wheelbase wagon, this would entail the use of a pilot wheelset ahead of the main wheelset, so the idea was dropped. It later became clear that, for a particular suspension geometry, this minimum radius is roughly proportional to the length of the fixed wheelbase.

Many trials were carried out using this unfinished driving car chassis. It was towed



A view of the braking system as installed by the Author in his own driving car. Commercially available components are reliable and easy to replace.



Brake control and pressure gauges. Brakes are applied slowly and surely with the lever set to 'ON' but an 'EMERGENCY' application is also available.

behind trains when its passenger was able to observe the behaviour of the leading wheelset. It was, to say the least, uncanny to see how the floating wheelset quickly accommodated all the various rail excursions and other variations, and appeared to be self-stabilising. The self-steering could be observed, and the flanges appeared never to touch the rail sides. Lurching was non-existent and the ride was extremely comfortable and quiet.

Development of brakes

The development of a suitable braking system also took up a lot of time. I had experienced some nasty shocks when using some so-called braking systems on both driving and passenger cars. Yet some societies possessed some superb passenger cars, having disc brakes which did not appear to suffer from contamination of the braking surfaces.

Disc brakes are not new, and I have spent some time looking into the dynamics involved, in order to establish where and how they should be fitted. One of the requirements was that the wheelset should be allowed to self-steer, even when braking. Therefore no external reaction anchorages could be entertained. The wheelset had to be contained within a sub-frame on which the brake would be mounted. A number of experiments were carried out to observe the behaviour of wheelsets when braking. It was observed that if one wheel picked up (slipped), the tangential stresses between the remaining wheel and rail were immediately doubled and immediate pick up on this wheel occurred. The time interval was so small that it did not appear to alter the attitude of the wheelset, i.e. it appeared to be stable. It seemed that the limited yaw-relaxation allowed by the loaded swing-links had a lot to do with this. Thus, I found no need to fit traction rods to act as stabilisers.

A means of operating the brakes without interfering with the self-steering was essential, and Bowden cable loops offered a ready solution.

Because the brake calipers are mounted on the sub-frame, all the reaction forces due to braking are contained, and the wheelset behaves as if it is equipped with leading link suspension. The development of suitable brake shoes and calipers has occupied a lot of time and many versions have been produced. Each successive one was more simple and easier to produce.

The first brake blocks were cut from Ford Escort brake pads and Araldited into steel cups, but they required too large an application force, which was not available. Now, I have seen some driving and passenger cars equipped with hydraulic actuators

which seem to be quite satisfactory, so it would appear to be a case of horses for courses. I later discovered that bicycle brake blocks are much superior, and their action at our slower disc speeds is much kinder. They are smooth and progressive, with little tendency to grab, even when the rails are wet and greasy. So for many years they have been used as a standard item.

Now, I have listened to criticisms about the wheelset assembly being too complex and not simple enough for a driving car. This is something I do not understand. Locomotive builders will go to extraordinary lengths with their creation, and yet they (at least some of you) will put up with something resembling a frame with four wheels, connected to their pride and joy by a piece of nondescript chain. This is just not good enough, especially when hauling passengers. Moves are afoot to remedy this. Mind you, there are also some very fine driving cars (as opposed to trolleys).

With the advent of the Health and Safety legislation, it has become the responsibility of each individual driver to see that his driving car will at least conform to a minimum standard of safety, though this has yet to be determined. One of the most common problems facing societies with miniature railways is the stopping of trains. Ideally, every carriage should be braked, and the brake should be capable of being applied by the driver and the guard, but I will address this issue later on.

Returning to the criticism of being too complex, I have looked at ways of simplifying the construction. There is now no silver-soldering or welding required; even the sub-frames and brake assemblies are bolted up using steel strip and angle. Just the odd bit of riveting is all that is required. The suspension cups and caps can be turned from solid so they should present no problems. During the development period I required so many of these that I had a batch of 500 cups made professionally at a very reasonable price. I see no reason why some model supplier should not have a batch made for resale if demand warrants. He could supply the cups, caps, links and rubbers having the right specification. These would ensure that the swing-link units have the right characteristics.

These swing-link suspension units really are maintenance free. I still have the original ones, including the rubbers, in my first driving car. This was constructed some twenty years ago, and has travelled many hundreds of miles. The wheels show very little wear on the treads, and no wear on the flanges. The wear really is almost non-existent.

Because of the nature of cast-iron, the rolling action displaces some metal to a different place and gives the impression of wear; i.e. it becomes a worn-wheel profile. Do not forget that I am talking about cast-iron wheels on aluminium alloy rails. I shall have something more to say regarding steel rails later on.

Vacuum brake gear

Having regard to the increasing necessity for adequate braking on our trains, and the apparent difficulty of maintaining a braking system in good condition, I have resorted to using a commercially available vacuum braking system. The system has proved to be very reliable, and the parts are easy to replace. It allows a driver to use his existing vacuum ejector, but in the event of low steam pressure, a back-up system automatically cuts in. The control of the vacuum brakes is just like a full size system with 'OFF', 'LAP', and 'ON'. The 'ON' position applies the brakes slowly and surely, but if quick braking is required, there is an additional 'EMERGENCY' position of the brake handle. This system allows any type of locomotive to be used for hauling trains, and full train braking is always available.

The braking system works as follows. A 12 volt motor drives a diaphragm-type vacuum pump which empties a master reservoir to 20in. Hg, controlled by a pressure switch. This vacuum is then reduced to train pipe vacuum, of 10in. Hg by a regulator. This is connected through the driver's brake valve to the train pipe. The use of a master vacuum reservoir ensures a fast train pipe recovery and brake release.

The logical place for housing the vacuum generator is in the club driving car. Then passenger cars may be coupled in any order so that wear can be distributed evenly. It could also be housed in the leading passenger car, though the complete vacuum generating assembly would then have to be transferable from car to car for the same reasons.

The use of standard club driving cars would go a long way towards ensuring that passenger safety is never jeopardised. I believe that some societies insist on this. There is no reason why a club driving car should not be equipped with coal and water bunkering facilities to suit any locomotive. If a driving car is made long enough it could support the driver and some passengers for optimum stability. Then, driving car extension footboards would enable the driver's feet to be in front of his body for better balance and security.

●To be continued.

18pdr QUICK FIRING GUN

David Wilcox

continues his description of this historical weapon starting with the shield.

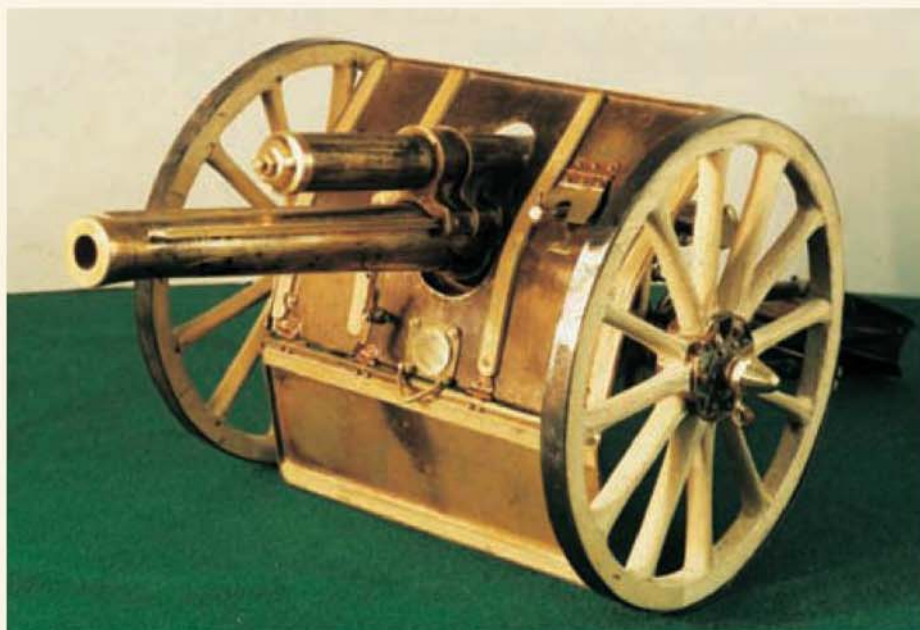
●Part II continued from page 310
(M.E.4191, 21 March 2003)

The upper portion of the shield is bolted to a flanged band fixed to the front end of the trail tube and also to the stays, which are riveted to the axletree brackets. Some later marks of gun had yet a further hinged top portion, hinged forward into the parked position.

Barrel and breech

The barrel is of the wire-wound type. The rifled, forged steel 'A' tube is surrounded by layers of wound steel ribbon, which in turn is contained within a forged steel jacket. Recoil guides form part of the jacket forging.

The breech ring is a steel forging. The mechanism embodies an interrupted screw with alternate 90deg. segments cut away. The breech



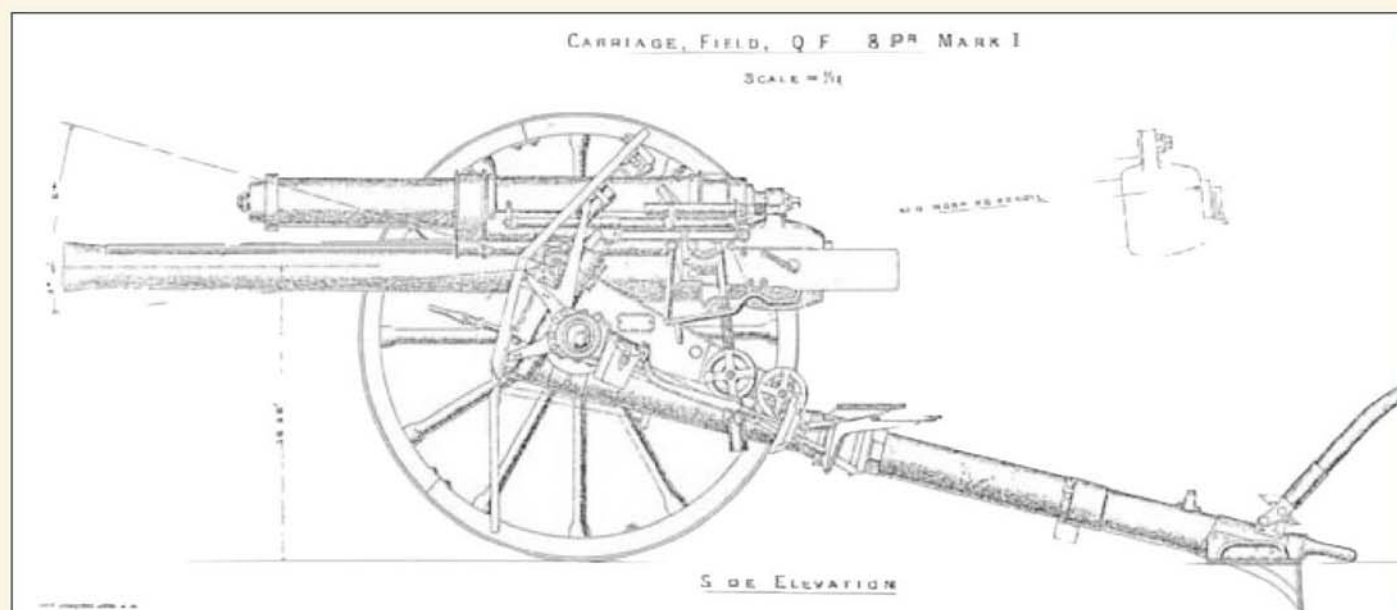
A view of the finished but as yet unpainted model showing the appearance of the shield from the front.



The barrel for the model. The recoil guides can be clearly seen. These form part of the outer jacket of the barrel of the full size gun.



Cradle and recuperator assembly. The trunnion which forms an integral part of the central collar is clearly evident.





A view of the rear of the part-finished model showing the breech mechanism in the closed position.



The breech mechanism in the open position. Note also elements of the elevating mechanism described in the accompanying text.

lever locks/unlocks the breech block and swings it clear in a single motion.

Cradle

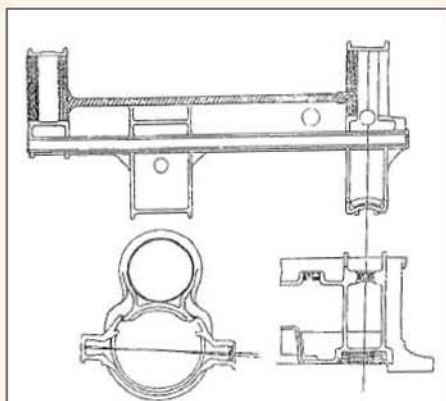
The cradle is a one-piece bronze casting. It has a single collar at the front, which wraps around the cylindrical buffer/recuperator case; a single collar in the centre which wraps around the barrel and in which the trunnions are formed; and a double collar at the rear which wraps around both the buffer/recuperator case and the barrel. The collars are connected by wedge shaped grooves facing inward and running the length of the cradle. These grooves interface with the barrel recoil guide ribs or supporting wings on the barrel and support the weight of the barrel and buffer/recuperator.

The rear collar is pierced horizontally to receive the cross spindle shaft of the upper elevating gear and is further pierced 6in. in front of this to take the cross spindle for the range gear.

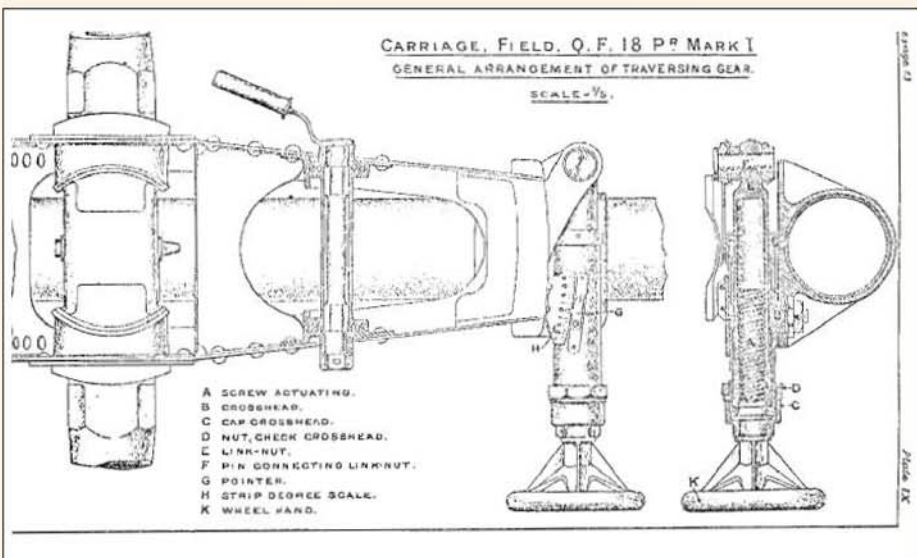
The buffer cylinder/spring recuperator is bolted to a lug that projects from the top of the breech ring. On recoil, the buffer is pulled out of the inner spring case and the inner and outer banks of springs are compressed permitting a full working recoil of 41 inches. The hydraulic buffer limits the resistance during recoil to an amount below that which would upset the stability of the carriage, and the recoil springs return the barrel to the run-out position.

Traversing gear

Refer to the traversing gear drawing: a steel tube crosshead pivots in the socket on the left-hand



Cradle - side elevation, section at trunnions and plan at rear collar.



rear corner of the traversing bracket on the trail. The traversing screw, operated by a hand wheel, works in an extended nut in the crosshead, the end of the nut pivoting in the bracket at the right hand rear of the top carriage.

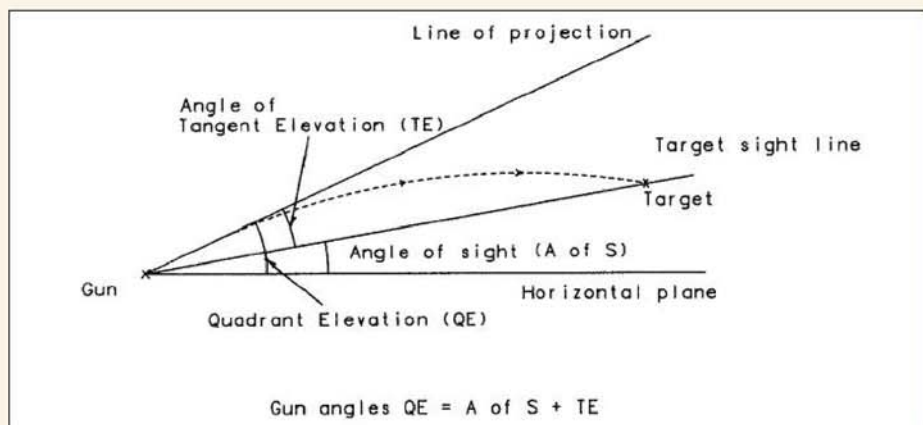
Elevating and range gear

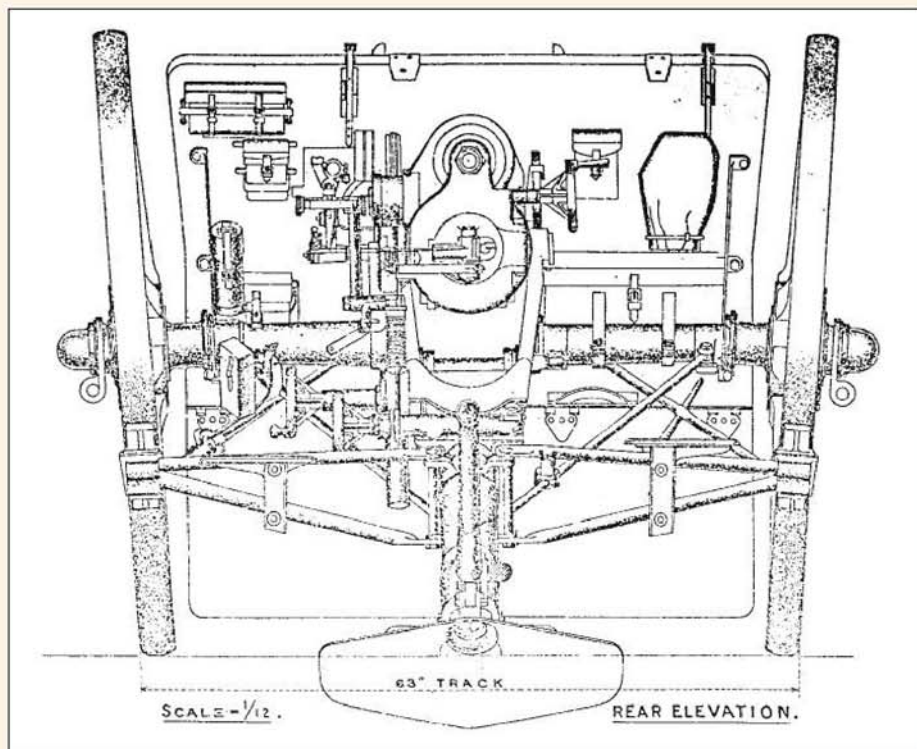
Refer to the gun angle diagram: this embodies the principle of independent line of sight in which the setting of the 'angle of sight' (i.e. the angle between the line of sight to the target and the horizontal) is quite distinct from the setting of the 'angle of elevation' (i.e. the angle through which the gun barrel has to be elevated above the sight line in order to achieve the required range).

The elevating gear is divided into two parts, upper and lower, using a double ended elevating screw, to the centre of which is attached the sight. The upper portion moves the gun relative to the line of sight and so regulates the angle of elevation to suit the range required. The lower portion moves the line of sight and the gun together, relative to the horizontal, and so regulates the angle of sight. Thus alterations of range do not affect the sight line, merely raising or lowering the gun relative to it.

Upper gear

This consists of a hand wheel on the right hand side of the cross spindle, which works the elevation





screw via a bevel gear, the driven pinion also acting as a nut. The nut moves the cradle with gun in a vertical plane, angular movement being recorded by the range gear.

Lower gear

A lower elevating nut is similarly actuated by a bevel pinion but in a gearbox pivoting on the left hand side of the top carriage, and is worked by the lower elevating hand wheel. Turning the hand wheel works the elevating screw up or down thereby moving the cradle and the sight simultaneously.

Range gear

A projecting arm is formed on the centre of the elevating screw to which is bolted a link which in turn is pinned to the arc bracket. The outer end of the bracket is connected to the rocking bar sight and the inner end to the toothed arc of the range gear. The arc moves in a curved guide fixed to the cradle and engages a pinion attached to the left hand end of the range gear cross spindle. The right hand end of this spindle carries the yard and degree scale ring read by a pointer mounted on the cradle. When the lower elevating gear is worked no rotary motion is imparted to the range

gear. But when the upper elevating hand wheel is turned, the toothed arc remains stationary, while the pinion working up or down the arc rotates the range gear, thereby showing the range in yards and degrees.

Sighting gear

The rocking bar is bent down at its front end at an angle of 60deg. and is pivoted to an arm screwed into the left hand trunnion. The rocking bar carries the deflection gear at its rear end, which is also bolted to the toothed arc bracket. The arc bracket carries mountings for the sight clinometer (with which to set the angle of sight for indirect fire) and the dial sight (which measures direction in the horizontal plane for indirect fire).

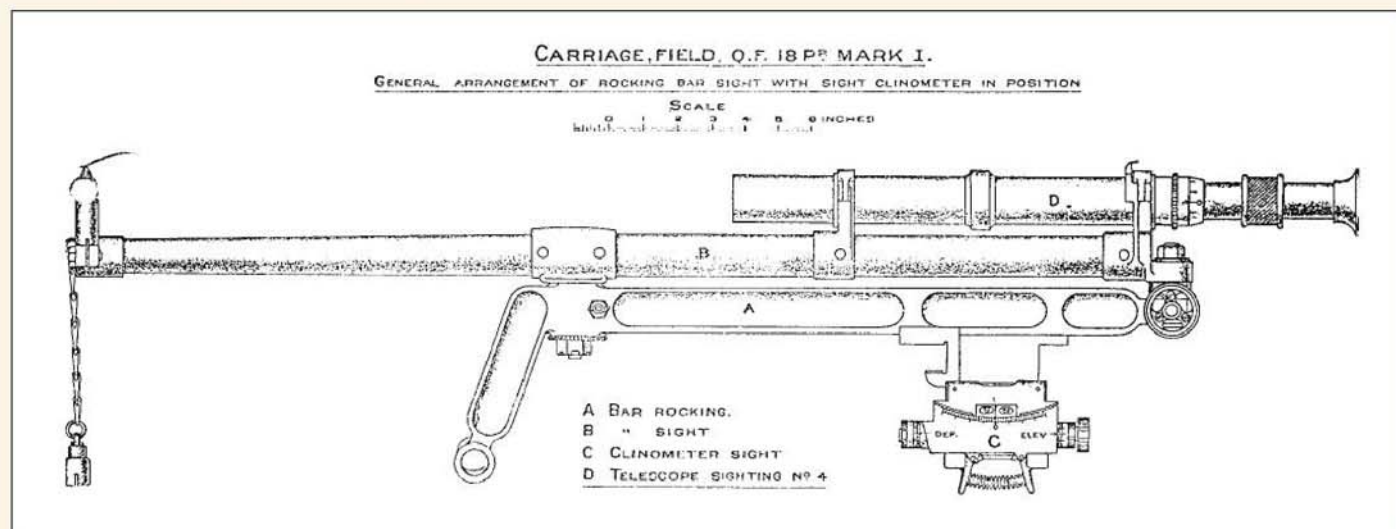
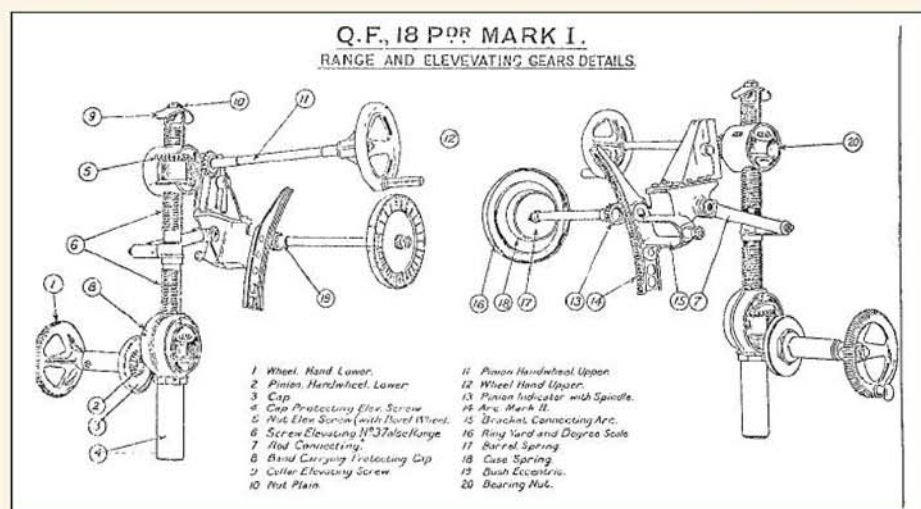
The sight bar pivots horizontally at the front end of the rocking bar, the rear end being attached to the deflection gear. A telescope clips into the sight bar. Note that the drawings are for a Mark I gun in which a simpler dial sight was fixed to the top edge of the shield.

Laying the gun

Direct laying (target visible at the gun): the left-hand layer aims the gun at the target using the telescope and applying deflection for any cross wind. The right-hand layer sets the range ordered.

Indirect Laying (target not visible at the gun): the left-hand layer applies the angle of sight ordered to the sight clinometer. He points the gun in azimuth by applying the bearing ordered to the dial sight and then traverses the gun until the sight is laid on the aiming point.

●To be continued.





A SOUTHERN RAILWAY MERCHANT NAVY CLASS LOCOMOTIVE FOR GAUGE 1

Roger Thornber
introduces his new project for
gauge 1 enthusiasts.

●Part I

Judging by the feedback that I have had, my previous articles describing the building of a gauge 1 version of *Evening Star* seems to have been reasonably well received. I know of versions being built as far afield as Australia, USA and Tenerife. The only adverse comments I have had were that the frames were $\frac{1}{32}$ in. too long and that I needed some drawing lessons! It has also been noticed that several model engineering clubs are adding a gauge 1 layout to their tracks. On this basis it may be that a description of the building of a Merchant Navy class locomotive might be of interest.

After building *Evening Star* I vowed that I would never build another locomotive with working Walschaerts valve gear; I have broken this vow, but that is another story. Before its rebuild, the original

Merchant Navy 'Spam Can' satisfied this criterion and I have used a simple slip eccentric gear.

Although there are some interesting pieces of fabrication for the trailing truck, the chassis is fairly straightforward. All wheels are sprung, but strictly speaking the trailing truck is sprung as a complete unit. An inside steam chest is used and some reasonably accurate drilling is required for the steamways. Slide valves are used and their setting is simple. The stop collars for the slip eccentrics are removable, so their cut off positions can be easily 'fettled'. A simple displacement lubricator is fitted as this type seems to work well at this scale.

The boiler is gas fired using a closed flue system and ceramic burner, very similar to *Evening Star*. However I have made some small but significant alterations as a result of running experience. Once lit *Evening Star's* boiler performs excellently; however, sometimes lighting it can be a bit troublesome. I have put this down to the fact that the original design had seven small tubes. When lighting, the flame has to pass down the

length of the tubes to the ceramic element in the firebox. Sometimes, because the tubes are long, the flame does not do this. Quickly turning the gas off and on usually does the trick. The boiler for our Merchant Navy therefore replaces six of the tubes with two $\frac{1}{2}$ in. dia. flues. This seems to have completely eliminated the lighting problem and I will illustrate this more clearly when we get to the boiler article.

The bodywork is not difficult, but care is needed care to obtain the right shapes. I should perhaps admit here that I do not pretend that the locomotive is to an exact scale, but I hope it looks about right. The body has been built in several sections but when assembled can be removed as a single unit. The locomotive can be run without any of the platework.

The tender is much along the lines of that for *Evening Star*, but here too some changes have been made as a result of running experience with the latter. The 'standard' reciprocating water pump has been replaced by a vertical unit; I think LBSC described one many years ago. I have also changed the gas filling arrangement. There are now two modified Schroeder tyre valves in the top of the gas tank, one for filling and one for venting. The modifications are very simple and will be described later. With the previous arrangement it was best to disconnect the tender/locomotive connection for filling which was a bit of a nuisance at the trackside.

Perhaps I should also confess that I am not sure whether this locomotive actually ever had this particular outline of tender. I am not very good at research and find that there have been many different types of tender. By examining the tenders at several model shows which I have attended I have yet to find any two that are alike!

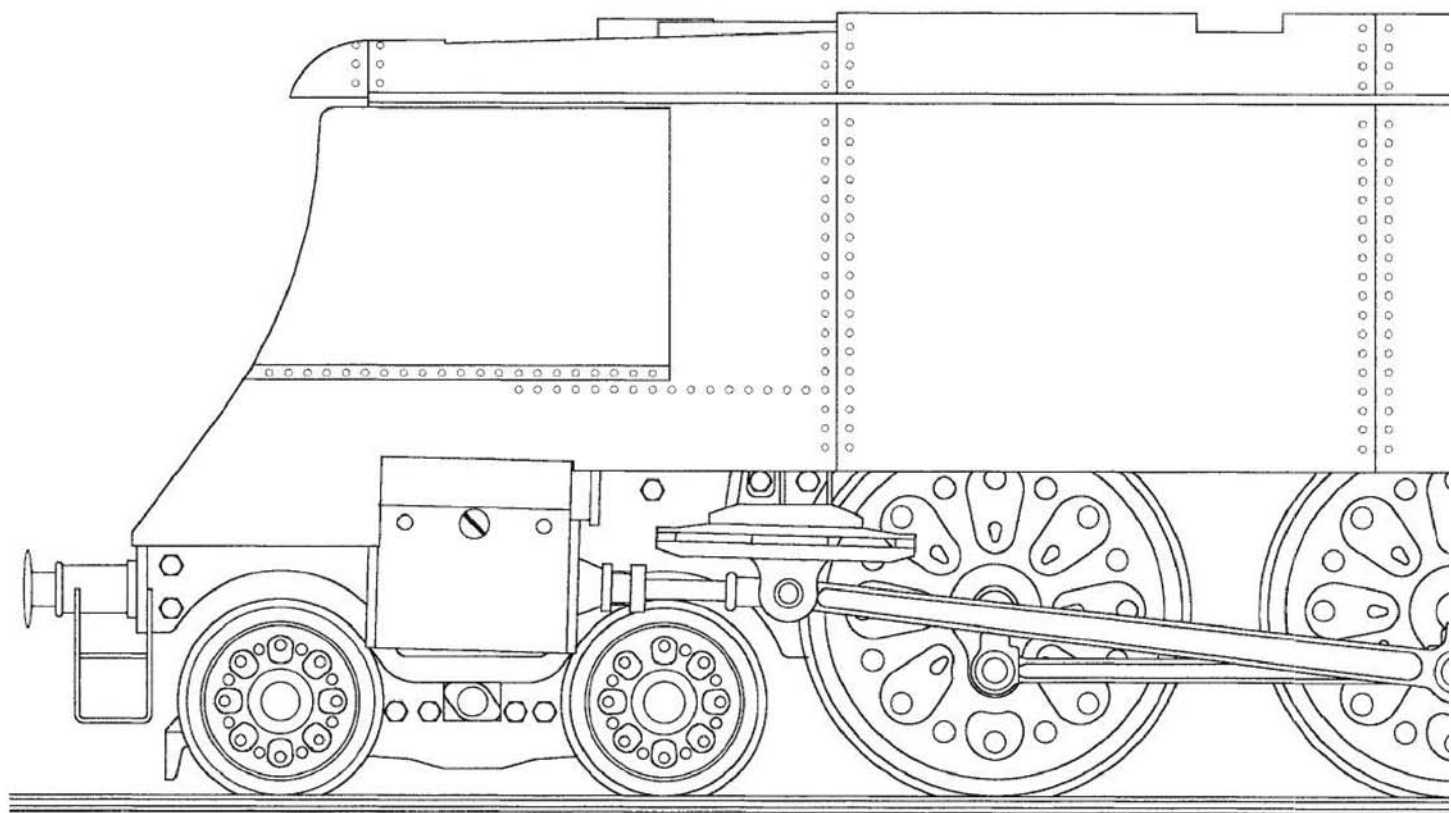
It has been well stated that 'a picture is worth a thousand words' so throughout the series, as for *Evening Star*, I have included some three-dimensional drawings generated using Turbocad 7. With these it is possible to rotate the views so that the item can be viewed from different directions. If anyone has the facilities to view them, these could be sent in DXF format.

With that preamble I will close with the General Arrangement drawing which has been created by overlaying the various items as drawn. This technique indicates that they should all fit!

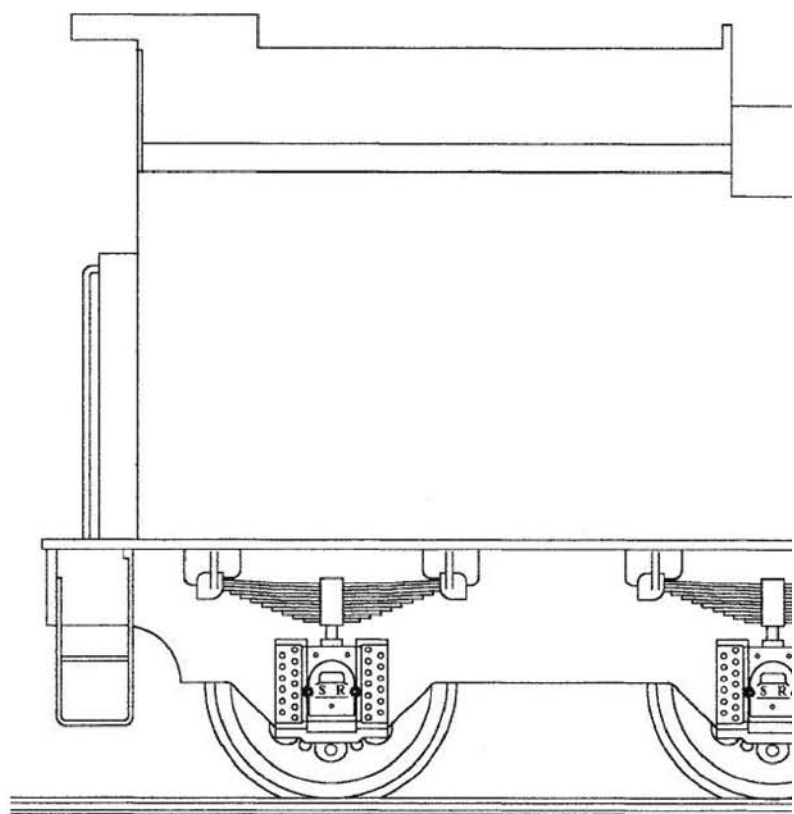
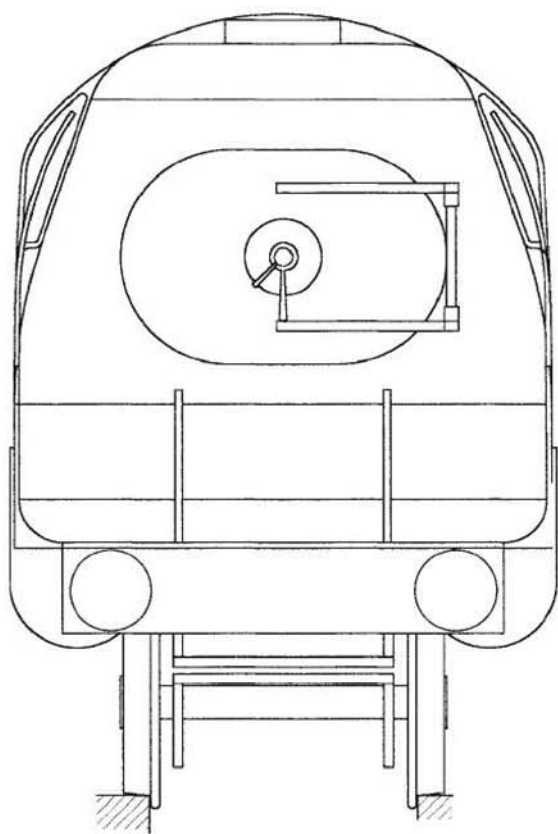
●To be continued.

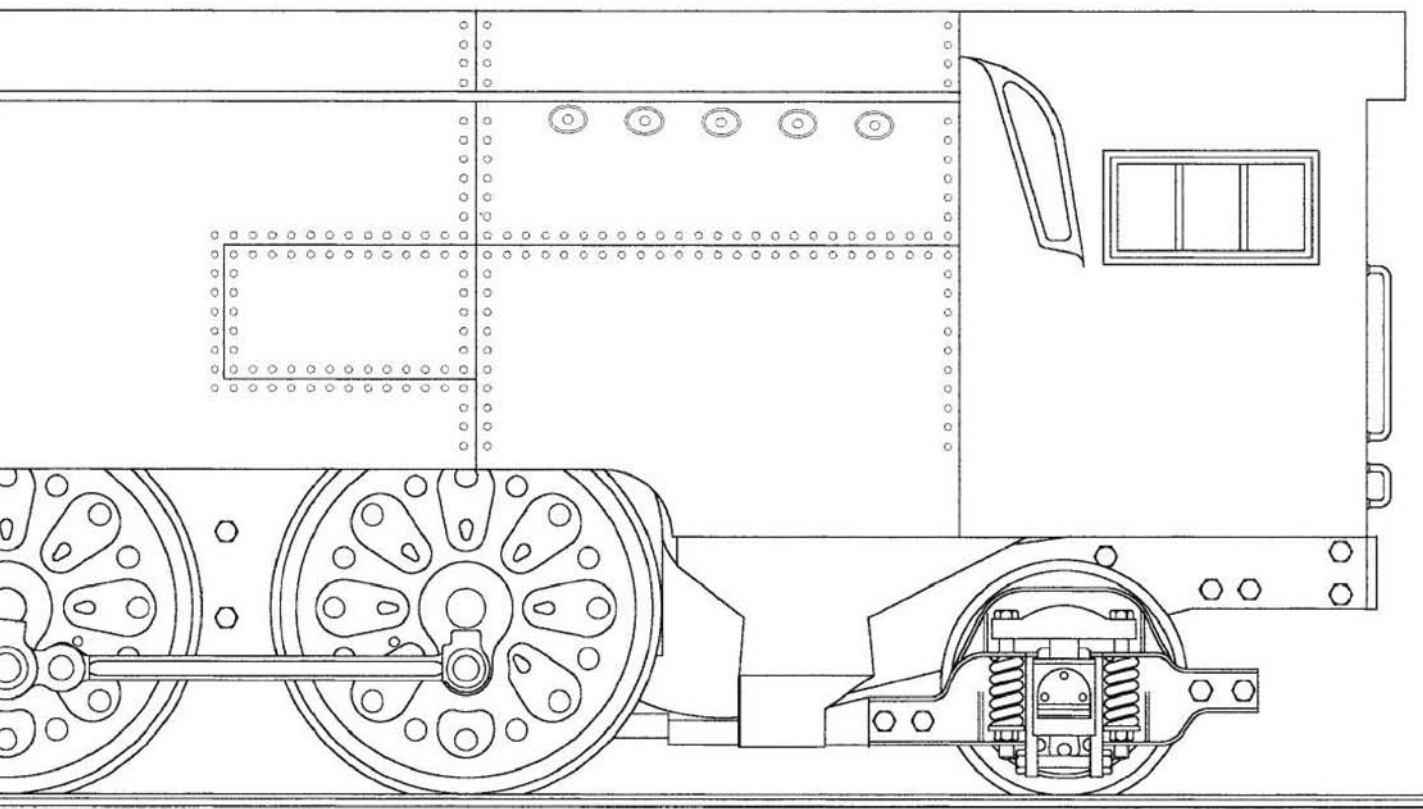


Our contributor, Roger Thornber has prepared his new design using CAD overlay techniques to minimise problems of non-assembly of individual components. He has built his own model from this design work; potential builders may therefore assume that all will be well when they come to assemble their own creations. Roger Thornber has named his own gauge 1 locomotive United States Lines.

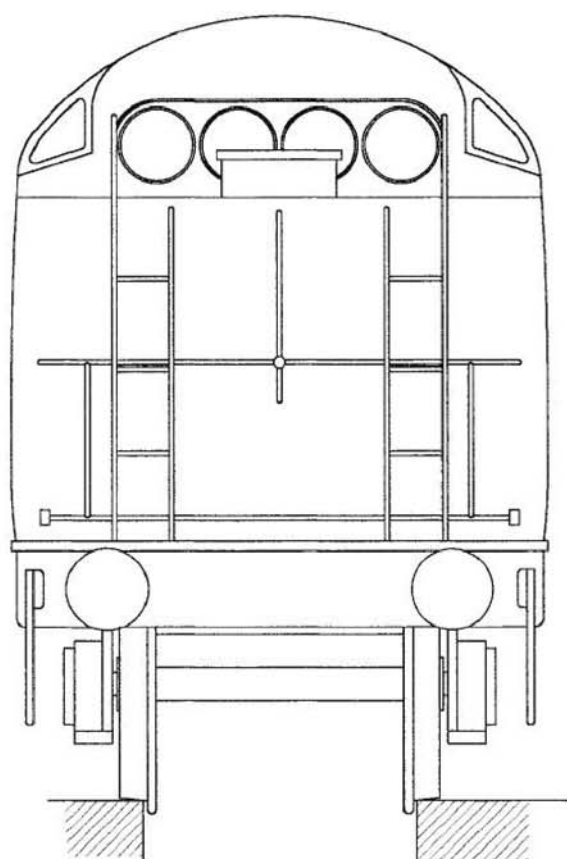
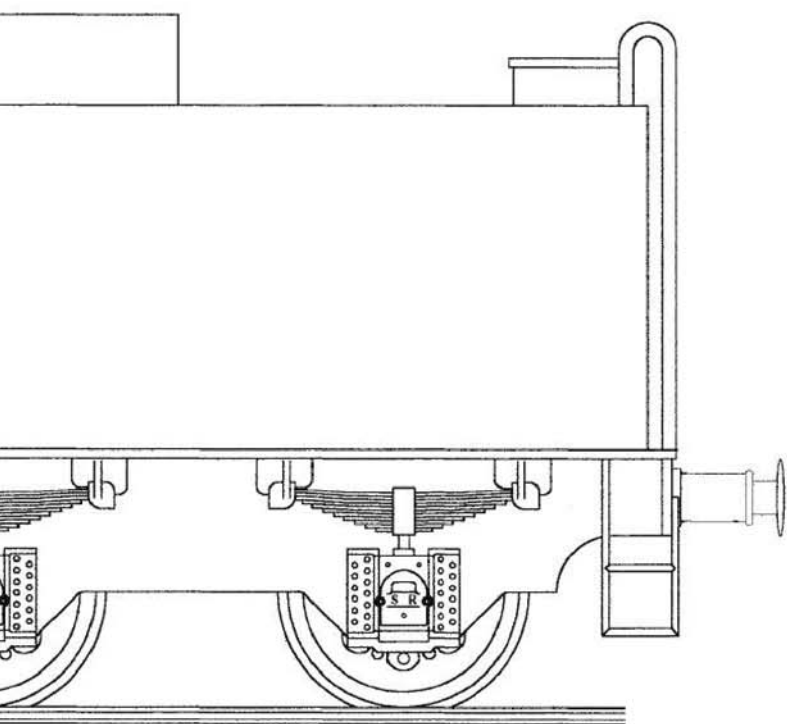


A SOUTHERN RAILWAY MERCHANT NAVY CLASS L





LOCOMOTIVE FOR GAUGE 1 BY ROGER THORNBUR



FINE TUNING A WARCO BH600G LATHE



Anthony Mount

continues with his improvements to this popular lathe by making and fitting a new rear toolpost and dealing with the top-slide.

●Part II continued from page 326
(M.E. 4191, 21 March 2003)

I use a quick-change tool post for the rear tool holder on my Myford. To transfer it to the BH600, all I needed was a new cast iron column. I ordered a lump of cast iron from the College Engineering Supply (tel: 01902-842284) and cut out the L-shape using my bandsaw.

The block was milled to size, a tongue (tenon) being used to position it on the cross-slide. My drawings show the fixing bolts set back from the centre line of the block. For neatness, I used M8 cap head Allen screws. The rear bolt holes are very deeply counterbored so I could use the same length screws. If longer screws are available then the counterbores can be shallower. I made up a long Allen key with a cross bar handle to tighten up these screws.

A word of caution on using the rear tool post may be appropriate here. If you are used to, say a Myford S7 lathe with a 3½in. centre height, the BH600 is approaching twice that, the rear tool post is a lot higher off the cross-slide and the leverage is therefore greater. A lot more power is available too, so it is not difficult to crunch things up, especially if the tool jams. Until you have become used to it, it would be as well to take things carefully and do not have a lot of parting tool sticking out. I found the chips from a carbide insert tool came off a lot smaller and more easily than with a HSS tool.

Top slide

The top-slide has the same form of gib strip as the cross-slide and I found that on mine, one of the counterbored holes was slightly offset from the tapped hole. The bolt tightened up as it was screwed in. All that was needed was to put the slide under the milling machine spindle and drop an end mill down the counterbore to remove a few thousands of an inch from the tight side, after which all was well.

Additional holes were drilled for push button oilers for the dovetail slides. These went in 75mm from the handle end, avoiding the locking screw. The underside of the slide was machined with a small ball nosed cutter to form a groove at an angle to coincide with the oil hole. Now when oil is pumped in, it spreads across the width of the sliding area.

The cross-slide has a nicely graduated protractor scale, but on setting the top-slide square against a test bar I found the datum line on the top-slide base to be inaccurate. It was only a shallow line, so I filed it off and cleaned up the whole of the radiused base of the top-slide, to improve the

finish. The top-slide was then re-set true. Ideally, this should be done against a test bar, but failing that it could be set against a piece of silver-steel held in the chuck. Alternatively, it could be set against a piece of mild steel previously machined true using only the saddle for feed.

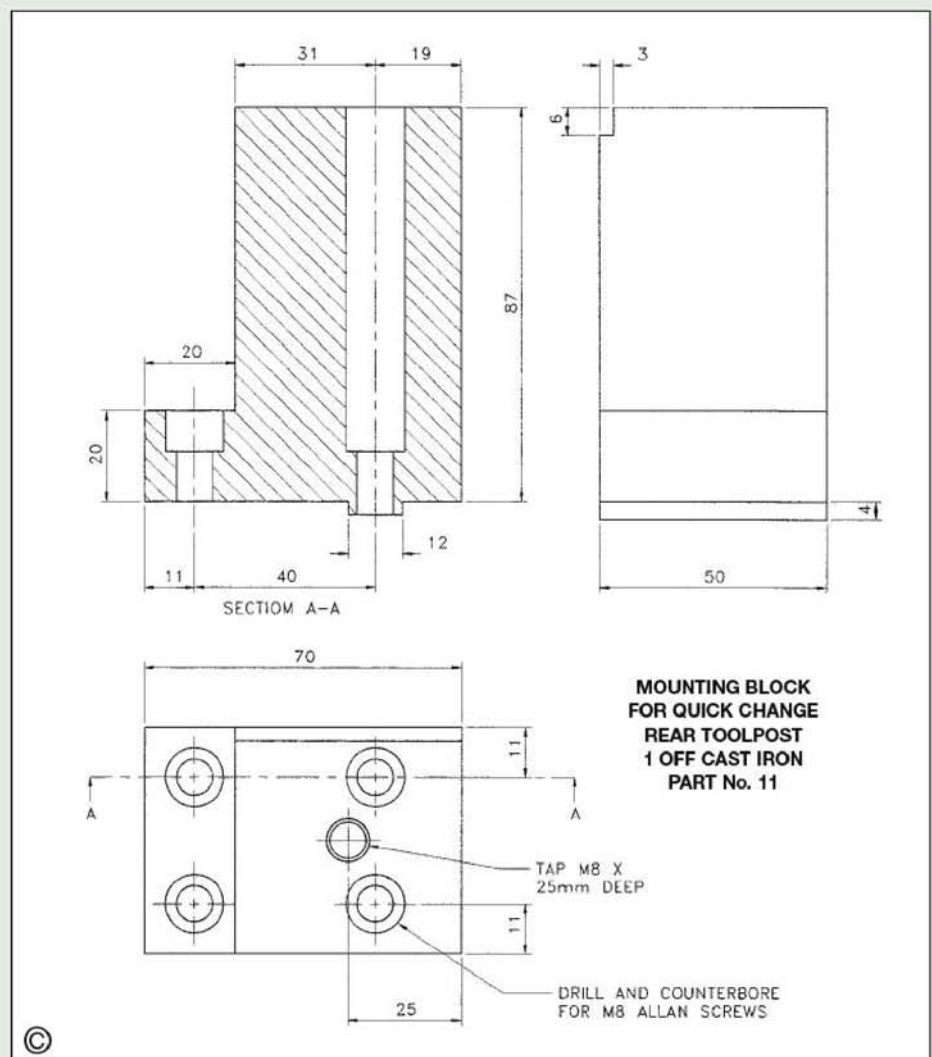
A dial test indicator (dti) was set up and used to obtain a constant reading over about 75mm of travel. A new datum line was then marked and two extra lines marked at 45deg. either side of the centre line. Now when the top-slide is swung around to an acute angle the graduated scale can still be used.

The spacer between the slide and the graduated dial is counterbored at one end for a thrust bearing, but not at the other end. A line was scribed along the underside of the slide against the end of the spacer before dismantling anything. The assembly was then taken apart and it was noted that 14mm of material could be

milled away before the counterbored hole was reached. I was hoping to gain this 14mm as extra travel, but the nut is too near the end of the slide and I could only gain 4mm extra travel.

Two rods were put through the screw holes and rested on the top of the machine vice on the vertical milling machine — underside up of course. Material was then milled off to just below the previously scribed line. The base of the top-slide was then bolted to the milling machine table and 5mm of the dovetail at the handle end milled away. On re-assembly the top-slide travel was increased by 4mm.

Although the saddle and cross-slide were nicely fitted, I was not particularly happy with the top-slide. I could not get smooth travel through the length of movement, finding it tight at the front and loose at the rear. While it was





Cutting the bevels on the new gib strip in the milling machine using a 60deg. reverse dovetail cutter (similar to a countersinking bit).



The gib strip was supported on tapered packing to facilitate the machining of its tapered form. It was made over long to facilitate clamping.

dismantled I checked the fits and found the gib strip to be too sharply tapered. By making a little fence of panel pins, I fixed the strip to a piece of wood gripped in the vice. This held the strip in place while I carefully filed off the thicker end until the gib strip fitted the slide evenly along its whole length. By making it thinner, the gib strip now went in too far for the front screw to be effective, so I put a strip of shim steel behind the gib to bring it back to its original position.

However, after all this I still was not satisfied with the fit. So I went back to basics and started again. First, I checked the base dovetail for parallelism by the classical method of measuring across two equal diameter rollers placed against the sliding surfaces at the slideway ends and in the middle. All seemed to be correct but however much I fiddled I could not get a smooth travel. Something was wrong somewhere. I set the base of the top-slide on parallels on the milling machine table, and as I was setting up a dovetail cutter I noticed that the flat sliding surfaces of the base were not in line. Here was my problem, so I took a skim of about 0.25mm from all the working surfaces to bring them true.

A new gib strip was made up somewhat longer than required. The original gib strip was of cast iron, but I made the new one in steel. I used hot rolled (black) material as cold drawn (bright) would have bent when machined. The strip was clamped onto a spacer on the milling machine table, and the bevels machined (photo 5). A

reverse dovetail cutter like a countersink was used but with a 60deg. instead of a 90deg. taper. A tapered packing piece was used to support the gib strip, and the taper machined (photo 6). The gib strip was then bedded in, cut to length and finally refitted and adjusted.

At last the top-slide worked as it should. Before reassembling the top-slide I made up two C-spanners with which to tighten the lock nuts.

It was only after all the performance just described had been completed, and I was looking at the assembly a few days later, that I realised that the entire design could be improved. As supplied, the top-slide travel is quite limited, because the base is so long.

Top-slide base replacement (Part No. 16a)

I re-drew the whole base unit, starting with a circle the diameter of the 'ears' and removed the extensions front and back. The spigot is the same, the dovetail went straight across the diameter, a semicircular groove gave clearance for the screw and the two bolt holes are as for the original. There was no need for a casting as cast iron bar is available, even in this size, from the College Engineering Supply. A slice was mounted in the chuck, the spigot machined, and the outside brought to finished diameter.

The whole was then mounted on parallels on the milling machine table and the dovetail machined in. As much material as possible was

removed using end mills, reserving the dovetail cutter for just the undercut and to finish the flat faces.

The groove for the screw was milled, then the base was drilled and bored for the nut itself, and finished by drilling and counterboring for the two bolts. The base was then bolted in position on the cross-slide and the gib strip re-fitted. A new base like this would give longer travel to the existing slide.

I was not particularly happy with the top-slide handles as supplied. These are solid and screw into the handwheel. The screwdriver slots cut into the fingers and the bodies of the handles do not revolve, as do the other handles. So, I made up new handles with sleeves and sunken screws, making them the same length as the originals. They feel satisfactory to me, but they can be made different lengths if preferred.

The locking screw in the side of the slide is the same as for the cross-slide, but as the top-slide is narrower, the length of the screw can be reduced by about 6mm. The pivoted lever can also drop down and cause a foul on the end of the base and in the top of the clamping bolt counterbore. A small pin can be fixed in the side of the slide for the pivot lever to rest on, out of harm's way.

The above would make a nice top-slide base giving extra travel for those who want to follow the traditional style of top-slides. However, this lathe suffers from the same problem suffered by all my other lathes: that is, when working on small diameters with tailstock support, the top slide fouls the tailstock, leading to excessive tool overhang to reach the workpiece.

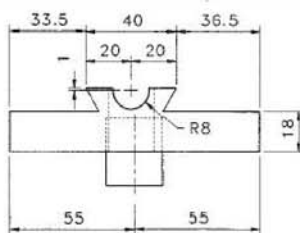
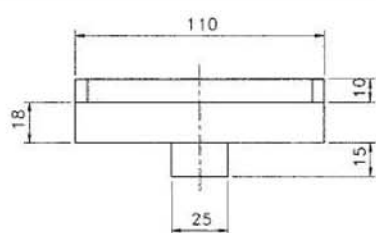
One solution would be for manufacturers to design the tailstock with a recess in the side to take the top-slide, but I am not aware of any that do. Another way around the problem was described in the 1970s by J. A. Radford of New Zealand. This is to make a top-slide L-shaped in plan to fit around the tailstock. I made one for my Myford and found it solved most of the problems. However, it requires a complete new top-slide assembly.

Another, partial solution was designed by G. H. Thomas. This involved setting the handle of the top-slide to one side and then using gears to transmit the drive to the feed screw. However on the BH600 the top-slide is wider than the handle swing so this method would not work.

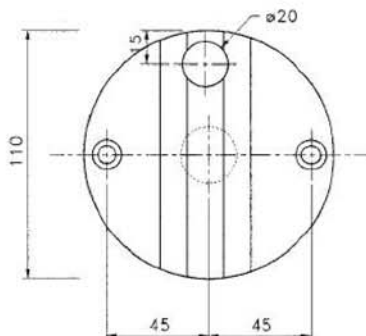
Supplier

The WARCO BH600 lathe is currently available for £1600 inclusive of VAT and delivery (UK mainland) from WARCO, Fisher Lane, Chiddingfold, Surrey GU8 4TD; tel: 01428-682929; fax: 01428-685870/686812; e-mail: warco@warco.co.uk Visit the WARCO website at www.warco.co.uk

●To be continued.

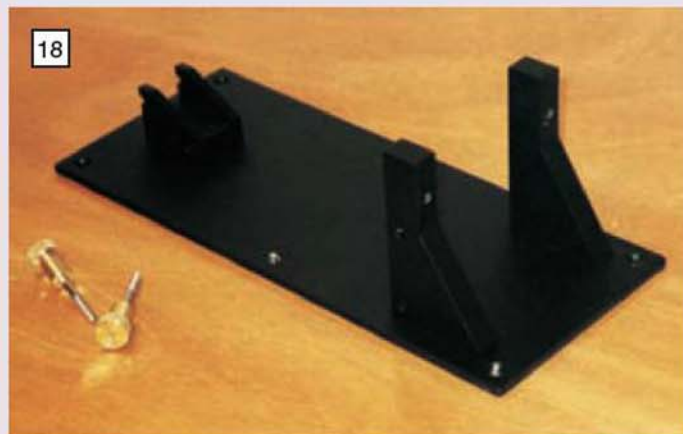


**NEW TOP-SLIDE BASE
FOR USE WITH
EXISTING TOP-SLIDE
1 OFF CAST IRON
PART No. 16A**





Front view of the clock movement; the temporary seconds hand can be seen in the centre of the photograph.



Mounting bracket finished, painted and complete with its two holding down screws. This version was made from aluminium alloy.

MONTH GOING REGULATOR CLOCK

Peter Heimann

makes a start on the motion work for this attractive clock.

●Part VI continued from page 316
(M.E. 4191, 21 March 2003)

The centre arbor of the movement revolves one revolution per hour. The 'motion work' described on drawings 12 and 13 will enable the hour hand to make one revolution in twelve hours. It also incorporates a friction clutch to allow setting of the hands. Photograph 17 is a front view of the movement. You may notice a short pointed little brass temporary 'hand' fitted to the end of the arbor for test purposes, and this should be done. The eccentric pillar and its 2BA nut (drawing 13) can be fitted finger tight in the 2BA clearance hole previously drilled in the front plate at 45deg. and 0.945in. down from centre. This pillar will be used to adjust the mesh between the wheels.

The action of the motion work is as follows. The plain clutch disc is friction driven by the curved spring. Attached to this disc is a 16 tooth pinion (wheel), both fixed to a 'pipe' which has a square formed at the outer end for the minute hand and runs freely on the $\frac{3}{32}$ in. dia. centre arbor. Item 'C' on drawing 12 refers to this item. The 64 tooth 'reverse minute wheel' with its attached 20 tooth pinion, item 'A' on drawing 12, runs freely on a $\frac{1}{8}$ in. dia. stud located in the eccentric pillar. Running freely on the outside of the 'pipe' previously mentioned is the 60 tooth 'hour wheel'; item 'B' on drawing 12 refers. The collet attached to this wheel accepts a split hour hand collet.

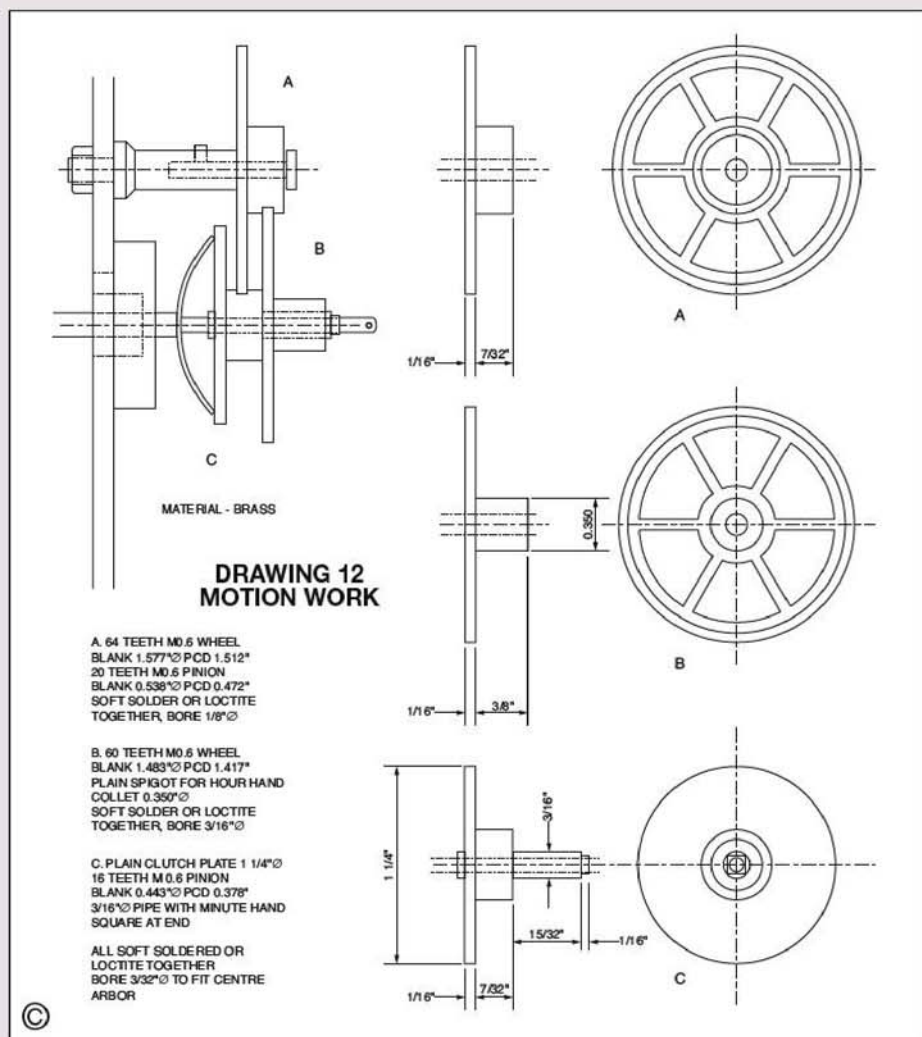
The minute hand fits onto its shouldered square and is retained by a hemispherical 'minute hand' collet, which in turn is retained by a pin through the hole in the end of the centre arbor. The clutch spring curvature is adjusted to give sufficient pressure between the shoulder against which it sits and the collet and locating pin at the other extreme, to provide drive to the hands. Yet it will allow the minute hand to be physically rotated to set and adjust the reading.

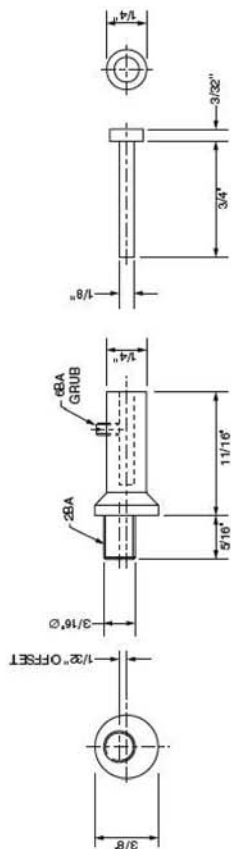
The eccentric pillar is obviously adjusted so that the mesh of all the wheels is smooth and free. A touch of light clock oil on the arbor and pipe is a

good idea as it is difficult to reach after assembly. Remember that all these components are only very lightly loaded and free running is important. The split hour hand collet, previously mentioned, simply pushes onto the hour wheel collet and is retained by slightly closing the 'split'.

After turning on the lathe, it is best mounted on a suitable stub for sawing the slot, either by

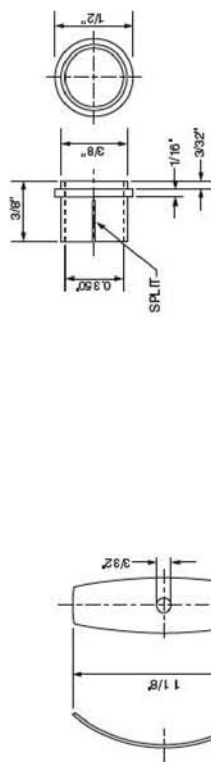
hand or with a slitting saw. The hour hand will be a Loctited press fit onto the $\frac{3}{32}$ in. shoulder. The wheels of the motion work are in full view and should be particularly nicely finished. To avoid friction, slightly reduce the outside diameter of the minute pipe in the centre where the hour wheel and its spigot will run, so that this item only makes contact at its ends.





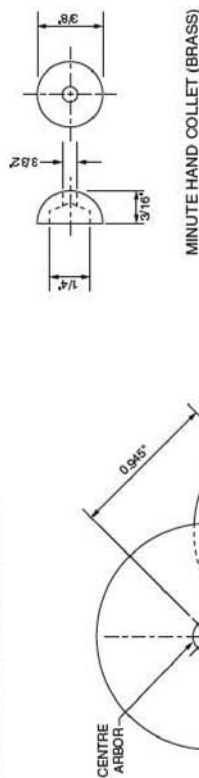
ECCENTRIC PILLAR (BRASS)

BEARING PIN (STEEL)

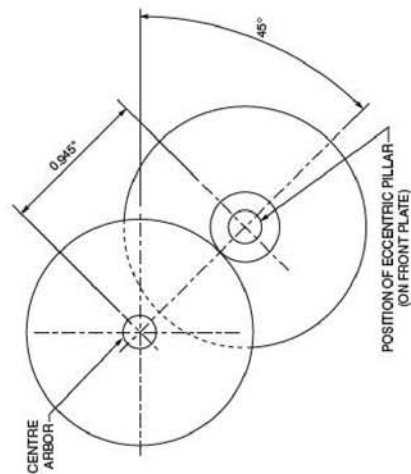


HOUR HAND COLLET (BRASS)

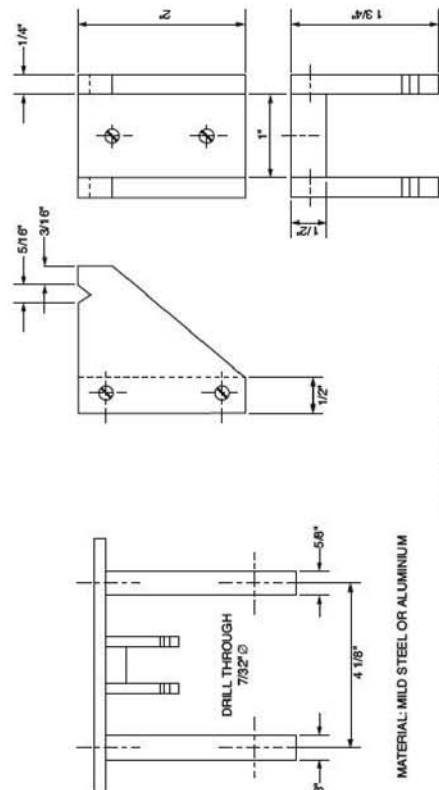
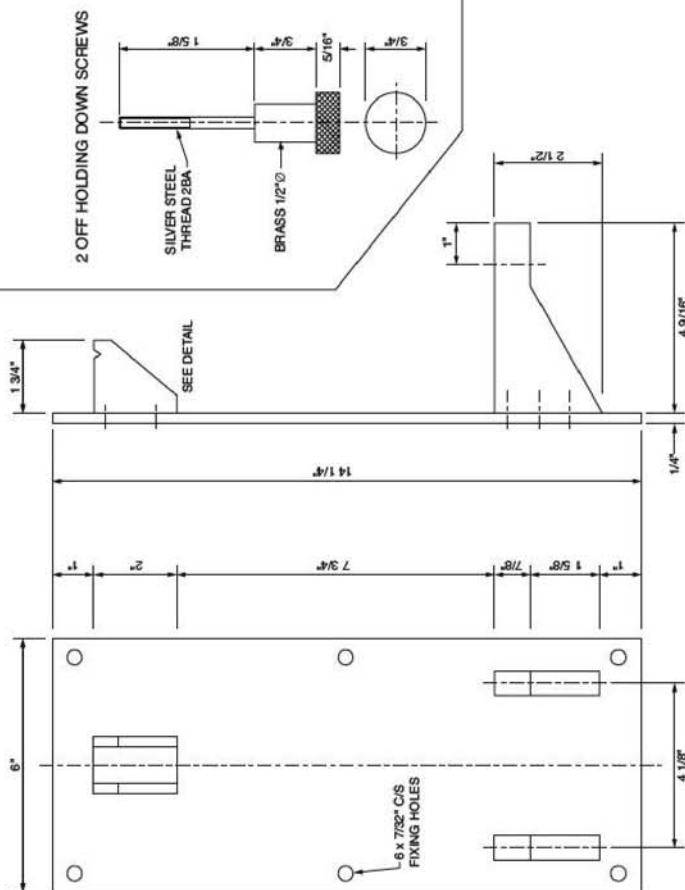
HAMMERED BRASS CLUTCH SPRING



MINUTE HAND COLLET (BRASS)



DRAWING 13
MOTION WORK
(CONSTRUCTION)



MATERIAL: MILD STEEL OR ALUMINIUM

DRAWING 14
MOVEMENT AND PENDULUM
MOUNTING FIXTURE

Mounting bracket

I think it will be appropriate now to proceed with the manufacture of the mounting bracket. This will enable safe storage of the pendulum, also giving facilities for testing in due course. Traditionally, this bracket is very heavy, indeed even a casting. I have designed it somewhat lighter but have not detected any problem on my own clock. In fact, mine is made entirely using aluminium alloy. **Drawing 14** gives all relevant measurements. It will be noted that there are six fixing holes in the back plate. The back of the cabinet will be $\frac{5}{8}$ in. thick veneered chipboard. When the bracket is through-bolted to this with, say, M6 countersunk set screws, an extremely stiff construction results.

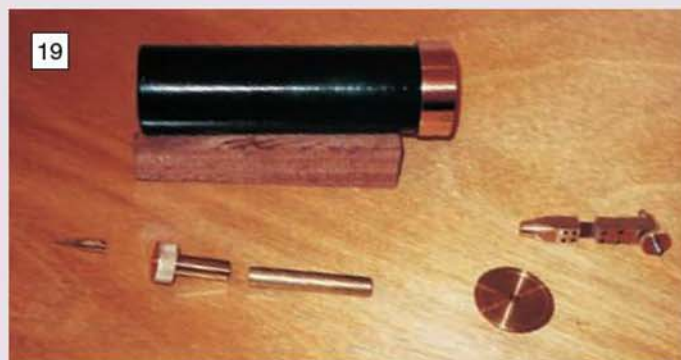
The main support brackets are each fixed with three recessed M6 cap head screws through the back plate. The diameter of the heads of the screws were reduced to leave just enough socket remaining for location of the Allen key. If you have countersunk head screws, there is no problem. The assembly is fairly visible. I have used matt black aerosol automotive cellulose on mine. The top edges of the two brackets are best left unpainted, as the movement sliding

in and out here would soon scrape off any coating. **Photograph 18** shows the finished item, also the two holding down screws.

It must be remembered that the unit will support not only the movement but also the heavy pendulum and the two weights. I have plugged a flat piece of wood, approximately 16 x 8 x 1in. to a workshop wall, top edge at eye level, which serves as a convenient test bed for every clock I build. Choose the site with care, because the clock will be ticking away here while you work on the dial and hands, as well as when you are making the cabinet.

Suspension and invar rod

The suspension for the pendulum is detailed on **drawing 15**. It will be best to make the spindle in $\frac{3}{16}$ in. dia. silver-steel, the other components being brass. The bottom of the lower block has a slight taper turned as shown, which looks attractive.



Pendulum suspension components and a temporary pendulum bob which will be mentioned in the next article in this series.

While you have this in the 4-jaw chuck, drill and tap the $\frac{1}{2}$ in. deep hole for the pendulum rod. This is likely to be M6, unless your rod is of $\frac{1}{4}$ in. diameter. The suspension spring itself is shown as 2 x $\frac{1}{2}$ x 0.006 inch. If there is difficulty in obtaining this size, coils of $\frac{1}{4}$ in. wide, 0.006in. thick spring are generally available off the shelf and quite cheaply. Simply use two strips side by side.

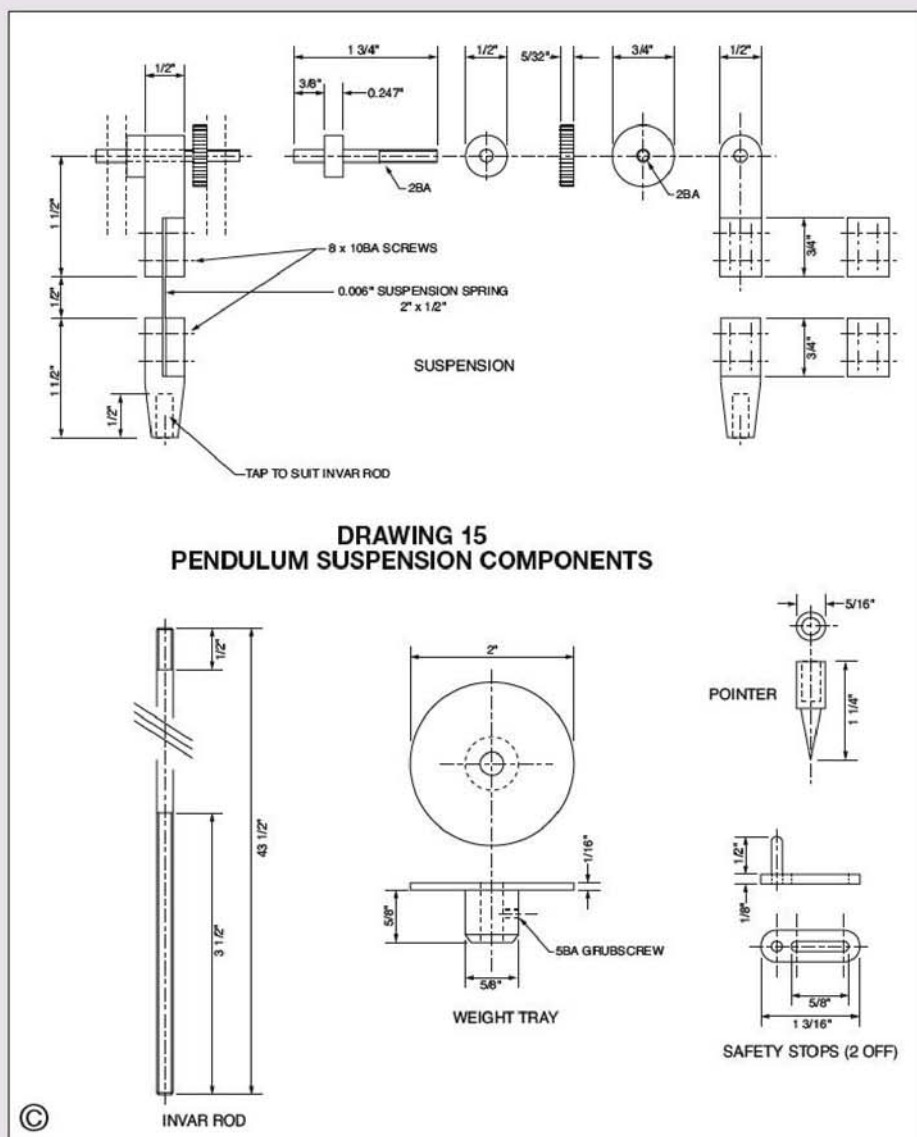
Another alternative is to use two $\frac{1}{4}$ in. long case suspension springs and cut off the blocks. A simple jig will have to be made to hold a 10BA clearance diameter hardened punch to form the holes in the spring. The spring needs to be clamped firmly into the body of the jig when a sharp blow with a hammer will do the job without problem. File a small radius on the four 'open' edges of the clamp section rather than leaving them sharp. The spring will flex more than 31 $\frac{1}{2}$ million times in a year and sharp edges might promote cracking. The completed suspension assembly is shown in **photo 19**.

The invar rod is cut to 43 $\frac{1}{2}$ in. length and polished with fine wire wool. As shown on **drawing 15**, a suitable thread is required at both ends for a $\frac{1}{2}$ in. length at the top and 3 $\frac{1}{2}$ in. at the bottom. Being prone to tearing, this is not a nice material to work. Start the die in the lathe to ensure that it is square, use a good cutting lubricant, and avoid running the die back until you have slackened this right off. Two light cuts will be better than one full one. The rating nut, which will be described quite soon, has to be a good fit on the 3 $\frac{1}{2}$ in. section of thread. I suggest you leave the rod for now until the nut has been made.

Also shown on **drawing 15** is a brass weight tray. This will slide approximately half way up the rod and be retained by a grub screw. In due course, the clock will be 'rated' by means of the rating screw to run slightly slow, approximately 30 seconds per 24 hours. Small weights will be added to the tray with tweezers without stopping the clock to bring it to 'rate'. The brass pointer clearly fits onto the end of the rod and will indicate the beat against a graduated plate. Both the tray and the pointer show on **photo 19**.

The final items on **drawing 15** are two 'safety stops' made in brass with a silver-steel pin. These will be fixed to the back of the mid-plate by 5BA screws in the tapped holes provided by you a long time ago. The pins will be positioned on either side of the pendulum rod in such a way as not to interfere with the normal swing, but to prevent possible damage to the escapement in the event of an over enthusiastic start. I suggest fitting a 5BA washer between the surface of the plate and the underside of the component as well as one under the head of the screw. This will avoid damage to the surface of the plate.

●To be continued.





Keith Wilson

discusses the steam chest covers and deals with the cylinder liners.

●Part XVI continued from page 319
(M.E. 4191, 21 March 2003)

“Wilson’s Words of Wisdom” will repay much thought. I have been collecting them for nearly fifty years now, and the list is quite long. I shall omit a few which may cause offence, but every one bears a message, often quite profound, which invites deep thought. Some, including the reference to a lightning conductor and an irate pedestrian have come from my own cerebrations, but most are from many other authors from around the world and I here acknowledge their wisdom. They include Isaac Asimov, Robert Heinlein, Arthur C. Clarke, Socrates, Confucius, Ernest Bramah, Richard Austin Freeman and Benjamin Franklin, to name but a small few. There are a number from sacred writings which are most certainly not available to the general public, but most are the result of a sharp eye.

Steam chest covers

Now, I have given quite a bit of thought as to exactly how the rear covers could be made, for as you will note they will be quite tricky to machine. At first sight, a casting is an obvious starting point, however we immediately see the difficulty

Wilson’s Words of Wisdom:
One of the Greek philosophers, Socrates, was taken to see the equivalent of the early Greek ‘supermarket’.
He is said to have looked around and remarked:
“Wonderful; so many things that I can do without.”

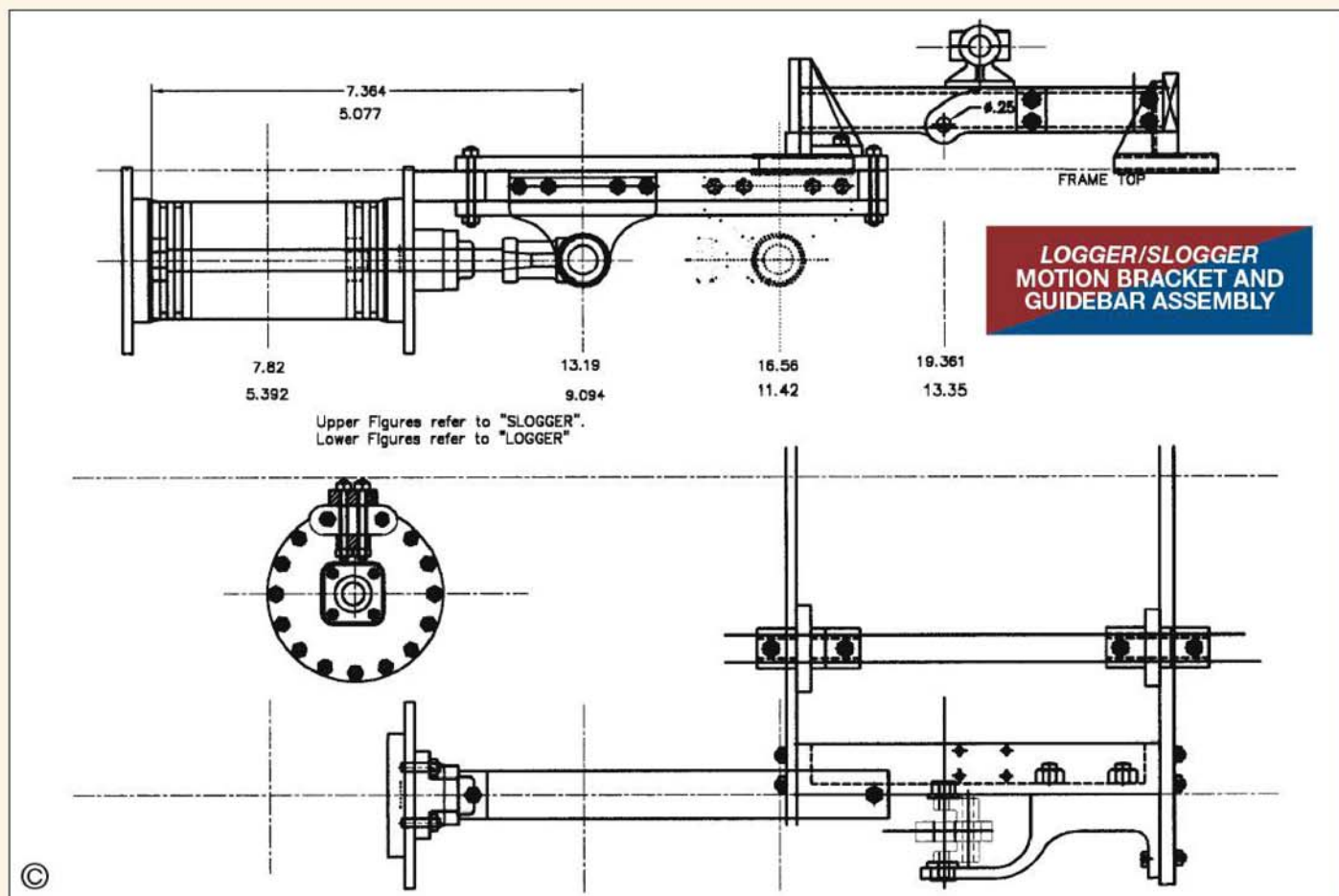
of mounting it to machine the slide-ways for the guide plates and the relevant nearby bits.

If I were making *Slogger* myself, I think I would start with a solid block of material 50mm square (35mm) if of black iron, or 2in. (1½in.) square if of brass or bronze. It would be about 9in. (7in.) long to make two covers at one go. (The figures

in brackets are for *Logger*.) Made end-to-end rather than back-to-back, mounting for milling is instantly improved. So I would begin by mounting it between centres in the lathe and dealing with the central part, which at this stage will be just turned down to a cylinder of appropriate diameter, leaving the ends square. If this strange-shaped item (a square-headed dumb-bell?) is now mounted on the flat face of the milling table (if your vice is not big enough) then it should be a doddle to machine off the peculiar profile and do the inside bits.

If you then go back between centres, the squares can be rounded to the correct size and the parts that go into the valve liner bores dealt with. At the risk of stating the obvious, do not attempt to part off in the lathe or you will certainly rue the day, but separate with a hacksaw or a bandsaw, trimming up with a file or Linisher.

If you start with a casting, then mill the ends square to start with, then proceed as above — and the best of luck!

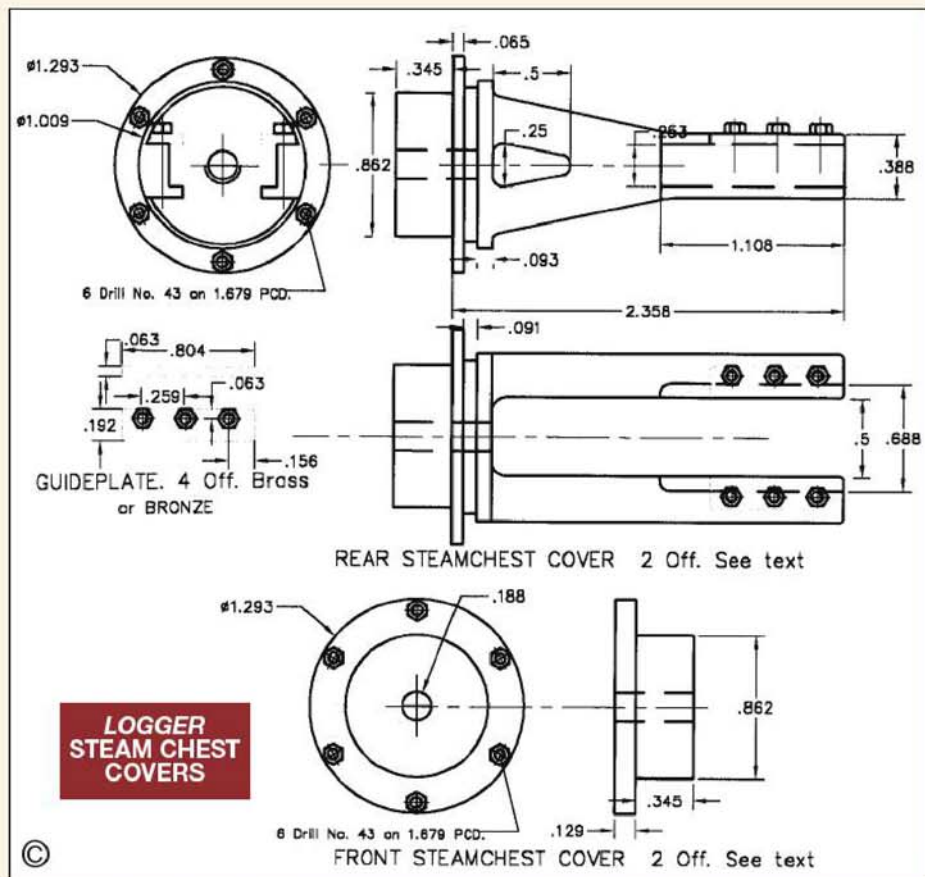


There is less room than perhaps we would prefer for clearance around the nuts (on studs) that will hold the cover to the liner, but if you decide you need a bit more room, then widen the undercut or groove shown as 0.132in. (0.091in.) but be careful, and/or reduce the diameter of the ridge just beyond it — or better still, chamfer it. But with careful assembly (nut-tightening a bit at a time) there should be just enough clearance.

The liners (*drawings to follow next time, apologies — Ed.*) require some accuracy, for the better they are (lengthwise) the simpler it will be to set the valves, and (diameter wise) the better the valve for sealing. Once again, honing to an eggshell finish is vital. The outside should be a snug fit in the steam chest bore in the cylinder block. Be careful to get the liners in handed pairs, or else! Note the taper lead into each end of each liner. If possible round off the inner edge thereof. The lead may be omitted from the rear edge of the rearward liner on each side and take care to make the relevant part of the cover to match.

They (the liners) are each hiding in a block of cast iron, sometimes two per block as this is the easiest way to machine them. It is far easier to hold one end firmly in a chuck while machining the other end. A good way to machine the ports is to mount the liner on a mandrel of which one end is held firmly in a chuck mounted on a vertical rotating milling table and with the other end supported on a centre. Do not worry about the slot drill for the ports cutting into the mandrel, for this can be made out of an odd piece of scrap steel.

Incidentally, if you have a friendly steel stockholder nearby, a visit to his scrap bin, (with permission) might well pay dividends. I have quite a pile here, frankly most of it has no actual



immediate purpose, but every now and again some need turns up — a big slab for a jig for example; and the pile pays for itself. Perhaps the oddest piece, here for curiosity, is a 1/4in. thick slice. So what? Of 14in. diameter!

The lengths of the ports need to be accurate (parallel to axis), but the width is less important. In due course, when you get to assemble the

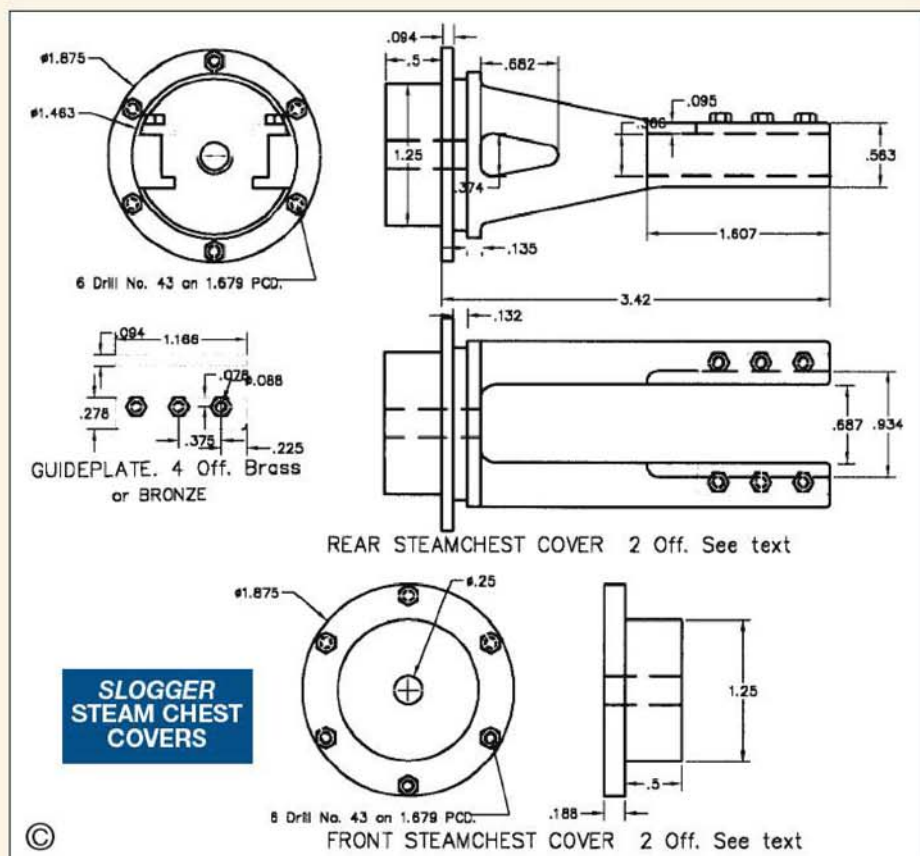
liners into the cylinder block, use acetone which is cheaper than tetrachloromethane (carbon tetrachloride) to wash off all traces of grease or oil from the mating faces of the liners and steam chest inside. These solvents are recommended by the makers of Loctite. Note that although washing off in the slightly cheaper white spirit produces a strong bond, it is somewhat inferior to that obtained using the recommended solvents. Although white spirit removes sufficient oil/grease to enable mild steel to rust easily, it leaves a film that can often be seen (especially on a polished surface) which, although it can be rendered invisible by wiping off dry with paper kitchen towels (recommended) it still remains, albeit in minute quantities. We are seeking what might be best thought of as atomically clean.

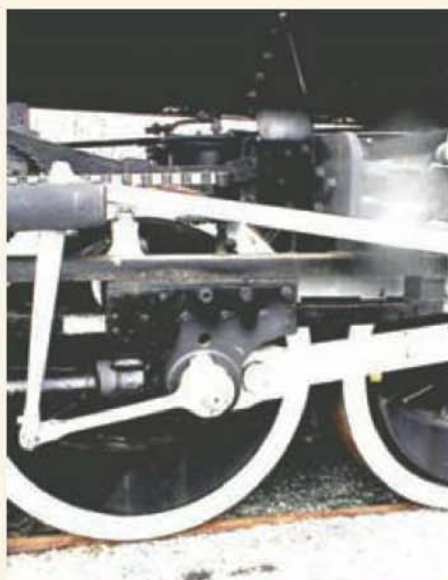
Have a mandrel ready, long enough to go right through the assembly of liners and cylinder block, let the diameter of this mandrel be of great accuracy. Silver-steel in mint condition is probably okay if you have honed out the liners exactly (worthwhile), if not turn down one from mild steel, lapping it to a first-class fit in the liners, which incidentally should match with great precision.

Grease this mandrel — but not too much. Anoint the outside of one liner with Loctite 603, or even the hot-strength 620 if you can get it, and anoint the inside of the steam chest, mating surfaces. Slide the liner into the block, give a twist or two to ensure complete sealing and repeat with the other liner (into the opposite end of the chest, dummy!) and twist as before. Insert the mandrel and check that the liners are in the correct radial position so that exhaust passages and ports line up with their proper items.

Lay the assembly somewhere safe; a warm radiator is probably ideal. Next day (by choice), gently persuade the mandrel out and put in the opposite set of liners.

The covers are fixed next, locating the holes for the studs from the covers. These covers do not





really need sealing for the exhaust pressures to which the joints are exposed are very low. Likewise, the holes in the covers through which the valve rods pass need no glands.

Guidebars

No, we're not talking about meeting-places for sweet young girl scouts, but the parts which take the vertical component of the angular thrust of the connecting rods. We don't really want this loading to a: bend the piston rods or b: wear the packing glands out before they're even run in!

Incidentally, when running forward, that is, cylinders ahead, the lower guidebars do no work to write of. When the wheel cranks are below the centreline, the thrust is upwards because the piston is pushing the crosshead rearwards; similarly above the said centreline it is pulling the crosshead forwards. That explains why several designs of locomotive meant for 99% forward running use triple-bar crossheads.

Guidebars can be made from silver-steel, but unless you can get it in the required sizes, you need to be careful when getting it down to width, because if it happens to curve as you machine it (bright mild steel most certainly will) it will be the devil of a job to bend it straight again.

I once tried milling guidebars from black mild steel — no trouble with that, but then I made the mistake of casehardening them. Quenching gave them curves only marginally less interesting than those of Kylie Minogue or Carol Vorderman, but which did not assist the required objective!

A certain well-known and confoundingly awkward Law of Nature says that not only are the outer ends of the guide bars not well shown on the Baldwin drawings, but that they are also hidden from view in the photographs; however, I have done what I can with facility of construction in mind. The little bracket on the left-hand end of

the 'Guidebars' drawing bolts onto two of the studs that also hold on the rear cylinder covers.

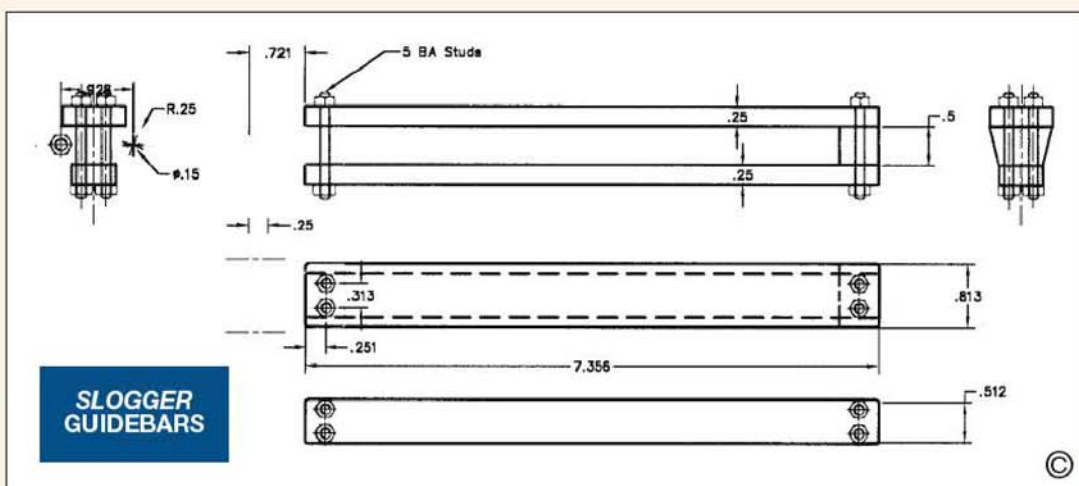
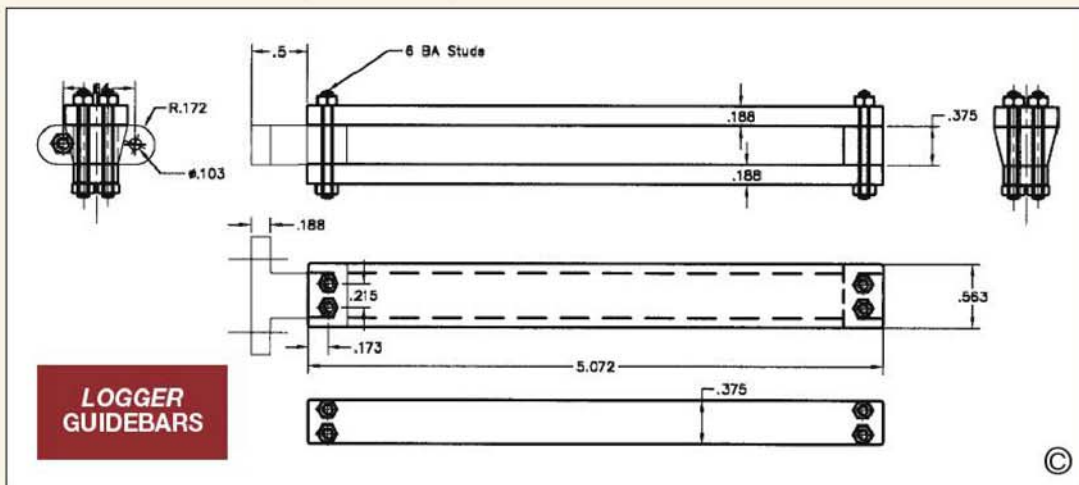
I also show (note non-GWR spelling!) a layout drawing giving an idea of the assembly of the piston rod, crosshead and guidebars. It shows how the guidebars are attached to the cylinder covers, and my idea of the attachment of the rear ends thereof. Close study of the photographs suggests that the bracket or block where the guidebars are attached to the cylinder covers might well be cast integral with the cover, but it could be a right pain to mould and machine in our sizes. Fuller details of these will appear in due course, of course!

This drawing includes an important dimension

that, alack and well-a-day, I missed from the drawing of the valve gear cradle. It is of course the distance along the frames for this item to be fixed. Most easily located either from the front edge of the frames, or from the intermediate driving wheel centre-line, it is 0.897in. in front for *Slogger* (0.618in. for *Logger*).

Three nice photographs are included here, no descriptions needed, courtesy of some Vancouver Island friends. Incidentally, if anyone would like copies of the published photographs and if they are on e-mail, then I can send them 'down the pipe' if they will but contact me, at keithgwrloco@fsbdial.co.uk No charge!

●To be continued.



AERONCA E113 AERO ENGINE in 1:4 scale

Les Chenery

details the machining of the crankshaft for this 36cc miniature.

●Part IV continued from page 323
(M.E. 4191, 21 March 2003)

The crankshaft was made from a piece of EN8M free cutting steel bar. If you can obtain this in the form of a $5\frac{1}{2}$ in. length of $5\frac{5}{8}$ x $1\frac{3}{4}$ in. flat bar you will save yourself a lot of time. Unfortunately I could only find a piece of $1\frac{3}{4}$ in. dia. rod. With access to a milling machine, it is not too much of a problem to remove 0.562in. from either side, but if you only have the use of your trusty Myford lathe, well, it will just take a little longer.

The jaws of my 4-jaw chuck protrude just over $\frac{3}{4}$ in. from its face which meant that when the rod was held lengthwise across the face of the chuck on the first step of two reversed jaws, the tips of the other two jaws, which should clamp on the sides of the rod, were below its centre line and tended to make the rod rise when clamping. I made two brass collars $1\frac{1}{8}$ dia. x $\frac{5}{8}$ in. thick with a centre hole to fit closely over the front step of the jaws, and tapped a 2BA hole $\frac{5}{32}$ in. in from the edge of the collar for a clamping screw.

Fixed onto the two jaws, these collars raised the contact point above the centre line of the $1\frac{3}{4}$ in. dia. rod. With the latter set reasonably central in the chuck and the lathe set to run at about 200rpm, light cuts were taken across the rod to remove 0.562 inch. This is a tedious process, especially if like mine, your lathe has no automatic cross feed. When this was done, the operation was obviously repeated for the other side but with the collars removed as the jaws were long enough to clamp above the centre line of the rod with one side removed.

After machining the second side, the bar was removed from the chuck and a file run over all the edges to clear any burrs. The whole bar was

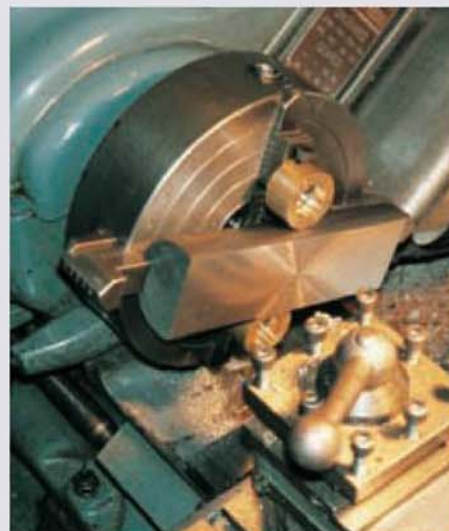
then given a coat of marking blue; a felt tip marker pen would have served just as well.

Now, holding the flat side of the crankshaft blank against an angle plate, mark out the centre line across each end as well as the two other lines for centre drilling on each end. Centre drill the three holes in each end. Hold the workpiece in a vice and machine away the unwanted material to the dimensions shown on drawings for the crankshaft blank. Next, make the spacers that will be needed for packing the webs of the crankshaft. These can be made from $\frac{5}{8}$ in. dia. brass rod parted off at 0.343in. thickness for a push fit into each web or held with a touch of Superglue.

Cut a $\frac{3}{8}$ in. bolt to fit loosely into the long undercut side of the blank and fit a nut on the bolt to make a spacer which can be expanded finger tight into one side of the blank after first pressing one of the brass spacers into the web which will be in line with the bolt. Do not have the bolt or spacer too tight or it will distort the blank. Clamp a driving dog across the end nearest the journals and with this end nearest the headstock, set it up between centres.

A substantial parting tool is needed, approximately 0.156in. wide, as it will need to protrude $1\frac{3}{8}$ in. or so to clear the revolving depth of the web and not bend sideways when taking a cut. It is important to have the cutting edge of the parting tool square with the work between centres and to have a small radius on each corner. Feed the tool into the web and check carefully that nothing will foul up when the machine is switched on, ensuring that the driving dog will clear the top-slide, etc.

Taking small cuts, especially while breaking the corners, the first journal can then be turned down to $\frac{3}{8}$ in. diameter. Aim for the best possible finish on the journal. When done, remove from the centres, fit the $\frac{3}{8}$ in. bolt into the opposite side and the brass spacer into the other web, and then set up between centres again to machine the second journal. When this is finished remove the



Roughing the crankshaft blank. The brass collars extend the jaws to enable them to grip the bar.

blank from the lathe and hacksaw or machine the two outside centre drilled holes from the ends of the crankshaft.

Hold the blank between the middle centre drilled holes and reduce the rear end of the blank to 0.625in. dia. by 0.500in. long. This is to hold in the 3-jaw chuck while you rough out the front end of the shaft, which will have the lathe centre to steady it at the front. With the two brass spacers between the webs, machine the front shaft to 0.562in. diameter. Now reverse the shaft, set it up between centres and turn the rear to the measurements shown on the drawings, leaving the $\frac{9}{32}$ in. dia. reamed hole to a later stage.

The crankshaft can now be reversed again and the front of the shaft can be turned, the end screw cut $\frac{3}{8}$ in. BSF and the 3deg. taper machined. Bring the outside edge of the webs to 1.625in. dia. and chamfer their corners. Remove from the centres, machine the flats across the bottom of each web to take the counterweights, and mill the $\frac{3}{32}$ in. slot for the keyway in the taper section.

Drill the oil ways through the webs, taking great care while doing so. Keep clearing the drill and take extra care when breaking through into the crossing holes. Breaking a drill in this operation will mean big trouble. I drilled the centre web through from each side to meet in the middle so as to reduce the risk of breaking the drill in one deep hole. The rear of the crankshaft can now be drilled 0.093in. dia. to join up with the oil ways and the end opened out to 0.281in. reamed by 0.312in. deep to take the end gear.



Using the milling machine to further reduce the blank to resemble the finished shape of the crankshaft.



Set-up for turning the crankpins. The tool must be very rigid in order to avoid chatter and to give the best possible finish to the crankpin surfaces.

[illegible]

CRANKSHAFT BLANK

SEE CRANK SHAFT DRAWING No 3

SEE CRANKSHAFT DRAWING No. 3

DRILL .15% DIA.

1.425

.032

.657

1.437

.012

1.196

.008

.750

.110

1.626

.012

.750

A. DIA. .125 DIA. 1.196 DIA. 800-150-1000 800-150-1000

PROPELLER HUB DRG-N° 6

* ANNUAL FOR PROPELLER
INCHES.

2. BSF 20 rti e. 562 amp

□

COUNTERWEIGHT
MILD STEEL 2 OFF

TURN THIS ANGLE WHEN COUNTERWEIGHT
IS FIRED ONTO CRANKSHAFT WITH ALLEN SCREWS.
TO MATCH ANGLE ON WES.

DRILLING FOR OILWAYS

AERONCA E-113
1931
1:4 SCALE MODEL

CRANKSHAFT DRG N° 3
ENB STEEL

SHEET 3 of 9
 Jan. 2000
 L. W. Sherry



Another view of the crankpin turning operation. Note the brass packing piece and jacking bolt.

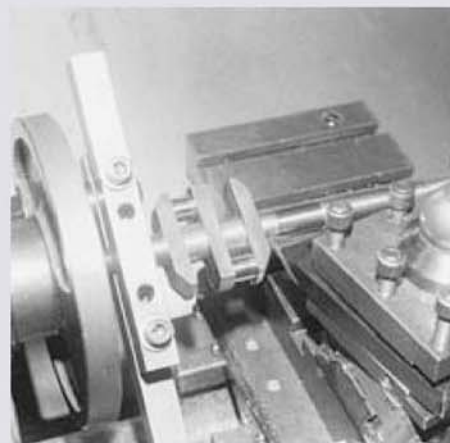
Make the two counterweights and hold them accurately in place on the webs while spotting through the fixing holes. Drill and tap these holes

Castings and drawings for this and other engines are available from
**Les Chenery, 18 Orchard Grove,
Edgware, Middlesex HA8 5BH.**
Please enclose SAE with any enquiries.

Readers are asked to bear with Les Chenery who is currently recovering from hospitalisation and unable to deal with orders/enquiries for a few weeks.

after numbering each one.

The oil ways can be plugged where necessary. I usually cut a taper pin until the small end just begins to enter the hole, then cut off about $\frac{1}{8}$ in. and with a smear of Loctite tap it into the hole, making sure it is not so long that it covers the hole which crosses at right angles to it. File the pins flush and polish the webs. With the counterweights screwed in place hold the rear end in a collet and, with a centre in the tailstock to steady the front end, turn the 35deg. angle on the outside edge of each counterweight matching up with the top edge. The end gear can be pressed home, but not too tightly, and held with a



Turning one end of the main shaft to finished dimensions.

taper pin. The oil will flow around this pin and into the webs.

●To be continued.

LETTERS TO A GRANDSON

M. J. H. Ellis

describes the operation of Edison's patent Sextuplex Telegraph.

●Part II continued from page 213
(M.E. 4189, 21 February 2003)

Dear Adrian, You could be forgiven for supposing that I have been tantalising you deliberately by taking so long in getting round to explaining the Sextuplex telegraph. But it really isn't true; it's just that I yield too readily to the temptation to explore enticing byroads on the way. So, before I start wandering off again, let's get on with it.

The diagram (fig 1) is a transcription into detached-contact form of the diagram which formed part of Edison's patent application No. 453601. It is by no means complete, and shows only enough of the circuit to show how it works. In fact, although the document is headed 'Sextuplex Telegraph', it starts off:

"To all whom it may concern:

Be it known that I, Thomas A. Edison, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented an Improvement in Sextuplex Telegraphs, of which the following is a specification.

The object of this invention is to transmit three independent messages in the same direction over one wire at the same time."

The specification continues with a description of the operation of the system in one direction only, followed by:

"I will mention that all the receiving instruments are to be wound with double coils and worked upon the differential system when sextuple transmission is obtained, or the receiving instruments may be placed in the bridgewire of a 'Wheatstone' balance, both systems being provided with devices for obviating or neutralising the effect of the static charge of the line."

I can see that the arrangement could be incorporated into a bridge circuit easily

enough, but I shall have to think about it in order to be able to suggest how the circuit could be operated on the differential principle.

Now see if you can put what I told you about the detached-contact conventions to good use. There is a dotted line down the middle of the diagram. The transmitting equipment is to the left, and the receiving apparatus to the right of it.

The first message is transmitted on the key K1, which closes the operating circuit of relay C. C1 very neatly commutates the current sent to line, which at its minimum value is that contributed by the battery F. At the distant end the change in the direction of the current is detected by the polarised relay G, whereupon G1 causes the operation of the sounder S1. The basic current is insufficient to operate any of the other receiving relays L, M, or N.

The second message is sent on key K3. When the key is depressed it causes relay B to operate. B1 brings into use the supplementary battery D, which has 100 cells, to augment the 50 cells of battery F. The increased current which now flows through the line is enough to operate relay L. This is the lowest of the current levels to which L will operate, but it also operates to any higher level. Relay M

would operate to this level of current, or indeed, to a lower one, but L1 disconnects its operating circuit. At the same time, L1 disconnects relay R, which hitherto was operated. R1 now returns to normal, causing sounder S3 to operate.

The third message is transmitted by key K2. When depressed, this key operates relay A. A1 augments the basic battery F by the 50 cells of battery E. The current is insufficient to operate relay L (which needs at least 100 extra cells to operate); but it is enough to operate relay M, the circuit of which has not been opened by the operation of L1. M1 opening releases relay T, and T1 closes to operate sounder S1.

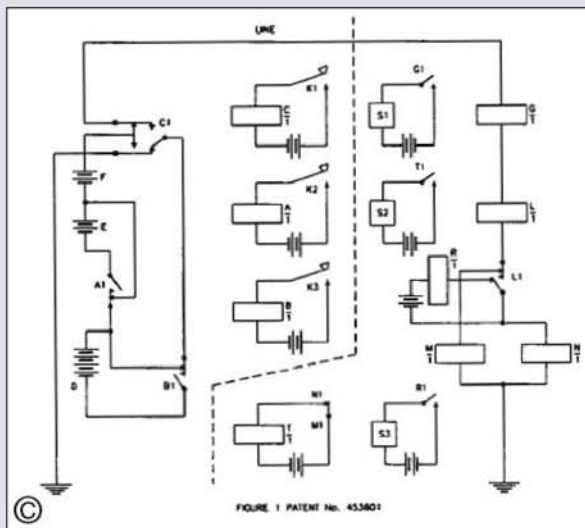
Finally, suppose that both K2 and K3 are depressed at the same time. Contacts A1 and B1 are now both operated, with the result that both battery E and battery D are brought into circuit. The basic battery is now augmented by 150 cells. Relay L operates, so breaking the operating circuits of both relay R and relay M at L1. The current level is at last sufficiently high for relay N to operate. M1 remains normal (i.e., closed), but N1 opening releases relay T. T1 closes to operate sounder S2. As relay R has also released, R1 closing has also caused sounder S3 to operate.

Every possibility has thus been covered.

In practice, I don't suppose that the multiplicity of small batteries, each operating only one relay or sounder would actually have been provided, as a good many of the batteries, if not all, could be replaced by a single battery serving the lot.

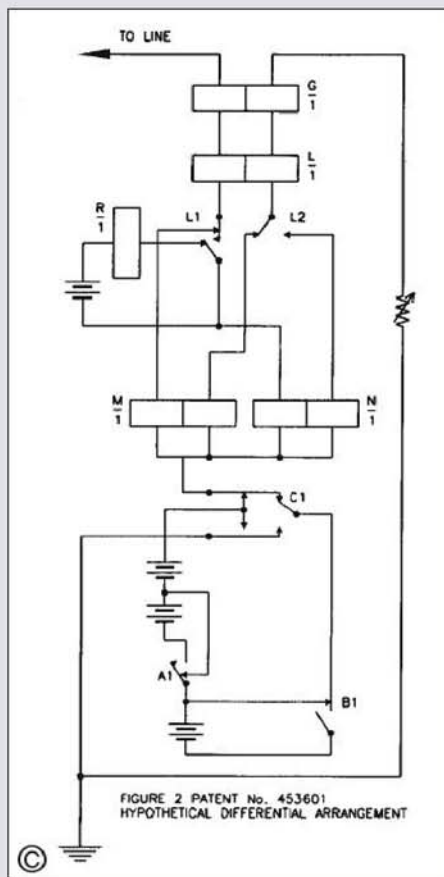
Circuits of comparable or greater complexity would, decades later, be found in automatic telephone exchanges, and display considerable ingenuity. But in 1877, Edison was breaking completely new ground, and, in my opinion, he did so with commendable energy and resourcefulness.

In my last letter I thought that the worst things which the sextuplex had to contend with were primary batteries of unstable voltage and bad joints in the overhead iron wire lines. I have been thinking about these two factors, and as regards the latter,



the poor state of the lines became all too clear as soon as experiments with the telephone were carried out over them. They were so noisy that speech was hardly intelligible at all. I suppose that no telegraph company would have been willing to upgrade its circuits before it was satisfied that the sextuplex would work, but at the same time, there was no prospect of proving that it would work until the lines were improved.

It seems to me, however, that the instability of the battery voltages was a more intractable problem still. It is reliably stated that the voltage of a Leclanché cell could vary over a range of 1.00 to 1.55 volts. As the current through all the cells of a particular battery would be the same, it is reasonable to suppose that what applied to one cell would apply to them all, and that the voltage of the entire battery could vary in the ratio of 1:1.55; by, that is, over 50%. But the batteries which Edison proposed to use in his patent specifications were, including the 50 cells of the 'priming' battery, of 100, 150, and 200 cells in aggregate. The greatest ratio between the number of cells used for adjacent channels is thus 100:150, or 1:1.5, which is rather less than the possible variation in battery voltage under extreme conditions, and of course the ratio separating the other pair of channels, 150:200, or 1:1.33 is even smaller.



I said earlier that I would think about what Edison might have had in mind when he mentioned that the circuit could be duplexed on the differential principle. At first sight relay R appeared to be the stumbling block; how could it be made differential? But then I realised that it plays no part in the primary business of signal recognition; that is the business of relays G, L, M, and N. There is no difficulty in bringing these into the differential fold. All that is required is to provide relay L with a second, change-over contact. I have shown the essential elements of this scheme of things in my other diagram (fig 2) as they would be at the distant station. I have left out the trimmings, such as the keys, relays A, B, C, and T, and the sounders, which remain just as they are shown in the first diagram (fig 1). The only difference in the *modus operandi* is that L2 brings into use the second (right-hand) coils of relay M or N, to maintain the differential operation.

That seems to have tied up the Sextuplex for the present, although I dare say that I shall have thought of something which I ought to add when I come to write my next letter. Perhaps, also, I shall have worked out the answer to my injector conundrum.

●To be continued.

THE ROMANCE OF STEAM!

Wessex Trains announces a new programme of steam hauled train services.

Using its recently restored locomotive *Tangmere*, Wessex Trains will give passengers the chance to experience the Good Old Days of steam-hauled rail travel. *The Golden Arrow*, one of Britain's most famous trains, together with *The Excalibur Express* and *The Royal Wessex* are scheduled to take passengers to places of historic interest throughout the south of England. The 2003 programme runs from April to October; details of the services are listed below.

Services will depart from London Victoria, Kings Cross, Liverpool Street, Waterloo or Paddington between 08.00 and 11.00 and return

around 9pm the same day. Passengers will be able to take in the sights along the way, with a four to five hour stopover at the chosen destination. Wessex Trains will also provide comprehensive detailed information of destinations on board, allowing passengers to plan their trip prior to arrival. For dining passengers, a brunch will be served on the outward journey and a full dinner on the return journey. A buffet car will also be available to all customers.

The price indication for Standard Class passengers is £55, Standard Plus at £79 and First Class (includes full dining) £140. Perfect for those special occasions, a number of seats on



luxurious Pullman carriages will also be available at £225. There is also a Standard Family Group Fare of £160 for 2 adults and 2 children under the age of 16.

For more information or to make a booking, please call 0870-747-3829 or visit www.wessex-trains.co.uk

Please note that train times will be confirmed upon booking.



2003 PROGRAMME

Date:	Time:	Departing from:	Destination:
05 April	10.45	Victoria	Canterbury
26 April	09.45	Paddington	Bath & Bristol
03 May	TBA	Kings Cross	Spalding (Flower Festival)
10 May	09.00	Paddington	Stratford upon Avon (via Warwick)
17 May	10.30	Victoria	Dover & Canterbury
31 May	08.30	Waterloo	Swanage
07 June	11.00	Victoria	Salisbury for Stonehenge
15 June	TBA	Liverpool St.	Norwich
26 June	10.30	Victoria	Dover & Canterbury
05 July	10.45	Paddington	Bath & Bristol
12 July	11.00	Victoria	Salisbury for Stonehenge
19 July	08.30	Waterloo	Swanage
26 July	TBA	Liverpool St.	Norwich

2003 PROGRAMME (continued)

Date:	Time:	Departing from:	Destination:
31 July	11.00	Victoria	Dover & Canterbury
09 August	09.30	Paddington	Stratford upon Avon (via Warwick)
16 August	09.45	Paddington	Bath & Bristol
23 August	08.30	Waterloo	Swanage
07 September	TBA	Victoria	Arundel for Goodwood
14 September	TBA	Victoria	Brighton
20 September	10.30	Victoria	Dover & Canterbury
27 September	11.00	Victoria	Salisbury for Stonehenge
04 October	08.30	Waterloo	Swanage
10 October	09.00	Victoria	Dover (for ferry connection to Paris)
12 October	18.00	Dover	Victoria (return from Paris)
18 October	09.45	Paddington	Bath & Bristol
25 October	10.30	Victoria	Dover & Canterbury

A HEINRICI HOT AIR ENGINE

Mike Thurgood

in South Africa, deliberates on the activity of running his completed engine at a two-day field event.

●Part X continued from page 327
(M.E. 4191, 21 March 2003)

The Heinrici hot air engine was finished on a Friday, just in time to run it for the following two days at SARDA 2000, a field event organised by the South African Riding for the Disabled Association and held at their grounds in Constantia, about 20km south of the centre of Cape Town. The Cape Vintage Engine & Machinery Society (CVE&MS) had been invited with their open crank engines, together with a restored Aveling and Porter 8nhp steam road locomotive of 1921 vintage and a restored Ransomes portable steam engine of 1980s vintage, all present and running.

The CVE&MS very kindly invited me along with my stationary steam engines and three hot air engines, and made me a member, to boot! I had the engines on exhibition in the field on a flat bed trailer in perfect but somewhat windy weather, typical of the Western Cape in the summer months. I was able to run the Heinrici hot air engine most of the time, principally because it was the only one with a totally enclosed firebox.

The firebox made for the Ericsson hot air engine (described in M.E. 4086-4090, 29 January-26 March 1999) was open at its base, and the Robinson B4 hot air engine has only the most squat of skirts surrounding the hot end of the displacer cylinder, typical of the 5in. size made commercially. Photographs I have seen of larger Robinson engines show enclosed fireboxes. Although I could get the Ericsson to work reasonably well in the prevailing conditions, I only tried the Robinson once because it was being pretty awkward about wanting to get going.

Two of the photos presented here are substitutes for the missing originals for which the negatives have also been mislaid. **Photograph 51** shows the Heinrici in its brand new livery taken a little while after the engine had been constructed and a water pump had been added which will be the subject of a separate short article. My original **photo 52** showed the engine running at SARDA 2000; its substitute here was taken in 2001 at the Bien Donne Agricultural College Show at Groot Drakenstein on the road between Paarl and Franschhoek in the Western Cape of South Africa.

Before attaching the engine firebox/stand to a baseboard, vibration caused it to wander about. Its wanderlust was minimised by a few strategically placed matchsticks until proper mounting cured this tendency but not the cause, which is the result of the weight differential between the displacer piston, its piston rod and connecting rod, plus a contribution from the crank axle and webs, and the power piston assembly plus its connecting rod, crank pin and cast-in crank boss on one flywheel.

In the absence of circulating water through the



The Author's completed Heinrici hot air engine. The components were primed using an etching primer and finished with Hammerite paints of various colours. The simple air vent needle valve can be seen on the centre line of the engine just below the power cylinder. My trademark handle is scalloped for grip, not knurled. The permanent water tank is on the right of the picture.

water jacket, I resorted to topping it up at intervals so that at least it couldn't boil (100deg.C, 212deg.F). I had no problems with this method, and when using the relatively low temperature meths burner, the cooling water did not reach boiling point, a matter to which I shall shortly return.

In his articles, Edgar Westbury makes the point that the angle between the displacer and power piston cranks does not necessarily optimise at exactly 90deg. (with the former leading and dictating the direction of rotation). The reason suggested was that there was a lag, or 'dynamic hysteresis air flow phenomenon' (my own terminology) due to the finite air flow rate from the displacer cylinder into the power cylinder and back again, which obviously isn't instantaneous.

Having made no attempt to set the angle between the cranks to exactly 90deg., I guess it is about 85 degrees. However, the engine ran well enough that I do not intend to bother with experiments to optimise the angle between them. A check with a mechanical rev. counter showed that once it had reached thermal equilibrium, it ran at about 450rpm, a speed which it maintained for the two days of the show.

I noticed that despite the enclosed firebox, the meths flame was occasionally and prematurely extinguished. With a closed firedoor, the wind could not possibly have blown directly onto the flame to douse it. However, could it have been possible that the passage of wind across the top of the chimney pipe somehow set up a turbulence which temporarily prevented the burnt gases from

escaping? That said, I can't pretend to having heard any musical notes emanating from the tube!

If this was the case, then the flame would quickly use up the limited supply of unreplenished oxygen in the firebox and self-extinguish. Perhaps the conical (comical?) caps seen mounted on the tops of the chimneys in photographs of hot air engines are the answer — or perhaps they are fitted only to prevent rain from getting down the chimney and dousing the fire? That the meths flame occasionally went out is indisputable, but my tentative explanation above may stir a reaction. Further cogitation and a recollection of the chemistry of burning alcohol provides a less prosaic but more plausible explanation which will have to wait for some other occasion.

A totally unexpected feature of this engine was that if the air vent from the displacer cylinder was cracked open, thus causing the engine to slow down, and then closed again, the speed of the engine very rapidly increased. So there are obviously various places where air can readily leak back into the system to restore the pressure.

The puzzling point is that, assuming air can leak in, why doesn't it also escape when the working pressure exceeds atmospheric, and thereby prevent the engine from running? The factors involved in this re-start phenomenon could undoubtedly be determined with appropriate instrumentation, e.g. to determine temperature and pressure differentials with crank movements, and air leakages into and out of what is always referred to as a 'closed' system, but the cost of doing so would be difficult to justify as a personal expense.

Prior to SARDA 2000, I had only ever thought of running the hot air engines in a draught-free hall or garage. But from the reaction which these engines attracted from the visiting public, it required little thought after the show to realise that their interest was largely the result of having them running, and very silently too, quite unlike steam engines.

Running hot air engines indoors presents its own problems. If combustion is incomplete, meths burners produce an unpleasant and pungent-smelling flue gas, and errant oil invariably gets onto hot surfaces, producing its own distinct, and to some, highly objectionable smell. So at public events, I think hot air engines are better seen running outdoors than in some hall, room, or whatever other closed area is available.

At such shows it is unlikely that there will be any possibility of connecting to a water supply for the water jackets, therefore under *alfresco* conditions, not only do these engines require enclosed fireboxes (furnished with holes for the ingress of air), but also a relatively independent water supply, preferably re-circulating, which can be topped up as it evaporates, and replaced if it gets too hot. A water supply at such events may simply be a full bucket or watering can which has to suffice for several hours' operation. The prospect of a long walk to replenish this supply may not be welcomed by the exhibitor.



52
A general view of the Author's models on display in 2001 at the Bien Donne Agricultural College Show at Groot Drakenstein, Western Province, South Africa. Two visitors are obviously interested in the explanatory notes. The three hot air engines from left to right are: Ericsson, Robinson and Heinrich.

Following SARDA 2000, I designed and constructed a self-contained water flow system for the Heinrich. Having given the matter some thought, I decided that as an interim measure a small cylindrical tank cut from a length of stainless steel tube would be adequate for a feed water supply to the water jacket inlet. The tank can be topped up as frequently as necessary.

The only possible location for mounting this tank to minimise the required space was between the flywheels on the inlet side of the water jacket, the side on which I had originally mounted the chimney elbow (photo 48, *M.E.* 4191, 21 March 2003). The tank couldn't be satisfactorily mounted on the outlet side of the water jacket because the necessary outlet pipe would have made it considerably more difficult to devise a means of mounting it.

The part-finished assembly of this small tank with its water fittings and pipes is shown in photo 52. However, the permanent solution can be seen in photo 53, with a water tank on a mini-stand, and including a water pump, similar in design to that fitted as standard to the Ericsson hot air engine.

By the way, I have discovered that a company called Tiny Power in the USA can supply cast bronze 'trees' of an extensive selection of versatile water and steam fittings in three different scales. I use them wherever possible. They can be machined to suit most applications; a normal tee-piece can be made into a valve or a stopcock. Others can be made into globe valves but I must admit that I'm not sure if this is their real intention.

A thin light reddish-brown coloured line between the body and the top of the stand can be seen in photo 53. This is a Klingerite heat insulating gasket. I don't suppose the old form of composite asbestos-filled gasket material I used would be generally acceptable these days. Manufacturer, James Walker & Co, still make Klingerite, which I assume no longer contains asbestos.

The water tank was cut from a suitable length of 45mm O/D thin walled stainless steel tube. Anticipating the possible requirement for a re-circulating water pump for the engine to work (photo 53), I included provision for a connection to such a pump by extending the power piston drive crank on the flywheel (photo 38, *M.E.* 4187, 24 January 2003).

However, as mentioned in a previous part of this series, I abandoned this idea when I saw how the water pump for the Rider hot air engine is operated from an extension bracket attached to the top edge of the power piston, thus providing a vertical movement, not a rotary one.

Since the temporary water tank assembly now got in the way of the chimney and its mounting elbow, these were removed and remounted on the firebox panel opposite to the power cylinder.

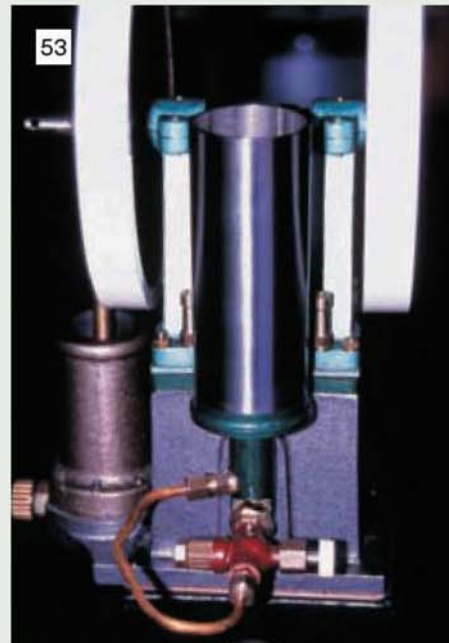
The interest attracted by running these hot air engines at SARDA 2000 indicated that they are far better run outside. In order to provide future successful demonstrations, it was obvious that an enclosed type firebox and a water supply were necessary. The fireboxes for both the Ericsson and Robinson hot air engines, which were constructed some years ago had to be totally enclosed, with air access holes, so that they can be run in less than perfect outdoor weather. Any modifications and/or additions must be in character, even if they couldn't be expected to reproduce any original features;

A suitable water supply for maintaining a continuous flow through the water jackets with minimal topping up from static water, was also necessary. It is essential for water to be available at the working site, and be capable of replenishment from a nearby piped source.

I realise that the foregoing is pretty obvious, but I have come across so few photographs of hot air engines working in the field. That said, they seem to be becoming more common at various model engineering exhibitions which, of course are presented in enclosed exhibition halls. My perception is that exhibitors seem to prefer modern high temperature, high speed engines with highly efficient regenerators (heat exchangers), with either gas or electric heating, and air cooled because of their high running temperatures.

The modifications being made to the Robinson and Ericsson hot air engines, and the recirculating water pump for the Heinrich engine, are the subject of a two-part article in the *Journal of the Society of Model & Experimental Engineers (SMEE)*, the first of which was published in Vol. 10 No. 3, January 2002.

Strangely, before mid-1999 I had never actually seen any commercial hot air engines, i.e. of the old commercial pumping types, in a



53
The temporary water tank assembly fitted before the water pump shown previously had been constructed. The water inlet connection uses a globe valve made from fittings supplied some years ago by Tiny Power in the USA. The two short brass pillars either side of the tank are mounts for a brass support plate for a stainless steel tank retaining strap, not fitted when this photo was taken. The chimney elbow just below the water tap assembly had yet to be removed and remounted on another side of the firebox

museum or anywhere else. I obviously missed those examples on display when visiting the Science Museum in London in 1991, probably because I wasn't looking for them at the time! But in 1999 I came across a 5in. or 6in. dia. (power cylinder size) Heinrich hot air engine on display in the entrance hall to the Engineering Department at Stellenbosch University. In magnificent condition, it stands about 1.8m high and I understand that it is occasionally run.

I must get to see it running. If I offer to have my small scale version running alongside as well, maybe, they will run it for me!

●To be continued.

OIL CAN STORAGE

Oil seems to have the unique propensity to escape from virtually any container you store it in. This seems to be particularly true of the typical oil can or oil gun used to lubricate the model engineer's lathe or other machine tools. A collection of oil cans and grease/oil guns can quickly build up and pretty soon, no matter how carefully you store them, the chances are that they will all end up standing in a puddle of lubricant. This is unsightly and can be downright messy as the oil turns sticky.

I find it helps to keep things tidy by obtaining a pressed steel baking dish or tray, the sort with no seams to leak, and stand the oil cans and guns in this. They will still leak, but the spillage can be mopped up regularly and the workshop remains tidy. Such dishes can be picked up new at discount stores or or maybe scrounged from the local tip. However, check that you get one which doesn't leak! Neil Read.

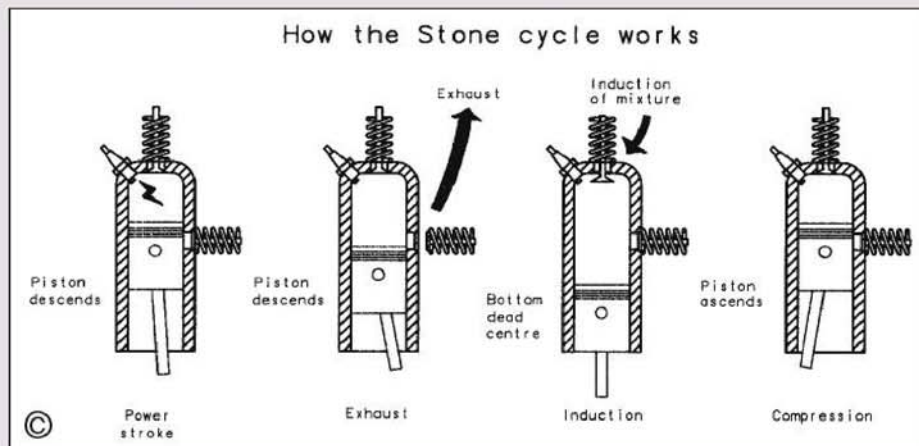
AN UNUSUAL TWO-STROKE ENGINE

Dr. Robert Kisch describes a two-stroke engine with an unusual operational cycle.

Traditional crankcase compression two-stroke engines suffer from one irredeemable flaw. Despite cunning design of the cylinder ports, unburned petrol and oil can escape through the exhaust port due to the exhaust port and transfer ports being open simultaneously. This, for example, is one factor in the banning of two-stroke outboard motors from many lakes. Additionally, the retained products of combustion due to the exhaust gas recirculation arrangements often used, reduce the peak combustion temperature and minimises the reaction between the atmospheric oxygen (20%) and nitrogen (80%) which forms nasty nitrogen/oxygen combinations. Consequently, the engine to be described may be of interest for environmental as well as historical reasons.

The last decade of the nineteenth century was a period when Otto successfully pursued infringement of his four-stroke patent in the courts. This encouraged workers like Day, Atkinson and others to explore two-stroke designs having one power stroke each revolution when single acting. One such worker was Monsieur A. P. Stone of Paris who, being familiar with steam engines, designed a long stroke engine with an open crank and spring loaded valves in the inlet tract and exhaust port.

In the Stone engine, the cycle is as follows: after firing, the piston begins to descend and uncovers an exhaust port approximately 63deg. after top dead centre. The exhaust gas pressure lifts the valve located in the exhaust port and the products of combustion escape to atmosphere. The piston continues to descend and, as the pressure in the cylinder reduces, it enables the adjustable spring to re-seat the exhaust valve. The piston descends further, creating a negative pressure in the cylinder which opens the automatic (adjustable spring-loaded) inlet valve, drawing in fresh mixture. After bottom dead centre the piston begins to ascend, and the inlet valve closes as the pressure rises. The exhaust



valve spring pressure should ideally be such that the rising pressure in the cylinder is insufficient to open the exhaust valve until after the piston has closed off the exhaust port. Compression is then completed, the mixture is fired and the cycle repeats.

It can now be understood how this exhaust valve arrangement should preclude the loss of inlet charge. Governing is achieved by adjusting the tension of the inlet valve and butterfly throttle opening. The disadvantages of the system is the long stroke required and the inlet valve bounce and resonance characteristics limiting engine speed. It is, however, a most interesting design.

I built my Mk. 1 version of this engine without drawings, 1in. bore by 1 1/2in. stroke. However, the stroke was insufficient. Castings for the Mk. 2 version with 1 1/4in. bore and 3in. stroke were obtained. The exhaust was modified to incorporate a 1/2in. dia. ball with adjustable spring loading leading via a 1/2in. dia. bore flexible pipe to a converted aerosol can silencer. I built the carburettor from scrap, initially with a 3/16in. venturi, adjustable needle jet and butterfly valve. A double row, spherical big end ball bearing allows for any cylinder misalignment, its housing allowing compression ratio adjustment by means of the screwed-in connecting rod. It should be remembered that adjusting the compression ratio also changes the exhaust port timing.

A flat ground on a spacer sleeve secured with grub screws over the crankshaft between the pedestal needle bearings serves as an ignition cam. I used my wife's old twin tub washing machine spin drier motor as a starter motor after the rest had expired spectacularly some years before. A dynamo driven off the flywheel rim emerged as the simplest way to achieve a measurement of the 11 watts at 1,350rpm output. The discarded power saw coil originally used turned out to have a dry joint, so it was replaced by an automotive item. Spring-loaded safety switches on both the starter motor and the coil complete the wiring.

Fuel used initially is 24:1 two-stroke mixture fed from an overhead fuel tank. This ensures adequate piston lubrication. Experimental adjustment of ignition timing, exhaust and inlet valve spring tensions combined with a reduction in venturi size to 1/8in. eventually produced excellent starting and running. On this little engine best running was at 950-1,100rpm with the 'white paper test' showing a clean exhaust. I then found that some 20deg. ignition advance and judicious tightening of the exhaust valve spring achieved the 1,350rpm output. However, running remains unsteady and obviously a proper analysis needs to be done one day but this is a start. The adjustments are rather critical. The excessive vibration indicated the need to do some flywheel balancing. The alloys used for the castings mean that the flywheel is too light to achieve any real dynamic balance.

All in all this little engine does have the potential to limit the loss of unburned fuel through the exhaust port in an easier way than with a mechanically driven rotary valve. Readers may wish to comment.

My thanks to Adrian Grimmer of L.A. Services, Warwickshire for his foundry efforts and to Robin James Engineering Services of Leominster for machining assistance beyond the scope of my ancient little Myford.

Casting and drawings for this engine are available from L. A. Services Ltd., Bramcote Field Farm, Bramcote, Warwickshire CV11 6QL; tel: 01455-220340, email: info@theengineersemporium.co.uk website: www.theengineersemporium.co.uk.



The Mk. 2 engine mounted on its test bed and showing some of the features referred to in the text.



UK News

The most recent newsletter from the **Gas Turbine Builders Association** contains an interesting feature about a new approach to the design and construction of jet pipes. There is also much useful information relating to lubrication with angular contact bearings. Although there are many letters of a technical nature from members both asking and answering questions, it seems to be generally agreed that most of the membership wish to build from existing designs or kits. This is not surprising when the complex nature of gas turbine engines is considered, and follows the pattern of model making in general. When all is said and done, modelling is generally about making a miniature version of a favourite artefact. Relatively few modellers have ever been true experimenters and developers. The GTBA annual competition was held last November, and attracted a relatively small entry but a wide range of prototypes. The competition is divided into two classes: Thrust, won by Rob Rowbottom, and Specific Fuel Consumption, won by John Wright.

Members of **Peterborough SME** will be holding an exhibition in conjunction with track open days at the Sue Ryder Hospice, Thorpe Hall, Peterborough on 1/2 June. Further information is available from Secretary Tony Meek at 10 Mossop Drive, Langtoft, Lincolnshire PE6 9LY; tel: 01778-345142; e-mail: tony@meek2.freemove.co.uk All the relevant information can also be obtained from the club's interesting new web site at www.peterboroughsme.co.uk

The annual **Model Steam Road Vehicle Society** rally takes place this year on 28/29 June with the possibility of one major programme change. Previous rallies have always featured a Saturday evening barbecue, and while no-one doubts its popularity, there have been some problems. For example, if (when) the weather is poor, people tend to collect their food and retire to their own tents or caravans to shelter from the rain while those operating the barbecue have to brave anything the weather throws at them. By way of an experiment, it has been suggested that the barbecue could be replaced with a ploughman's platter served inside the rugby clubhouse together with organised entertainment that

includes a live band, thus giving everyone the opportunity of socialising for a longer period. The scheme has not yet been settled, and any change to the arrangements will depend on feedback from the membership.

The new year **Melton Mowbray MES** steam-up turned out to be a non-event because on arrival, members found large areas of the track under water. Serious thought is therefore now being given to methods of drainage and carrying out the work as soon as possible. Good progress has been made with fencing around the track, and a hard standing has been built for loading and unloading models. The latest copy of the club newsletter contains a snippet from the *Leicester Mercury* which should give us all food for thought. It concerns a grinding machine with no wheel guard fitted, and a wheel which exploded when in use, leaving the operator severely brain damaged. Fortunately, few of us will ever have witnessed such an accident, but from all reports it is a most frightening experience and severe injury and damage to people and property can occur when a wheel explodes, apparently without warning. Grinding wheels should be properly inspected and fitted, and only used when protected with the appropriate guarding, work/tool rest and eye guard in place. They should also be examined regularly for possible signs of damage. We are told that only the periphery of a disk wheel as fitted to an offhand grinding machine should be used, but most of us need occasionally to use the flat side faces. On such occasions the work should be positioned as near to the periphery as possible and only light pressure applied. Proper eye protection is a must — no excuses — and grinding dust and debris should be cleaned off the machine after use. All due attention should be paid to the maximum operating speed printed on the wheel and any date which may be present on a resin bonded product. Properly used, a grinding wheel is no more of a hazard than any other powered workshop equipment, but careless use can result in serious damage and/or injury.

Members of **Newport MEC** continued working throughout 2002 in anticipation of moving to a new site at the Gbeblands Sports Centre later this year, although this move is still subject to the granting of planning permission. When the move comes about they will join forces with the **Caldicot Model Boat Club**, the new organisation retaining the

name of the model engineering society. After many years of service, the portable track has been retired and a new one built to replace it, this being far lighter as well as easier to assemble than the old one. A new portable boating pool has also been made and the use of the new track and the pool at several events has enabled a useful sum of money to be raised towards the proposed move. A new steam powered club locomotive is under construction as well as three radio controlled boats, the latter intended for use to give interested members of the public the opportunity to try for themselves the controlling of model boats by radio. The society would be pleased to welcome new members whatever their model engineering interest. Further information can be obtained from Terry Walters, Bywood, Mynyddbach, Monmouthshire NP16 6RW; tel: 01291-641338; e-mail: terracewalters@hotmail.com

All members of the **Wigan DMES** committee were returned unanimously and unopposed to their posts at the recent AGM. Following the official business, Brian Woodward entertained the meeting with a talk illustrated by slides of a journey he made on the Trans Siberian Railway.

The **Fylde SME** club locomotive is a petrol driven Class 08 shunter; however, it has been decided that the society would be better served by a battery powered locomotive. Conversion work has therefore commenced, which will involve some slight alteration to the bodywork as well as the necessary mechanical changes. Members have been asked to donate any surplus tools for sale during the club exhibition at the Marine Hall, Fleetwood on 5/6 April, the proceeds from which will go towards improving club finances.

The **Southern Federation MES** spring rally will be hosted on 17 May by members of **Bromsgrove SME** at their track at the Avoncroft Museum of Historic Buildings, Stoke Heath, Bromsgrove. The club has a raised track suitable for 2 1/2, 3 1/2 and 5in. gauge models as well as a garden railway for 32mm and 45mm gauges. Coal and water will be provided and both 12 and 230 volt power supplies are available. Several trade stands will be present, and refreshments will be available. Camping and caravanning facilities are available in the adjacent picnic site and can be booked at the museum office. The museum is on the A38 road and is signposted at Junction 4 of the M5 and Junction 1

of the M42 motorways. Subject to a separate entry fee, the museum will be open throughout the weekend, and the host society will be holding its own open day on Sunday 18 May.

Members of **Bradford SME** enjoyed a talk on ornamental turning presented by Jim Batchelor who brought along examples of his own work together with various special chucks he had made for his Myford lathe to enable him to do it. Despite the weather, work has continued on the tracks and inside the clubhouse at Northcliffe. The replacement of roller shutters for the clubhouse is being considered; although costly, once fitted there could be a considerable saving in insurance premiums which, in the long run, could make this the least expensive option. A grant has been authorised to cover the cost of railings around the ground level station, and the parks manager has agreed to put up a sign to deter obstruction at the gate, which can make it difficult for those who wish to bring in or take out models.

A longstanding dream of some of the older **Bristol SMEE** members to do away with manhandling the passenger stock on and off the raised track for each running session has at last come true. A great deal of hard work has resulted in the completion of a new carriage shed with a rail connection to the main track. The project has actually been completed ahead of schedule and from photographs we have seen, it is not only very practical but also looks very smart. When members arrived for the society AGM at Begbrook Community Centre, where meetings normally take place, they found the dance floor area out of bounds due to renovation. This was a difficult situation for the busiest of all evenings, but everyone managed to squeeze into the available space remaining. The annual club awards were presented at the end of the meeting as follows: *Founders Cup* to Pete Heimann; *H. M. Webb Trophy* to Eric Lindsay; *Steam Locomotive Cup* to Colin McEke; *Ted Knight Trophy* to Norman Rossiter; *Machine Tool Cup* to Ted Halliday; *I/C Engine Cup* to Donald Hamilton; *Eric Griffith Trophy* to Alan Hutfield and Alan Pierce; *Chairman's Plate* to Alan Hooper; *Joe Ginn Trophy* to Howard Janes; and the *Memorial Prize* to Jason Hill.

Themed meetings have proved so successful for **York City DSME**, has they are to be expanded. Two such meetings have been held so far, the first devoted to stationary steam engines and the second to

In Memoriam

It is with the deepest regret that we record the passing of the following members of model engineering societies. The sympathy of staff at *Model Engineer* is extended to the family and friends they leave behind.

Trevor Couvell
Harry Holland
Jack Howson
John Phillips
Maurie White

Isle of Wight MES
Huff Valley MES
Wigan DMES
Isle of Wight MES
Steam Locomotive Society of Victoria

internal combustion engines; these will be followed by meetings dedicated to boats and clocks. Chairman Pat Inwood stood down from the post of Chairman at the AGM, his place being taken by Don Paton. With the Vice Chairman and Treasurer also choosing to stand down, the only previous committee member remaining is Secretary Ken Bateman. Pat Inwood agreed to take on the post of Treasurer, thus ensuring that his experience remains available to guide the club through the coming year.

On 21/22 July, **Brighouse & Halifax ME** are to hold a themed rally for models of locomotives designed by Sir William Stanier, of which there must be countless examples. The society has raised tracks for 2 1/2, 3 1/2 and 5in. gauges and a ground level 7 1/4in. gauge railway. An enthusiasts' only event, the public will not be admitted to the track site which is situated in Ravensprings Park, Cawcliffe Road, off the A641 road between Brighouse and Bradford, not far from Junction 25 of the M6 Motorway. Limited camping and caravanning facilities are available and a barbecue is planned for the Saturday evening. For further information, contact Secretary Bob Durham, tel: 0113-293-8524 or 07884-356275.

Although heavy rain has hampered outside work and thus prevented the completion of alterations to their ground level track, members of **Isle of Wight MES** have nevertheless been able to make some much needed improvements to their premises by laying a new floor and repairing a sagging ceiling. They hope to complete the work on the ground level track in time for their forthcoming open day on 27 April.

World News

New Zealand

Christmas 'down under' is of course celebrated during their summer, but despite this, all previous attempts by the **Hutt Valley MES** to hold a Christmas barbecue have been ruined by rain, except that is for last year. With a combination of fine weather, good food and pleasant company, 2002 turned out to be an excellent event and members are hoping that 2003 will turn out to be as good. To facilitate storage of ground level cars, a single slip has been built to connect the storage sidings with the main line. The snag is that there is now no longer a complete ground level circuit for 5in. gauge models, a problem which no doubt will be rectified in the future.

Members of **Maidstone MES** have been restoring their 2 1/2in. gauge track which is now complete throughout the entire raised circuit. They also are converting a room of their premises into a sheet metal workshop. The ground level track was formally opened on 18 January by Wayne Guppy, Mayor of Upper Hutt, who was not satisfied with merely cutting the tape but rode behind and drove most of the locomotives which operated during the day. Having thoroughly enjoyed himself, he left vowing that it would not be too long before he returned.

Canada

This year sees the 75th Anniversary of **British Columbia SME**, and one of their major tasks is the completion of a raised track which, it is hoped, will be finished in time for the summer running season. The

local authority has granted planning permission for a canopy to be built over the passenger waiting area and work on this too is under way. This will not only shelter passengers and station staff from the rain in wet weather, but will also provide much needed shade during the hot months. The annual frostbite meet was as popular as usual but leaves on the track made for very slippery conditions to which the non-steam powered locomotives do not seem to have taken kindly.

South Africa

Although **Durban SME** is proceeding with negotiations to build a new ground level track, there is much to be done before work can actually start. Work is definitely under way on two new passenger cars which, when completed, will doubtless be used to raise some of the cash needed for the new track. The society is 90 years old this year and while there has been mention of a possible exhibition, as yet we have received no information regarding any other special celebrations.

Neels Ferreira, a long-serving member of **Knysna SME**, has retired and moved away from the district. In recognition of his long service with the club, he has been elected to honorary life membership. His departure presents the society with a special problem because the club track is laid on ground which is actually part of five different gardens, one of these being where Neels used to live. When originally built, all the gardens belonged to members of the club. Over the years,

the other four have been sold and the club is very grateful that the new owners were happy for the club to carry on as before. However, matters are less easy in the case of Neels' property because not only did the track pass through his garden, but also the clubroom, workshop, station and toilet facilities were all located inside his house! We understand that the new owners are content to allow the club to continue with the use of the track, but understandably will not condone the use of their house for club purposes! All club property has been moved out, but with no regular water supply, all manner of plastic containers are being pressed into use. Tea, too has to be made and served under the covered steaming bays and while it still tastes as good, with no toilet facilities now available, individual decisions have to be taken whether or not to drink any. No doubt members will all be much relieved when these matters are finally resolved.

Australia

So many turned up for the **Steam Locomotive Society of Victoria** Christmas Dinner that they had to move from the clubhouse, where it was originally to be held, into the Masonic Hall next door. There should have been running during the day, but the weather was so hot that the authorities had imposed a total fire ban, thus restricting activity on the track. There are plans to replace some of the normal signal lamps with clusters of LEDs which will give a bright light with a lower current consumption and have a longer service life. While sleepers were being replaced, rail corrosion was noticed; this is believed to have been due to a lack of drainage and perhaps driving rain forcing its way between sleepers and rail.

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.

APRIL

18 **Rochdale SMEE**. Meeting at Springfield Park.. Contact Mike Foster: 01706-360849.
18 **Romney Marsh MES**. Video Evening. Contact John Wimble: 01797-362295.
18 **Steam LS of Victoria**. Gathering. Contact Graham Plaskett: (03) 9750-5022.
18 **Surrey SME**. Running. Contact John Cook: 020-8397-3932.
18 **Tonbridge MES**. Start of Running Season. Contact D. C. Brunning: 01732-352153.
18/19 **Hornsby ME**. Easter Convention. Contact Ted Gray: 9484-7583.
18-21 **Auckland SME**. Exhibition and Running. Contact Gary Farquhar: 576-7025.
18-21 **British Columbia SME**. Easter Meet Contact Sean Laurence: (604) 931-1547.
18-21 **Leighton Buzzard NG Rly**. Easter Fun. Enquiries: 01525-373888.
19 **Chesterfield MES**. Running Day. Contact Mike Rhodes: 01623-648676.
19 **Erewash Valley MES**. Steaming Day. Contact Jim Matthews: 01332-705259.
19 **Historical MRS (Scottish Area)**. Martin Nield: Modelling the L&Y. Contact Richard Crockett: 01896-750730.
19 **Steam LS of Victoria**. Club Run. Contact Graham Plaskett: (03) 9750-5022.
19/20 **Luscombe Valley Railway**. Cobweb Run. Contact Richard Knott: 01202-709833.
20 **Annerfield Miniature Railway**. Easter Sunday Running. Contact David Jerome: 0118-9700274.

20 **Harlington LS**. Open Day. Contact Peter Tarrant: 01895-851168.
20 **Hornsby ME**. Sailing Day. Contact Ted Gray: 9484-7583.
20 **Leicester SME**. Running. Contact Raymond Wallis: 0116-285-8824.
20 **MELSA**. Easter Sunday Run. Contact Graham Chadbone: 07-4121-4341.
20 **North London SME**. First Running Day. Contact Tony Dunbar: 01992-465625.
20 **N. W. Leicester SME**. Running Sunday. Contact John Elliott: 01455-847040.
20 **Nottingham SMEE**. Peter Jordan: Darjeeling Himalayan Railway. Contact Graham Davenport: 0115-8496703.
20 **Plymouth MSLS**. Running. Contact John Brooker: 01752-671722.
20 **Reading SME**. Running. Contact Graham Bustin: 01189-615450.
20 **Romney Marsh MES**. Easter Track Meeting. Contact John Wimble: 01797-362295.
20 **Saffron Walden DSME**. Running Day. Contact Jack Setterfield: 01843-596822.
20 **Surrey SME**. Free Day. Contact John Cook: 020-8397-3932.
20 **Talylyn Railway**. Duncan's Easter Egg Specials. Enquiries: 01654-710472.
20 **York City & DSME**. Easter Day Special Steaming. Contact Ken Bateman: 01904-421445.
20/21 **Cardiff MES**. Easter Open Weekend. Contact Trevor Jenkins: 029-2075-5568.

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- 20/21 **Chesterfield MES. Steaming at Papplewick.** Contact Mike Rhodes: 01623-648676.
20/21 **Claymills Pumping Engines. Easter Steaming.** Contact: 01283-509929.
20/21 **Elmdon MES. Running at Wythall Transport Museum Open Days.** Contact Chris Giles: 0121-458-1291.
20/21 **Malden DSME. Open Days.** Contact John Mottram: 01483-473786.
20/21 **Nottingham SMEE. Running.** Contact Gerry Chester: 0115-9259096.
20/21 **Romney, Hythe & Dymchurch Railway. Easter Fun.** Information: 01797-362353.
20/21 **Sutton Coldfield MES. Easter Steam-Ups.** Contact Roger Timings: 0121-308-5875.
21 **Bedford MES. Running.** Contact Ted Jolliffe: 01234-327791.
21 **Chichester DSME. Easter Monday Steam-Up.** Contact Brian Bird: 01243-542266.
21 **Elsecar Heritage Centre. Easter Fair.** Contact: John Furniss: 01226-740203.
21 **Frimley & Ascot LC. Running.** Contact Bob Dowman: 01252-835042.
21 **Stockholes Farm MR. Running.** Contact Ivan Smith: 01427-872723.
21 **Surrey SME. Members' Steam-Up.** Contact John Cook: 020-8397-3932.
22 **Historical MRS (E. Lancashire/N. Manchester Group). Members' Model & Discussion Evening.** Contact John Sykes: 01706-823989.
22 **Romney Marsh MES. Track Meeting.** Contact John Wimble: 01797-362295.
22 **Surrey SME. Video Night.** Contact John Cook: 020-8397-3932.
23 **Chingford DMEC. Paul Harrison: Quiz Night.** Contact Martin Masterson: 0208-989-5552.
24 **Leyland SME. Embarrassment Evening.** Contact Mark Entwistle: 01772-422411.
24 **Sutton MEC. AGM.** Contact Mike Dean: 0208-657-5401.
24 **Worthing DSME. Ian Clarke: Restorations.** Contact Bob Phillips: 01903-700642.
25 **Chichester DSME. AGM & OGM.** Contact Brian Bird: 01243-542266.
25 **Colchester SMEE. AGM.** Contact L. G. Hammond: 01376-511686.
25 **Hereford SME. Bits & Pieces.** Contact John Arrowsmith: 01432-265151.
25 **Historical MRS (Essex Area). Bob Page: Medway Valley.** Contact Jem Harrison, 27 Colne Place, Basildon, Essex SS16 5UZ.
25-27 **Guild of Model Wheelwrights at Midlands Woodworking & Woodturning Exhibition, Warwickshire Exhibition Centre, Radford Semele.** Contact Biddy Hepper: 01492-623274.
26 **Historical MRS (Bristol Area). Members' Picture Show.** Contact Gerry Nichols: 0117-973-1862.
26 **Hornby ME. Family Day.** Contact Ted Gray: 9484-7583.
26 **Surrey SME. Outing.** Contact John Cook: 020-8397-3932.
26 **York City & DSME. Best Work of the Year.** Contact Ken Bateman: 01904-421445.
26/27 **Norwich DSME. 70th Anniversary Exhibition.** Contact Paul Reed: 01603-462925.
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Clarkson Mk 1 Tool & Cutter Grinder	£ 650.00
Clarkson Mk 2 Tool & Cutter Grinder	£ 650.00
Murad Double End Grinder 3ph	£ 150.00
Denford Victory Double Ended Pedestal Grinder 1ph	£ 250.00
Union Jubilee Double Ended Pedestal Grinder 3ph	£ 600.00
Eagle Hand Operated Grinder, Mag Chuck 3ph	£1500.00
Jones and Shipman 540 Surface Grinder, Mag Chuck 3ph	£ 200.00
R.H. Trim Tool Grinder 3ph	£ 375.00
Duplex Toolpost Unisher 3ph	£ 250.00
Exzell Rotary Filing Machine, 1ph	£ 250.00

SHAPERS

Elliot 145 Shaping Machine, Vice 3ph, VGC	£ 500.00
Ajax Mill Toolroom Shaping Machine 3ph, VGC	£1500.00
Adapt No 2 Hand Shaper	£ 250.00
Elliot 10M Shaper 3ph, Excellent Condition, Choice of 2	£ 350.00
New England 1P Shaper 3ph	£ 250.00
Alba 1A Shaper, 3ph, Rusty, But Runs Well	£ 150.00

BOXFORD SPARES AND TOOLING

Change Gears (Boxford) 3ph	£ 500.00
15T-10T, 18T-12T, 21T-15T, 24T-18T, 27T-21T, 30T-24T, 33T-27T, 36T-30T, 40T-33T, 45T-36T, 50T-40T, 54T-45T, 60T-50T, 63T-54T, 70T-60T, 75T-63T, 80T-70T, 90T-80T, 100T-90T, 110T-100T, 120T-110T, 130T-120T, 140T-130T, 150T-140T, 160T-150T, 170T-160T, 180T-170T, 190T-180T, 200T-190T, 210T-200T, 220T-210T, 230T-220T, 240T-230T, 250T-240T, 260T-250T, 270T-260T, 280T-270T, 290T-280T, 300T-290T, 310T-300T, 320T-310T, 330T-320T, 340T-330T, 350T-340T, 360T-350T, 370T-360T, 380T-370T, 390T-380T, 400T-390T, 410T-400T, 420T-410T, 430T-420T, 440T-430T, 450T-440T, 460T-450T, 470T-460T, 480T-470T, 490T-480T, 500T-490T, 510T-500T, 520T-510T, 530T-520T, 540T-530T, 550T-540T, 560T-550T, 570T-560T, 580T-570T, 590T-580T, 600T-590T, 610T-600T, 620T-610T, 630T-620T, 640T-630T, 650T-640T, 660T-650T, 670T-660T, 680T-670T, 690T-680T, 700T-690T, 710T-700T, 720T-710T, 730T-720T, 740T-730T, 750T-740T, 760T-750T, 770T-760T, 780T-770T, 790T-780T, 800T-790T, 810T-800T, 820T-810T, 830T-820T, 840T-830T, 850T-840T, 860T-850T, 870T-860T, 880T-870T, 890T-880T, 900T-890T, 910T-900T, 920T-910T, 930T-920T, 940T-930T, 950T-940T, 960T-950T, 970T-960T, 980T-970T, 990T-980T, 1000T-990T	£ 1500.00
100/227 Compound Gear	£ 500.00
127/131 Compound Gear	£ 500.00
54/101 Compound Gear	£ 500.00
22/101 Compound Gear	£ 500.00
32/1 Tumbler Reverse Gear	£ 1200.00
Boxford Manual 'Know Your Lathe' Copies	£ 1600.00
Boxford 4" Chuck Backplate NEW	£ 200.00
Boxford 5" Faceplate NEW	£ 450.00
Boxford 5" Catchplate	£ 150.00
Pratt Burnard 4" Jaw Chuck	£ 750.00
Boxford 6" Jaw Chuck, VGC, With Fitted Boxford Backplate	£ 1000.00
Boxford 6" Faceplate NEW	£ 150.00
Boxford 5" Catchplate	£ 150.00
Boxford Lathe Cabinets, suitable for many bench lathes	£ 1000.00
Headstock Saddle & Apron parts available	£ POA
4 1/2" or 5" Tailstock	£ 1250.00
Boxford Change Gear Cover	£ 150.00
Boxford Change Gear Quadrant	£ 150.00
Boxford Topslide Assembly	£ 450.00
Boxford Crossslide & Topslide Screw & Nut, New, Metric, Sold as Pair Only for A.B.	£ 1000.00

MYFORD SPARES AND TOOLING

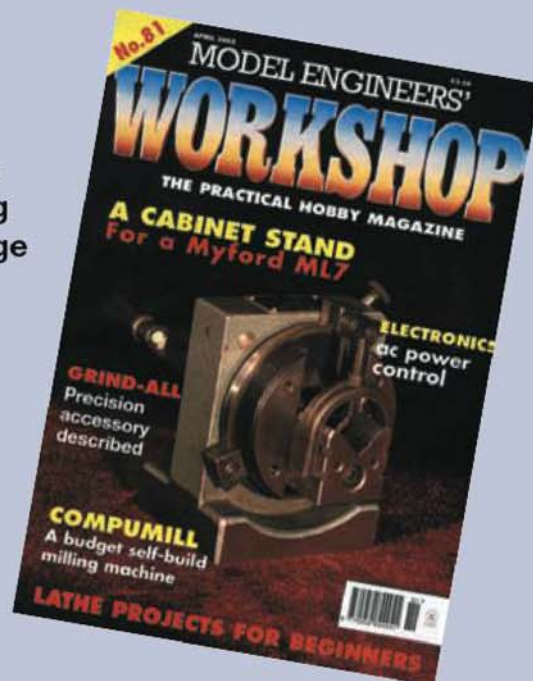
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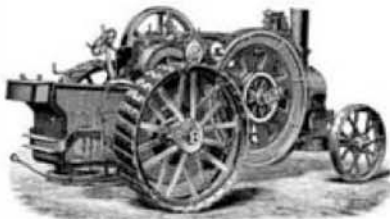


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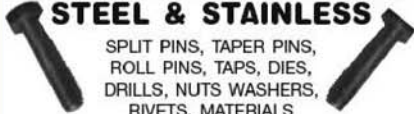
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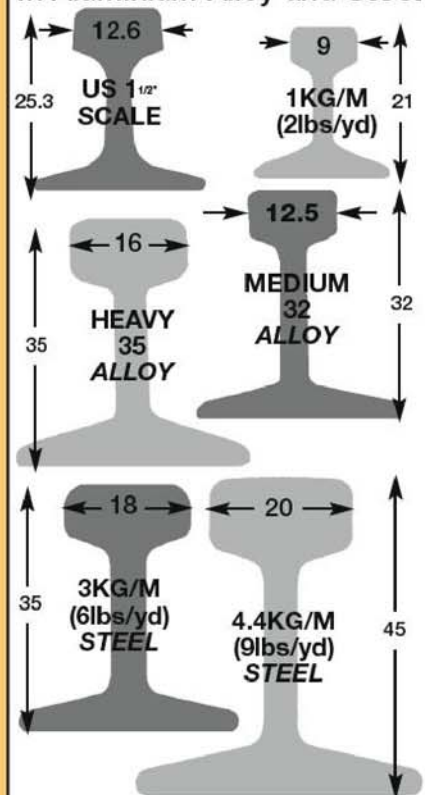
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STARTRITE 352 woodworking band saw.....£975

STARTRITE 14-S-5 woodworking band saw.....£775

ALCOSA GF 080/1 Rapid Melting Furnace.....£300

MYFORD BurnerD Gripper 3 Jaw Chucks.....Boxed £225

COLCHESTER D13 BurnerD 4 Jaw 8" light body independent chuck.....one off £225

RJH 4" Finisher / Vertical complete with built in extraction.....£625

MICROMETERS and associated measuring tools.....Still packaged as new

POTTERY WHEELS, kilns and associated equipment.....Just In Cheap

SPECAC Powder type press.....£225

HARRISON L6 metric gearbox.....As is £250

HARRISON L6 tailstock.....£245

NEW FROM NEW ZEALAND:- Machine vice, 55mm. Jaws precision miniature type ideal for vertical slides and smaller milling machines such as BCA now with the swivel base.....£134

Vice on own.....£65

Swivel base on own.....£49

SIP 1 TON MOBILE CRANE Manufactured 2000 (used just once).....As new £375

MITUTOYO grade A set of slips.....£245

F.J. EDWARDS 24" hole cutter.....£525

Large bench vice.....£70

LINK 1.5 ton vehicle crane + top hat.....£625

MITUTOYO 103-913 metric set micrometers.....£275

NORTON / EDWARDS arbor presses.....£75 / £145

AJAX 6" hacksaw.....£425

SURFACE plates from 12" x 12" to 36" x 36".....Very nice from £30

WEBER 11/2 ton mobile garage crane, late blue colour.....£495

ELLIOTT 1250 STURDIMILL vertical head.....One off (rare) £525

RJH 4" wide belt, pedestal.....£345

STEEL STOCK different stock rolling in almost daily.....to callers only

ELLIOT U1 / U2 Slotting Head.....£475

SWAGE BLOCKS.....£125 / £145

J & S Universal grinding vice.....Choice £275 / £325

BOX TABLES: Grade A and B, many sizes.....£40 - £150

SLIPS / GAUGES Metric / Imperial, New Sets; 87 / 81 piece.....£215 / £145

HORIZONTAL METAL BANDSAW 6" x 41 1/2" capacity.....New £170

COLCHESTER STUDENT / MASTER Round head, face-plates, small / large.....£50 / £80

QUALTERS AND SMITH 6" Hacksaw.....£345

BORING HEADS 2 / 3 Morse, R8 Taper, Max. Capacity 4 1/2" round bar.....New, each £90

ODONI Machine Bed Clamps (pair).....Special £24.50

HEIGHT GAUGES by Chessman, Shardlow, Moore and Wright.....From £95

ELLIOTT 10M Shaper, 10" stroke.....£325

DIE BOXES.....From £45

TRANSWAVE 3HP Converter.....£295

TRANSWAVE 5.5HP Converter.....New £385

TRANSWAVE MT & RT rotary converters.....From £485

CROMPTON PARKINSON 3/4 HP, resilient mount, Boxford / Myford Super 7 Type motor.....New £140



WE ARE CONSTANTLY CHANGING OUR STOCK FASTER

THAN THE ADVERTS CAN KEEP UP WITH US!!!

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DISTANCE NO PROBLEM!! DEFINITELY WORTH A VISIT ALL PRICES EXCLUSIVE OF V.A.T.

NEW STOCK ARRIVING
EVERY DAY, IF YOU
DON'T SEE WHAT YOU
ARE LOOKING FOR JUST
RING FOR UPDATES!!

- 2-Axis DRO from **£615** inc vat
- Made in the UK
- 5 year No-Fault Warranty
- 10 micron Accuracy

Conquest Lathe

NOW INCLUDES TEST CERTIFICATE



£395

VARIABLE SPEED
STANDARD ACCESSORIES

• 80MM 3-JAW CHUCK • Q.C.T.P. With 3 Tool Holders

Price includes VAT & Delivery*



920 Lathe Deluxe

- SWING OVER BED: 229MM
- SWING OVER CROSS SLIDE: 133MM
- DISTANCE BETWEEN CENTERS: 500MM
- SPINDLE BORE: 19MM
- TAPER IN SPINDLE NOSE: MT3
- MOTOR: 1/4HP
- 6 SPEED: 100-1800RPM
- NET WEIGHT: 100KG

STANDARD EQUIPMENT:

- 4" 3-JAW CHUCK WITH 2 SETS OF JAWS
- 7" 4-JAW CHUCK WITH REVERSIBLE JAWS
- STEADY REST • FOLLOW REST
- MT2 DEAD CENTRE
- MT3 DEAD CENTRE
- 4-WAY TOOL POST
- FACE PLATE
- TOOL BOX & TOOL KIT
- TRAY & SPLASH GUARD



£699

Price includes VAT & Delivery*

Model B-Super

- SWING OVER BED: 420MM
- DISTANCE BETWEEN CENTERS: 500MM
- MILL DRILL SPINDLE TAPER: 19MM
- TAILSTOCK BARREL TRAVEL: 80MM
- 7 SPEEDS 160-1360RPM
- SWING OVER CROSS SLIDE: 160MM
- SPINDLE TAPER: MT3
- DRAW BAR: M12
- CROSS SLIDE TRAVEL: 180MM
- MOTOR: 1/4HP
- NET WEIGHT: 155KG
- STANDARD EQUIPMENT
- 4" 3-JAW CHUCK
- 2 DEAD CENTERS
- 1/2 DRILL CHUCK
- CHANGE GEARS
- MT3 CHUCK ARBOR



£699

Price includes VAT & Delivery*

Centurion

- SWING OVER BED: 420MM
- DISTANCE BETWEEN CENTERS: 520MM
- MILL DRILL SPINDLE TAPER: MT3
- TAILSTOCK BARREL TRAVEL: 80MM
- 7 SPEEDS 160-1360RPM
- SWING OVER SADDLE: 160MM
- SPINDLE TAPER: MT3
- DRAW BAR: M12
- CROSS SLIDE TRAVEL: 200MM
- MOTOR: 2 x 1/4HP
- NET WEIGHT: 230KG
- STANDARD EQUIPMENT
- 4" 3-JAW CHUCK
- 2 DEAD CENTERS
- 1/2 DRILL CHUCK
- CHANGE GEARS
- MT3 CHUCK ARBOR



£1100

Price includes VAT & Delivery*

Champion Mill

- DRILLING CAPACITY: 20MM
- END MILL CAPACITY: 25MM
- FACE MILL CAPACITY: 63MM
- TABLE SIZE: 150x630MM
- NUMBER OF SPEEDS: 4
- SPEED RANGE: 400-1640RPM
- SPINDLE TAPER: MT3
- TILTING HEAD: 90° Left & Right
- MOTOR: 1/4HP

From **£585**

Price includes VAT & Delivery*



STANDARD ACCESSORIES

- 1-13MM DRILL CHUCK & ARBOR

Eagle 25 Mill/Drill

- MILL/DRILL CAPACITY: 25MM
- TABLE SIZE 190 x 585MM
- FINE FEED
- NUMBER OF SPEEDS: 12
- SPEED RANGE: 100-2150RPM
- SPINDLE TAPER: MT3
- SPINDLE TRAVEL: 100MM
- MOTOR: 1HP

Price **£699**

Price includes VAT & Delivery*



STANDARD ACCESSORIES

- 1-13MM DRILL CHUCK & MT3 DRILL CHUCK ARBOR
- EAGLE FACE MILL CUTTER
- T3 TILTING VICE
- M12 DRAWBAR
- NVR SWITCH GEAR
- INTERLOCKED CHUCK GUARD
- MANUAL AND PARTS LIST

Eagle 30 Mill/Drill

- MILL/DRILL CAPACITY: 32MM
- TABLE SIZE 210 x 740MM
- FINE FEED
- NUMBER OF SPEEDS: 10
- SPEED RANGE: 80-2300RPM
- SPINDLE TAPER: MT3
- SPINDLE TRAVEL: 130MM
- TILTING HEAD
- MOTOR: 1HP
- HIGH/LOW GEARBOX

Price **£899**

Price includes VAT & Delivery*



STANDARD ACCESSORIES

- 1-13MM DRILL CHUCK & MT3 DRILL CHUCK ARBOR
- EAGLE FACE MILL CUTTER
- V100 MACHINE VICE
- M12 DRAWBAR
- NVR SWITCH GEAR
- INTERLOCKED CHUCK GUARD
- MANUAL AND PARTS LIST

626 Turret Mill

- MILLING CAPACITY: 25MM
- DRILLING CAPACITY: 32MM
- TABLE SIZE 152 x 740MM
- FINE FEED
- NUMBER OF SPEEDS: 9
- SPEED RANGE: 190-2100RPM
- SPINDLE TAPER: MT3 OR R8
- TILTING HEAD
- MOTOR: 1 1/2HP

Price **£1340**

Price includes VAT & Delivery*



STANDARD ACCESSORIES

- ONE SHOT LUBRICATION
- HALOGEN WORK LIGHT
- MACHINE STAND
- DRAWBAR
- MANUAL AND PARTS LIST

Craftsman Gap Bed Lathe

- SWING OVER BED: 300MM
- SWING OVER GAP: 450MM
- SWING OVER SADDLE: 170MM
- DISTANCE BETWEEN CENTERS: 570MM
- SPINDLE BORE: 36MM
- SPINDLE NOSE TAPER: MT5
- CROSS SLIDE TRAVEL: 150MM
- COMPOUND TRAVEL: 89MM
- TAILSTOCK BARREL TAPER: MT3
- TAILSTOCK BARREL TRAVEL: 92MM
- RANGE OF SPEEDS: 50-1250RPM
- MOTOR: 1 1/2 HP
- NETWEIGHT 398KG

£1550

Price includes VAT & Delivery*



STANDARD EQUIPMENT:

- 6" 3-JAW CHUCK WITH 2 SETS OF JAWS
- 8" 4-JAW CHUCK
- STEADY REST
- FOLLOW REST
- STAND
- FACE PLATE
- SPLASH GUARD
- THREADING DIAL
- 4-WAY TURRET TOOL POST
- 3MT DEAD CENTERS
- T-SLOTTED CROSS SLIDE
- HALOGEN WORK LIGHT

Super LUX Mill

- MILLING CAPACITY: 25MM
- DRILLING CAPACITY: 32MM
- TABLE SIZE 240 x 800MM
- FINE FEED
- NUMBER OF SPEEDS: 6
- SPEED RANGE: 95-1600RPM
- SPINDLE TAPER: MT3
- TILTING HEAD
- MOTOR: 1 1/4HP

Price **£1500**

Price includes VAT & Delivery*



STANDARD FEATURES

- POWERED HEAD ELEVATION
- CAST IRON STAND
- ANGLE TILTING HEAD
- MANUAL AND PARTS LIST