

MODEL ENGINEER

Vol. 190 No. 4191

21 March - 3 April 2003 £2.30

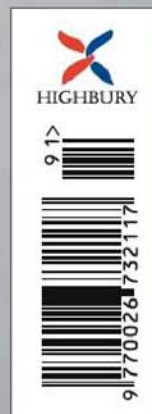
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Model Engineer is published by
Highbury Nexus Special Interests Limited
Nexus House, Azalea Drive, Swanley, Kent BR8 8HU
Tel: 01322 660070 Fax: 01322 616319
www.hbc.co.uk/modeng

Highbury Nexus Special Interests Limited is a
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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: news@highbury.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, Avenue 1, NJ 07001. Upps 0011099,
US Subscription Agent: Wise Owl Worldwide Publications,
5150 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 1-800-438-5005).
Model Engineer is published fortnightly.



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ISSN 0026-7325

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METALWORKING CRAFTSMAN OF THE YEAR 2003

Barry Jordan is the first British winner
of the Joe Martin Foundation Award
for Exceptional Craftsmanship.
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AERONCA E113 AERO ENGINE in 1:4 scale

Construction continues with the back
plate and gear cover. Part III.
PAGE 322



On the cover ...

*This elegant Strutt Epicyclic Skeleton
clock was exhibited at the
72nd Model Engineer Exhibition
where it caused much interest due to its
unusual ring gear with teeth on both the
periphery and inner diameter, thus
requiring special apparatus to enable the
cutter to operate inside the ring.
Well executed and finished, it was one
of two exhibits made by retired toolmaker
and Fareham DSME member Ken Pert, and
was awarded a Gold Medal.
A full Judge's report on Class A6
(Horological, Scientific and Optical
Apparatus) begins on page 303
of this issue.*

(Photograph by Gary Sinfield)

NEW SERIES: FINE TUNING A WARCO BH600G LATHE

Modifications to improve the utility of
this deservedly popular lathe. Part I
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A HEINRICI HOT AIR ENGINE

Completing work on the firebox and
making a first test run. Part IX.
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2 1/2in. GAUGE COMES TO FYLDE

Nonagenarian member Ernest Mann
cuts the tape at the Official Opening
of this brand new facility.
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CLUB CHAT & CLUB DIARY

Recent activities and forthcoming events.
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READER SURVEY

We value your opinion.
Why not enter for our prize draw?
CENTRE SPREAD

LETTERS TO A GRANDSON

With apologies to all for the
inconvenience, we regret the
omission of this regular feature
due to pressure on editorial space.

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5"G	Butch	0-6-0	3.1/2"G	Petrolea	2-4-0
5"G	Chub	0-4-0	3.1/2"G	Iris	0-6-0
5"G	Simplex	0-6-0	3.1/2"G	Doris	4-6-0
5"G	Springbok	4-6-0	3.1/2"G	Rainhill	0-2-2
5"G	King John	4-6-0	3.1/2"G	Heilan Lass.	4-6-2
5"G	Dean Goods	0-6-0	3.1/2"G	Rob Roy	0-6-0
5"G	2251	0-6-0	3.1/2"G	Miss 10 to 8	4-4-0
5"G	Firefly	2-6-2	3.1/2"G	Juliet	0-4-0
5"G	Mogul	2-6-2	3.1/2"G	Virginia 4-4-0	
5"G	Peggy	0-4-0	3.1/2"G	Maisie	4-4-2
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5"G New	Combyne	4-4-2T		Radial Tank - L.S.W.R. 415 Class	
5"G New	Nine Elms	0-4-2		L.S.W.R. A12 Class with Beyer Tender	
5"G New	Salisbury	4-4-0		L.S.W.R. 460 Class	
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0"G	Josie	4-6-4	2.1/2"G	Purley Grange	4-6-0

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2 CBB206	6 Drawer tool chest	£152.69	£109.95	£129.19
3 CBB209	9 Drawer tool chest		£139.95	£164.44
4 CBB203	3 Drawer chest-step up		£69.95	£82.19
5 CBB215	5 Drawer mobile cabinet	£234.94	£194.95	£229.07
6 CBB217	7 Drawer mobile cabinet		£229.95	£270.19
CBB212	3 Drawer mobile cabinet	£187.94	£149.95	£176.19
7 CBB213	3 Drawer mobile cabinet	£234.94	£179.95	£211.44

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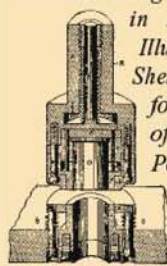
● **Soldering, Brazing & Welding - a Manual of Techniques [Pritchard] £16.94** ●

Good book on all ways of joining metal together. Covered are soldering and brazing, albeit slightly briefly and then, in much greater detail, Oxy-Acetylene, MMA, MIG and TIG welding. Most of the instructions refer to welding steel, but welding other materials and distortion control are covered in separate chapters, as is quality in welding. Recommended for those taking up welding, or as a reference book if you have some experience. 160 pages full of drawings, diagrams and photographs. Larger format paperback.



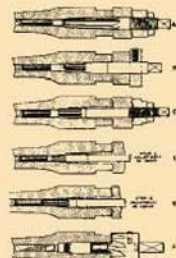
● **Punches Dies and Tools for Manufacturing in Presses {1931} [Woodworth] £20.95** ●

A companion to the same author's book Dies, Their Construction and Use this book is an Encyclopedia of Die-making, Punch-Making, Die-Sinking, Sheet Metal Working, and Making of Special Tools, Devices and Mechanical Combinations for Piercing, Punching, Cutting, Bending, Forming, Drawing, Compressing, Embossing, Forging and Assembling Metal Parts, and also Articles of Other Materials in Machine Tools, including Special Sections Illustrating and Explaining the Making of Cartridge Shells, Wire and Bar Steel Drawing Dies, Press Tools for Making Hydraulic Leather Packing, the making of Paint and Chemical Tablets, Manufacture of Pens, Pins and Needles, Jewelry and Eye-Glass Die-Making, Spoon and Fork-Making Dies, Sub-Press Die-Making for Watch and Clock Work, Drop Dies, Drop Forging and Ornamental Die-Making. Get the picture? 538 pages choc-a-bloc full of information. 736 illustrations, the bulk being drawings. Paperback.



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SMOKE RINGS

With the Editors

Looking to the future

We were particularly interested to read of the mentoring scheme proposed for adoption by Taunton Model Engineers as recently reported in *Club Chat* (M.E. 4190, 7 March 2003). The intention appears to be that new members are introduced to established members who then have the responsibility of ensuring that newcomers are made to feel welcome and rapidly become part of the society. It probably goes without saying that those involved will enjoy similar interests so that the more experienced member can advise and encourage the recently joined member to good effect.

Practising model engineers are not noted for being particularly sociable since they spend a considerable proportion of their time working alone while engaged on whatever project happens to be currently occupying their attention. That is not to say that they do not enjoy time spent in conversation with, or working with colleagues who have similar interests, but some may find it difficult to communicate with those whose knowledge has less depth or breadth simply through lack of experience. We would encourage established and skilful model engineers to extend their patience and convey at least some of their expertise to the less experienced among us.

Only good can come of the Taunton mentoring scheme and we wish the club well in this particular effort to promote our most satisfying and absorbing hobby. If they are not already doing so, perhaps other societies may wish to consider introducing similar schemes, for with relatively few formal practical activities available in the UK for the teaching and instruction of craft skills, it is difficult for the uninitiated to absorb the necessary knowledge and understanding which, to use the appropriate jargon, requires a degree of 'elbow level' instruction.

In similar vein, it is also pleasing to be able to report here of the success of the first day of a three day Model Engineering Seminar recently introduced by the Society of Model and Experimental Engineers at their Marshall House headquarters and workshops. So far as we are aware, this is a unique initiative to bring novice model engineers together for advice and instruction on a range of model engineering activities. Run on Saturdays at monthly intervals, the first day of the course introduced the requirements of a workshop before moving on to review the centre lathe and basic turning activities and tooling. At the time of writing, day two will deal with milling machines, cutters and milling processes followed by the offhand grinder and its use and application. The final day will be taken up with the important matters of measuring and marking out, and the course will close with a review of the equipment and techniques of soldering and brazing. It was good to see established SMEE members in attendance to provide moral and practical support to the seminar leaders.

Apart from the technical content of the seminars and the opportunity to explore Marshall House, the very modest course fee includes a very comprehensive set of notes, morning coffee and biscuits, a light lunch and afternoon tea and biscuits. Readers requiring more information about this and future seminars are invited to contact Gerry Collins on 01273-553228.

4th Stirling Hot Air Engine Rally & Competition

Kew Bridge Steam Museum and The Stirling Engine Society combine forces on Sunday 6 April 11am-5pm for this popular event. Contact the museum for further information: call 020-8568-4757; fax 020-8569-9978 or visit www.kbsm.org

Club News Editor

Regular readers will be aware that Stan Bray not only compiles our fortnightly *Club Chat* columns but also regales us with his experience and expertise in his monthly *Bray's Bench* column, currently dealing with the construction of *The Junior* from The Engineers Emporium (L. A. Services, tel: 01455-220340). Recuperating from a recent brief sojourn in hospital following a knee operation, Stan has written to explain that he feels it is high time for him to step back from these regular editorial activities after some 20 years in the 'hot seat'. Stan admits that advancing years (no, not you Stan!) find him taking longer to prepare *Club Chat* from the club newsletters which we send him. Assuming that his knee heals completely — and there is no reason to think that it won't, the other one did, Stan wants to spend more time with his family and to enjoy walks together with Dot, his wife, something which they haven't been able to do for a number of years. Not only that, but he has innumerable model engineering projects of his own which he wishes to complete while he is able.

We are very grateful indeed for Stan's unflinching contribution to *Model Engineer* and respect his wishes, so we therefore find ourselves in need of a new Club News Editor prepared to produce *Club Chat* on a regular fortnightly basis. As Stan notes, it is a wonderful way of keeping in touch with the model engineering movement and to make and maintain friends and contacts all over the world. Our magazine budget permits us to pay a small

reimbursement for the *Club Chat* pages which are enjoyed by a great many readers. If you wish to be considered for the role of Club News Editor, please write to PO Box 310, Hemel Hempstead, Hertfordshire, HP3 8AX with a brief indication of your proposals for the work involved.

Reader Survey

The easily removed centre pages of this issue feature a Reader Survey questionnaire which relates specifically to *Model Engineer* magazine. Our Marketing and Sales teams have also prepared questions which will hopefully elicit responses to enable them to provide the service you prefer.

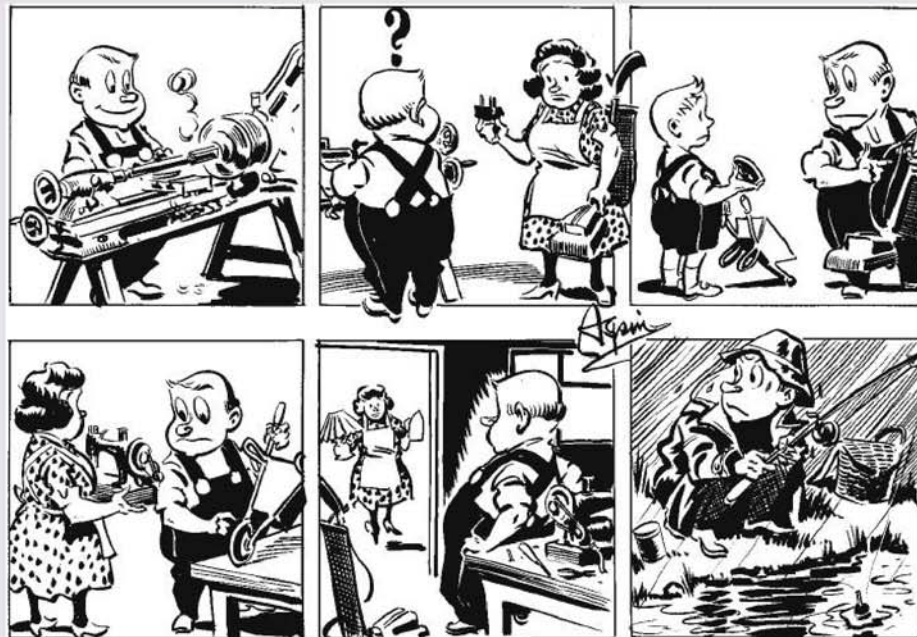
From the editorial standpoint, it has been a very long time since the last Reader Survey and although we have been delighted to hear informally from so many readers who have been complimentary about the present style, format and content of the magazine, we have no desire to be complacent and will therefore take careful note of your reaction to the questions. So, please take a few minutes to read it through and make your response to help us make *Model Engineer* magazine even better.

As if further encouragement were necessary, everyone who completes a Reader Survey questionnaire will be entered into a prize draw for one of three Actulite Polarised Natural Light System lamps. These patented lamps produce a quality of light similar to working outside in bright but slightly overcast conditions, i.e. shadow-less and glare-free with a colour temperature similar to that of natural daylight. The first lucky entrant 'out of the hat' will win a 1220mm Titan 2 slimline workshop light which retails at £149.95 and is designed for ceiling suspension over the work area. The next two lucky winners will receive fully adjustable Task Lights which retail at £129.95 and are designed for desk use.

So, please complete and return the Reader Survey questionnaire — we value your opinion.

CHUCK the MUDDLE ENGINEER

by B. TERRY ASPIN



POST BAG

HMS Magpie

SIRS, - I was interested to read Mr. Laing's letter (*M.E.* 4190, 7 March 2003) concerning the identity of the model frigate featured in a photograph of HRH Prince Philip on the occasion of his opening of the Model Engineer Exhibition at the Seymour Halls in 1952.

Following a recent visit to the Royal Yacht, I am able to assure Mr. Laing that the model of *HMS Magpie* remains on display in the Duke's sitting room on board *Britannia*. According to the informative guide book available to visitors, Prince Philip's study with its teak panelled walls and red leather topped desk was used by both himself and Prince Charles. In pride of place above the desk is a special display case which holds a model of *HMS Magpie*, the Duke's first naval command.

Elizabeth Marfell, Kent.

Acids

SIRS, - I was very pleased to see D. A. G. Brown's letter concerning acids for pickling. His strongly worded warning about keeping away from concentrated sulphuric acid was most appropriate. The only possible improvement would have been to word it even more strongly, perhaps with special emphasis on the first two paragraphs.

For many years, I have used dilute hydrochloric acid, in North America, many restrictions and regulations are in place concerning sulphuric, making it difficult to get. Most service stations no longer carry it as all modern car batteries are sealed. I suppose this is a result of the more sophisticated car charging systems which adjust the charge so that out-gassing does not occur. What happens when a battery runs down and has a mains supply charger applied overnight I don't know. Nitric and phosphoric are also difficult for the private individual to obtain.

However, interestingly enough, hydrochloric is readily available from the local hardware store under the name 'Muriatic'. All one has to do here is just ask and a one litre container is produced. I wonder how many of the store clerks are aware of the potential danger from a spill of this product.

Following Mr. Brown's comment that citric acid is available in health food shops I went this week into our local drugstore (chemist in UK) and they ordered, and produced next day, a 1 litre container of citric acid powder. Great: now I am 'in business' and can

follow his suggestion. I have two questions, as follows:

- 1: Does the warning about adding a drop or two of bleach apply to the powder, or only to the made up liquid?
- 2: What is the formula for the made up liquid? How much water to how much powder? How stable is the solution?

E. F. Wale, Nova Scotia, Canada.

D. A. G. Brown replies:

I was interested to read your words on the subject of hydrochloric acid (alias Muriatic acid or spirits of salts). There are two reasons why I eschew this acid. Firstly chloride ions give rise to stress corrosion cracking in austenitic stainless steels, so hydrochloric must definitely not be used for this purpose. Secondly the fumes from hydrochloric acid wreak havoc with tools and other bright steel parts lying around.

Now, admittedly if the acid is diluted say to 5%, this problem is not serious, although if a drop spills on the bench and evaporates, it will then do its dirty business as the concentration rises. Otherwise my workshop is so dry that I can keep even my micrometer out on the bench without a problem.

Now to the citric acid solution, it is only to the dilute solution that you should add the bleach (or other biocide). The solution should be made up as say 2oz (or 50g) in 1/2 - 1 pint of water, the strength is not critical.

Furthermore it matters not whether you are talking of imperial or short pints; on this side of the Atlantic a pint means 20oz., not 1lb.!

As to storage of the solution, it does keep for a long time, if you stop the whiskers growing in it: I have recently thrown away a batch which I made up in 1995; it was still active but heavily contaminated with copper ions and others.

Vertical slide

SIRS, - In his article on the Aeronca E113 Aero Engine (*M.E.* 4187, 24 January 2003), Les Chenery mentions the problem of vertical slides with a single, central clamping bolt moving out of alignment under cutting forces.

I used to have this problem with my ML7, particularly as I am reluctant to overtighten the clamping bolts for fear of bruising the cast iron table.

In the majority of cases, a solution is to insert a piece of writing paper between the clamped surfaces to increase the friction just enough to prevent unwanted movement.

Neil G. Heppenstall, Cheshire.



The traction engine about which Mr. Oakden seeks further information.

Traction engine

SIRS, - During a recent visit to a friend, he showed me a model steam traction engine which he had purchased. His research suggests that the model was built by a Mr. J. Pike for sale at Bassett-Lowke's London shop from about 1908 onwards for a period of about 20 years.

The engine has twin cylinders, a simple pot-boiler and, as far as I am aware, is modelled on no particular prototype. It is in remarkably good condition with what appears to be original paintwork. Unfortunately, however, its coal bunker and spirit burner are missing. The engine is not highly detailed and I guess it would be more appropriate to call it a steam toy rather than a model, but nevertheless Bassett-Lowke is a name to conjure with and my friend would like to restore the engine to something like its original condition.

The problem is that he has so far failed to locate any details relating to the missing parts. I have contacted the Bassett-Lowke Society for whom Peter Parks has been most helpful, but he said that he was not aware of the existence of any other examples of this particular model and to his knowledge no drawings are available.

I find it difficult to believe that if the model was supplied by Mr. Pike to Bassett-Lowke for a period of 20 years, my friend's example is the only one left in existence. I wonder therefore if there is anyone out there who may have, or know something of, this particular Bassett-Lowke model steam traction engine and who could provide some further information, especially relating to its coal bunker and spirit burner.

R. Oakden, Nottinghamshire.

Museum pieces

SIRS, - I am acting as an executor for a good model engineer friend who died last Autumn after a prolonged and distressing period of motor neurone disease. Among his effects which I am endeavouring to transfer to a good home are a steam engine and a very old machine drill.

The former is a single cylinder (6in. bore x about 4in. stroke)

enclosed piston-valve vertical engine made in the 1920s to the order of The Carrier Engineering Co. Ltd., London by E. Reader and Sons Ltd. of Nottingham. It was used in the basement of one of the large Park Lane hotels to directly drive ventilation fans from large, multiple steam boilers and was removed circa 1980 while still in good working order. The cylinder and valve gear were dismantled to make removal easier but otherwise the unit has since been stored as found. Its overall size is approximately 32in. wide x 18in. deep x 42in. tall.

The drill is a Herbert 6-speed (77/147/194/170/321/424rpm) machine. Although now driven by a single phase motor, I suspect it is old enough to have originally been powered from an overhead line shaft. Certainly all the existing drives are by flat leather belting which makes it a lovely machine to use. Dimensions are approximately 32in. wide x 52in. deep x 80in. tall.

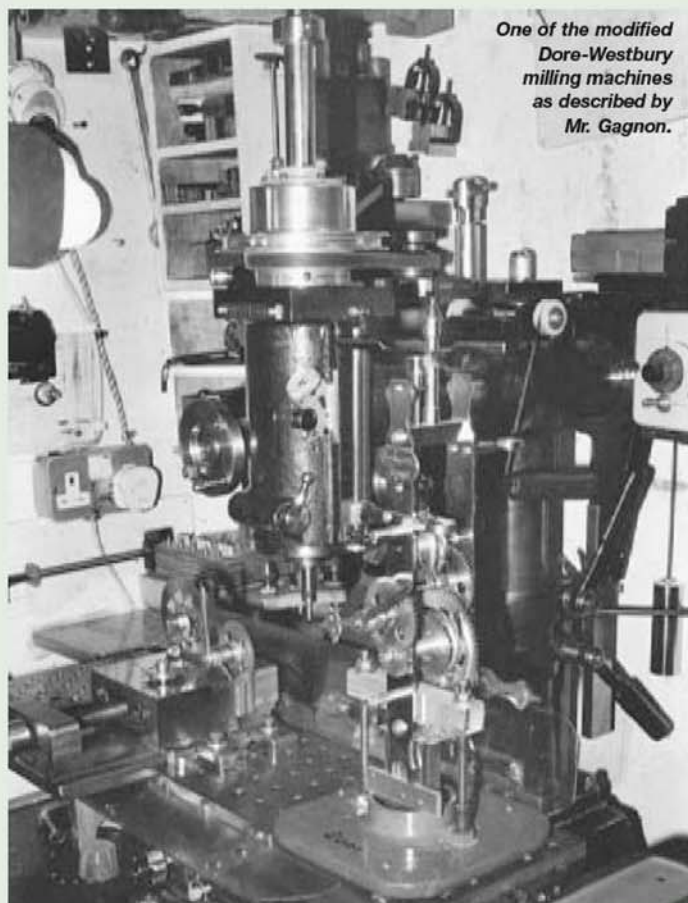
My colleague's widow and myself would both like to see these machines in a museum or similar location where they could be enjoyed by the public and enthusiasts; they would therefore be available for relatively nominal figures. I hope the bare bones of this information, bringing the items to the attention of a suitable body may arouse interest somewhere. In the event of no such response we would of course be pleased to hear from any interested individuals. Contact could be made direct to me on tel: 01432-850477.

My colleague had hoped to use the engine to drive some vintage workshop machinery used in the maintenance of his 7 1/4in. gauge railway. John L. Townsend, Herefordshire.

Sleeve valve engines

SIRS, - Further to the interesting series of articles written by David Boote on internal combustion engines (commencing in *M.E.* 4148, 15 June 2001) I would like to offer the following notes about my experiences with sleeve valves.

Near the end of World War II, I was an engine fitter in a squadron of



One of the modified Dore-Westbury milling machines as described by Mr. Gagnon.

Tempest fighters powered by the Sabre 24-cylinder sleeve valve engines. They were started by a Hoffman cartridge starter, which went 'bang' and gave a sudden impulse. Unfortunately, if the oil was cold, because of oil drag this was just as likely to break a sleeve drive rod as to start the engine. For this reason the engines had to be kept warm during the winter months.

The simplest method of doing this was for the duty fitter, often me, to begin with aircraft one, remove the padded cover, start the engine and run it until the oil was hot and then replace the cover. The procedure was then repeated on aircraft two and then the next, and so on. As this had to be done every four hours it could mean a continuous round of starting and stopping engines.

Long after this, a colleague whose father had worked in the Napier works at Acton, told me that only Bristol had the expertise and equipment to make the sleeves and so these were bought in.

Norman J. Shaw, Bedfordshire.

Model engineer's story

SIRS, - In 1969 an article appeared in *Model Engineer* announcing the introduction of the Dore-Westbury milling machine. This made model engineers aware of a machine that was modest in price and versatile in use but could be built in a small workshop.

This letter focuses mainly on a particular series of machines, which

evolved from the original design, and the events that followed.

Since details of the design were first published many other engineers have submitted their own ideas for design modifications. One such engineer/toolmaker/model builder was the late John Loudon. Among other things, he was the builder of a Gnome aero engine, which was at one time demonstrated by Professor Chaddock.

Another toolmaker/model builder was George S. Brown who had experience in hydraulics, pneumatics and was very skilled in sheet metal work and boiler construction. He set to work with assistance from his son Michael, later also to become a qualified toolmaker.

The third engineer (chartered) worked on the electrical equipment of these machines, being at this time employed by the large paper making complex of Tullis Russell.

The two toolmakers came together in engineering, as did the writer of this letter, and were employed at this time by The Hughes Tool, Aircraft and Space Industry of the USA in their factory in Glenrothes, Fife.

The design jointly created by these engineers is shown in the photograph above and, to date, at least six of these machines have been completed.

George S. Brown finally set up his own business successfully offering a design-and-make service for special tools and then later, volume production of special components. His Dore-Westbury type machine

was one of the machines used to found the business.

Although today the company of G. S. Brown Precision uses 'state of the art' CNC machine tools and other modern day marvels, much work was done on the humble, home workshop built Dore-Westbury mill in the early days.

Quite a success story for some model engineers, *Model Engineer* and the Dore-Westbury milling machine, I think.
G. Gagnon, Fife.

Octogenarians

SIRS, - I have been interested to read the letters which have appeared in these columns concerning starting model engineering at the age of eighty plus. I think I qualify for this group, having received my extra 25p. per week pension for the last seven years. I see no problem with this late start and welcome all 'Octos' to the fold.

I have been model engineering, on and off, since I was 14 years of age and have had a lathe of some sort ever since that time. I have worked in the sheet metal and motor trades when it was necessary to effect repairs, not just to replace faulty parts. So, I may have some advantage over some of your correspondents.

I fully agree with Mr. Parke's views and his suggestions on models to start with. Certainly a small type of locomotive is a good idea, but perhaps not a *Britannia*. I have friends who were young when they started but they look like approaching our age when they finish them!

On the other hand, do not attempt a small model; these can get very fiddly. Aim for at least 3 1/2 in. gauge. Bigger is easier except for the weight. A *Sweet Pea* is the ideal beginner's engine, but a knowledge of machining is essential.

Mr. Warren has made a start by getting a lathe and thinking about a clock. I would recommend a Hipp clock as being a fairly quick and easy project. A minimum number of gear wheels are required, and the rest is very straightforward. I built one three years ago, had no problems, and it ran from day one. It also acts as a showcase and encouragement to do bigger things



Mr. Wade's half-second Hipp clock.

John Wilding began his article on making a 3/4 second clock in *M.E.* 4076, 11 September 1998, which I believe is now available in book form from Rite Time Publishing (tel: 01429-487747), but although similar, mine was to a half second design published in about 1950.

An alternative would be a Stuart Turner engine, a No. 10 being a good start. This would give a good insight into the use of a lathe and many other tools.

I believe that Mr. Warren would benefit from joining a club, as I am sure that he will be able to get all the help, instruction and encouragement it is possible to get. A club may also have library with these clock articles in. But I think that the best advice to all 'wrinklies' is to have a go — you never know what you can do until you try.

Stan Wade, Leeds.

Engine identification

SIRS, - I was recently given a small oscillating steam engine which bears a maker's plate giving the manufacturer's details as *ESL, Model Minor, Drg. No. 1520, Made in England*. The engine is unusual in that no provision appears to have been made for a safety valve and the flywheel shaft runs beneath the boiler so it is therefore in the flames of the methylated spirit burner.

I wondered if any readers could throw any light on the manufacturer of the engine and its approximate year of manufacture.

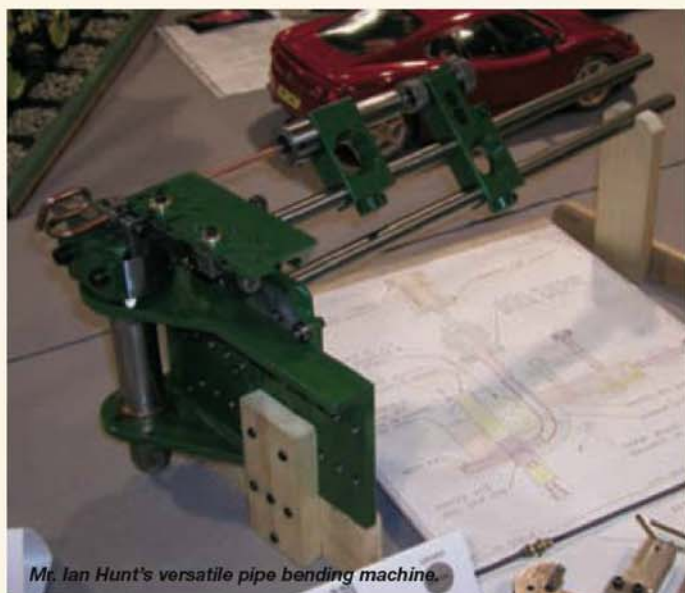
David Spooner, Sheffield.

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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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Publication is at the discretion of the Editor. The content of letters may be edited to suit the magazine style and space available. Correspondents should note that production schedules normally involve a minimum lead time of six weeks for material submitted for publication.



Mr. Ian Hunt's versatile pipe bending machine.



Convoluted bends are possible using Mr. Hunt's versatile pipe bender.

COMPETITION CLASSES

AT THE 72nd MODEL ENGINEER EXHIBITION

Class A5: Tools and Workshop Appliances

Geoff Sheppard reports

This year's competition section consisted of some half-dozen items of varied application and complexity. The outstanding device was a versatile pipe bending machine designed and constructed by Ian Hunt of Derby. Fabricated entirely from stock sections, it operates on well-established principles, but incorporates many features not normally seen in such devices constructed for use in the home workshop. Consequently, it is capable of forming closely spaced bends of small radius, with minimal distortion, in tubing of all sizes up to $\frac{1}{2}$ in. outside diameter. The angular relationship of adjacent bends can also be closely controlled.

The capabilities of the device were well illustrated by a selection of test pieces displayed with the machine in a well-presented exhibit. While employing the usual recessed circular former around which to wrap the pipe, profiled clamps are used to restrain both the stock section of the pipe and the part being curved, thus constraining the external form. Additionally, a tapered mandrel of a size tailored to the inside diameter of the pipe guards against collapse of the pipe wall at the start of the bend. This was made evident by severing the sample pipe shown with the machine, allowing the curved section to be swung clear to reveal the mandrel.

Fine adjustment of the position of this mandrel relative to the circular former is achieved by supporting it from a screwed 'tailstock' mounted on a pair of bars extending from the machine. A second 'tailstock' supports the outer end of the pipe and controls the angular relationship of the bends. The design of the machine results in the need for a set of tooling for each size of pipe and bend radius involved, but the outcome is the creation of neat pipe runs with minimal deformation. Mr. Hunt's efforts were rewarded with a Silver Medal and the award of the Bowyer-Lowe Trophy.

The only machine tool entered in the class this year was a small machine hacksaw built by David

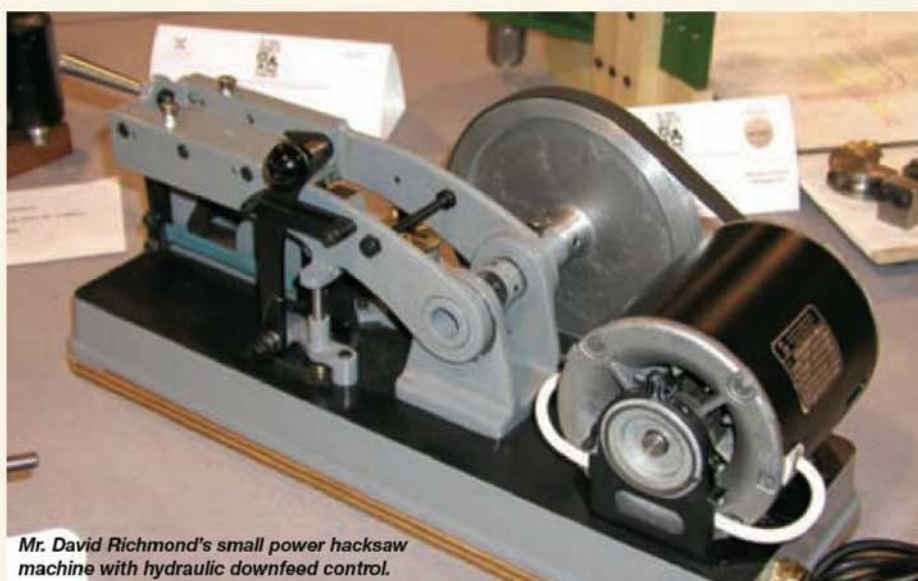


Examples of work and tooling for Mr. Hunt's versatile pipe bender.

Richmond of Hertfordshire. Constructed from a set of castings provided by N. Mole of Watford, it features a Poly-Vee drive in place of the flat belt originally specified. Blade descent is controlled by an effective damper and an automatic power on/off system is incorporated. The quality of machining and finish are excellent and the marks

awarded by the judges were sufficient to earn the builder a Bronze Medal.

Many users of lathes and milling machines are content to employ makeshift arrangements for clocking machine and work piece settings. John Slater of Rotherham has approached the task from first principles and designed a set of clocking



Mr. David Richmond's small power hacksaw machine with hydraulic downfeed control.



attachments specifically to deal with the most commonly encountered operations. Three of these were displayed as a group on a neat display board.

Two of the devices, intended for use in the milling machine, are provided with threaded shanks suitable for use with the standard Clarkson collet chuck. The first, designed for setting the position of bored components or rotary tables and the like, incorporates a means of fine radial adjustment using a screw similar to that seen on height gauges and vernier calipers. The commercial dial gauge can be mounted in a variety of positions thanks to the use of a number of dovetail clamping locations. These dovetails were produced using a special cutter obtained from a local tool and cutter grinder. In one of the positions, the attachment is ideal for setting the alignment of the swivelling head of the milling machine.

The second of this pair uses a plunger type dial indicator to align rectangular or round components with the axis of rotation of the machine spindle, so that slots, holes and keyways can be located quickly and accurately.

The third attachment is used in the lathe, employing a Myford Dickson type tool holder to secure the dial indicator to either the front or rear tool post, as most convenient. Provided with three bores and two clamps, the holder allows the indicator to be located in the optimum position. Accurately

constructed and finished to a high standard, the group was deserving of a Bronze Medal.

Two exhibits were concerned with lathe chucking enhancements. The first, from regular exhibitor Dr. Peter Clark of Southwold, was an adjustable ring chuck for a Schaublin 70 instrument lathe. The device is equipped with false jaws that can be expanded to grip delicate work from the inside. These jaws, which may be of metal, plastics or hardwood, are mounted on tee-slotted sector plates formed with an internal taper. A cast iron expander with a matching taper is mounted on the lathe spindle nose, so that, as the chuck is drawn into the spindle, the jaws move out to grip the work. It is, of course, necessary to true the false jaws when they are mounted on the lathe, a restraining ring is therefore employed to position them during this operation. All the components displayed exhibited the immaculate finish which is the hallmark of Dr. Clark's work, and they were presented in the usual clear and informative manner. A Bronze Medal was a fitting reward.

Two collet chuck adapters, designed to fit the Myford 7 Series lathe, formed the exhibit entered by Graham Tyler of Ashford, Middlesex. One, housing 8mm collets, features a draw bar tightening system and also incorporates a sliding work piece stop bar. Larger collets can be accommodated in



the second adapter which uses a locking cap nut instead of the draw bar. This chuck can also accept a stop bar. These accessories will significantly enhance the versatility of the standard lathe, particularly on second operation work and were deserving of a Highly Commended Certificate.

The final entry, a caliper type knurling tool, was made from a Hemingway kit by Ian Dickinson-Standing of Sevenoaks. Although a workman-like job, it just failed to gain sufficient marks to qualify for an award, but was a welcome addition to the class.

Class A6: Horological, Scientific and Optical Apparatus John Wilding reports

Although few in number, these were of excellent quality. The two in the competition section, both by Mr Ken Pert, were to a high standard and both awarded Gold Medals.

The Strutt Epicyclic Skeleton clock was very nicely made; this clock involves machining a ring wheel with teeth cut on both the outer and inner diameters. To cut the internal teeth requires a special cutter frame which can operate inside the wheel. The recoil escapement had a good action and I particularly liked the dial which had black Arabic numerals inside a brass ring.



Mr. Ken Pert's Strutt epicyclic skeleton clock.



Mr. Ken Pert's large wheel skeleton clock.



Mr. Pert's second clock was a John Wilding design. It was a large wheel skeleton clock. Although a simple design, the work includes machining a wheel with 290 teeth. You don't want to make a mistake when cutting that wheel! I particularly liked the ornamental washers which Mr. Pert made to secure the pillars in the frames. Both these clocks ran well throughout the exhibition.

Class A7: General Engineering Geoff Sheppard reports

There were two entries in this class, items which could not fit comfortably into any of the other recognised groups. However, they both generated a great deal of interest and demonstrated that it is worthwhile for constructors of more unusual projects to consider submitting an entry. Graham Tyler of Ashford assembled a display of components for steam fittings for a 5in. gauge locomotive to the *Firefly* design. Constructed to the principles exposed by the late Roy Amsbury, they are of near-scale appearance and much neater than those seen on most models. The group comprised a glandless water gauge, a vacuum brake valve and a set of cylinder drain cocks. Shown with them were some of the items of tooling used in their manufacture. The finish was of the highest order and, if completed to the same standard, the locomotive should be well worth seeing. The display was worthy of a Highly Commended Certificate.

The second exhibit was very unusual in that it was not so much the hardware on display

which was the subject of the entry, but the design concept behind it. Produced by professional electronics engineer Susan Parker, it was a design for an alternative layout of the computer keyboard. Freed from the constraints surrounding the conventional 'Qwerty' keyboard, with its origins in the relatively slow manual typewriter, this layout is designed to obviate the effects of repetitive stress, recognising that computer input gives rise to unique demands. Manufacture of the example on display had been carried out in a commercial environment using techniques developed by Ms. Parker as part of her professional activities, but the concept had been conceived as a hobby interest and is a piece of true experimental engineering, supporting the use of the term 'Model and Experimental Engineering' throughout our hobby. As such, the judges considered the project fully

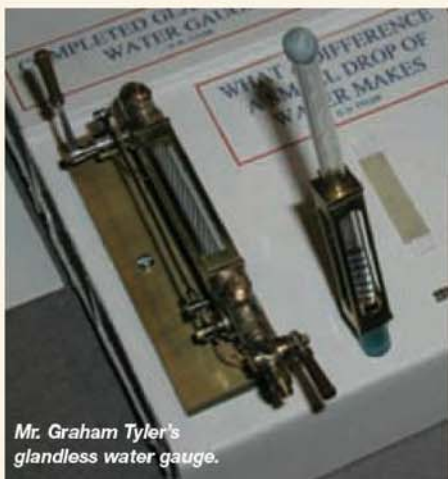
deserved a Commended Certificate. It is hoped that this will encourage more 'experimenters' to put their ideas on display for consideration by a wider audience.

●To be continued.

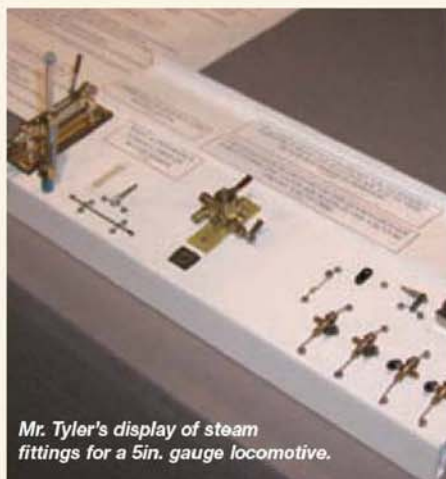
Ms. Susan Parker's ergonomic computer keyboard design.



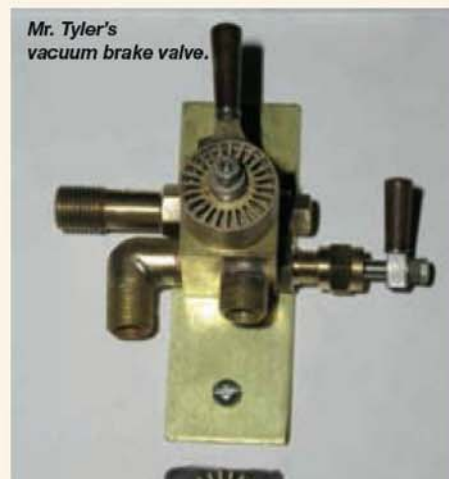
Mr. Graham Tyler's glandless water gauge.



Mr. Tyler's display of steam fittings for a 5in. gauge locomotive.



Mr. Tyler's vacuum brake valve.



SELF STEERING WHEEL SETS and SWING LINK SUSPENSION

David Hudson

describes the development of his wheel tyre profile and goes on to consider the phenomenon of creep.

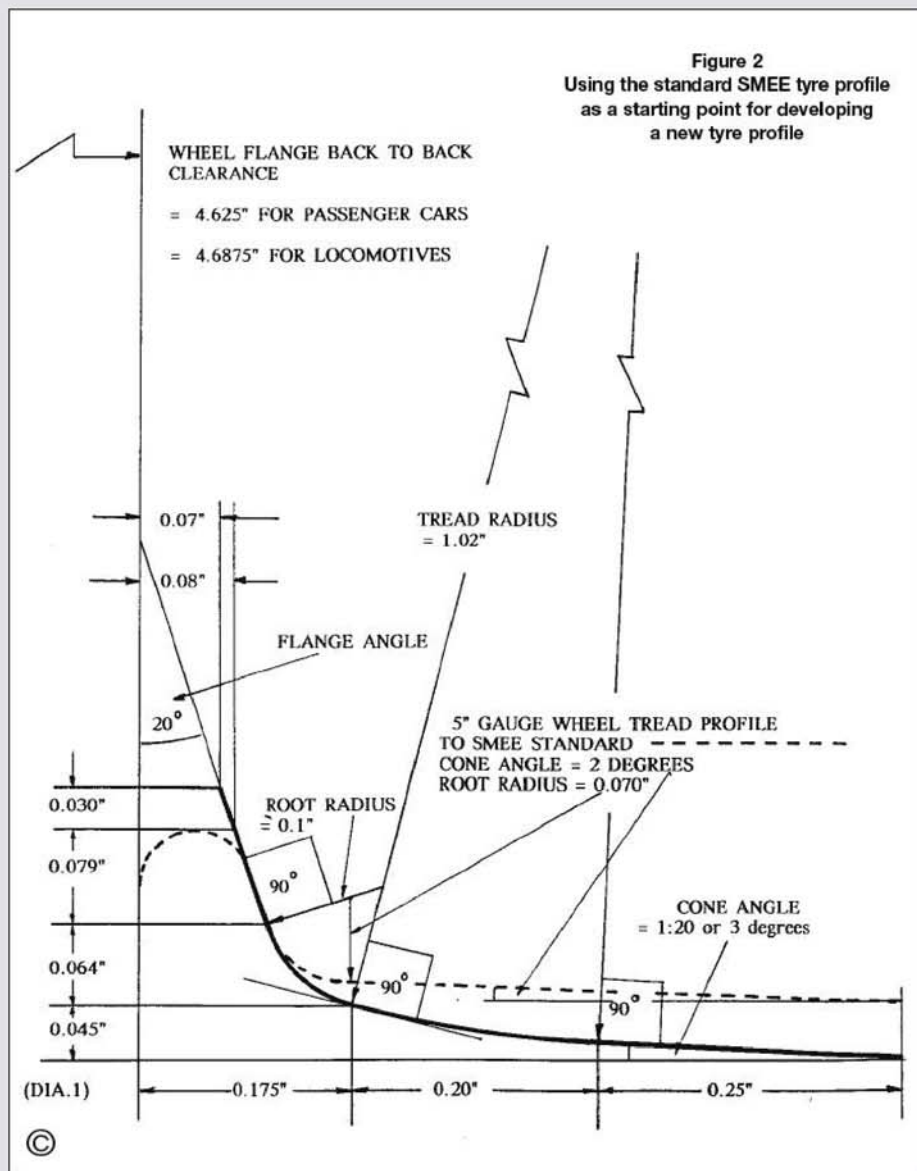
●Part 11 continued from page 193
(M.E. 4189, 21 February 2003)

My starting point was to take the SMEE standard wheel tyre profile (figure 2) and to introduce a curved section of tread between the 2deg. cone and the root radius. A few calculations showed that a rail-to-flange clearance of about 0.1in. was required each side. This could not be achieved with a back-to-back distance of $4\frac{11}{16}$ in. when used on track that was exactly 5in. gauge. After measuring the general widths of aluminium alloy tracks of many societies, I found that as a result of wear, and/or track spreading, figures of between $5\frac{1}{32}$ in. and $5\frac{3}{32}$ in. were quite common. So I decided that a back-to-back flange distance of $4\frac{5}{8}$ in. would be my starting point since this allowed what I considered to be the minimum rail/flange clearance. Remember that this is all preliminary investigation work, and I may well have to modify these dimensions in the light of later findings. Taking into account that there may be sections of track that are well over-gauge, it was decided that a wheel-tread width of $\frac{5}{8}$ in. (not locomotives) should be sufficient to prevent the possibility of a wheel dropping under extreme lateral side forces.

Next, by how much had the conicity to increase within the 0.1in. flange clearance allowed. It had to be more than is just sufficient, to allow for fast correction. The amount required was determined by both calculation and trial and error. It was found that if too much was applied, the tread would not hold its position on the rail-head, but tended to slip down (i.e. self-centre). This limited the minimum radius that a four-wheel, long wheel base wagon could negotiate without slipping.

Several curved portions of tread were tried, and the one that gave acceptable results had a mean slope of 8deg. or 9deg. to a point where it joined the 0.08in. root radius. However, this root radius had to be increased to 0.1in. in order to prevent the possibility of a two-point contact ever occurring. A satisfactory shape quickly evolved as a 3deg. cone angle for 0.25in., followed by an 'exponential' curve of $y = x^2$ for a further 0.2in., into the root radius of 0.1in., and thence into a flange angle of 20 degrees. A flange tip thickness of 0.08in. was retained as per SMEE standard.

I believed that I needed an 'exponential' curve for part of the wheel profile. I obtained this by the expedient of bending a cantilever beam some 50 times larger than actual size, and this followed a curve of $y = x^2$. I then traced around this curve onto graph paper and used part of this curve to fit a 50 times scale of the actual tyre profile. Then all the vertical ordinates were measured and



reduced 50 times. A table was thus obtained to index-turn the actual profile onto a wheel. It was long and tedious, and fraught with possible mistakes. So, after some time, I looked at the curve and wondered if a simple curve of fixed radius would suffice. I learned later that BR used this method, which proved to be just as effective and was adopted. Figure 3 shows the critical dimensions of the profile used for many years.

I have now designed and constructed a simple lever-operated type of cutting tool (photo 3) which uses a button-type carbide tip having a diameter of 0.2in. that fits on the top slide of my ML7. *Hey presto*, I can now profile a wheel-tread to the correct specification in a few minutes, right from the 0.1 inch root radius, through the curve, and on through the 3deg. cone angle, without stopping. I have used this profile for many years now, and it has yielded good results for the

many people who have constructed four-wheel driving cars. I believe that there is still room for improvement; however, this will have to be done by those better equipped and younger than I am.

A description of the technique for using this tool will be given later when describing the construction of a driving car.

Rolling resistance and the need to match wheel and rail elasticities

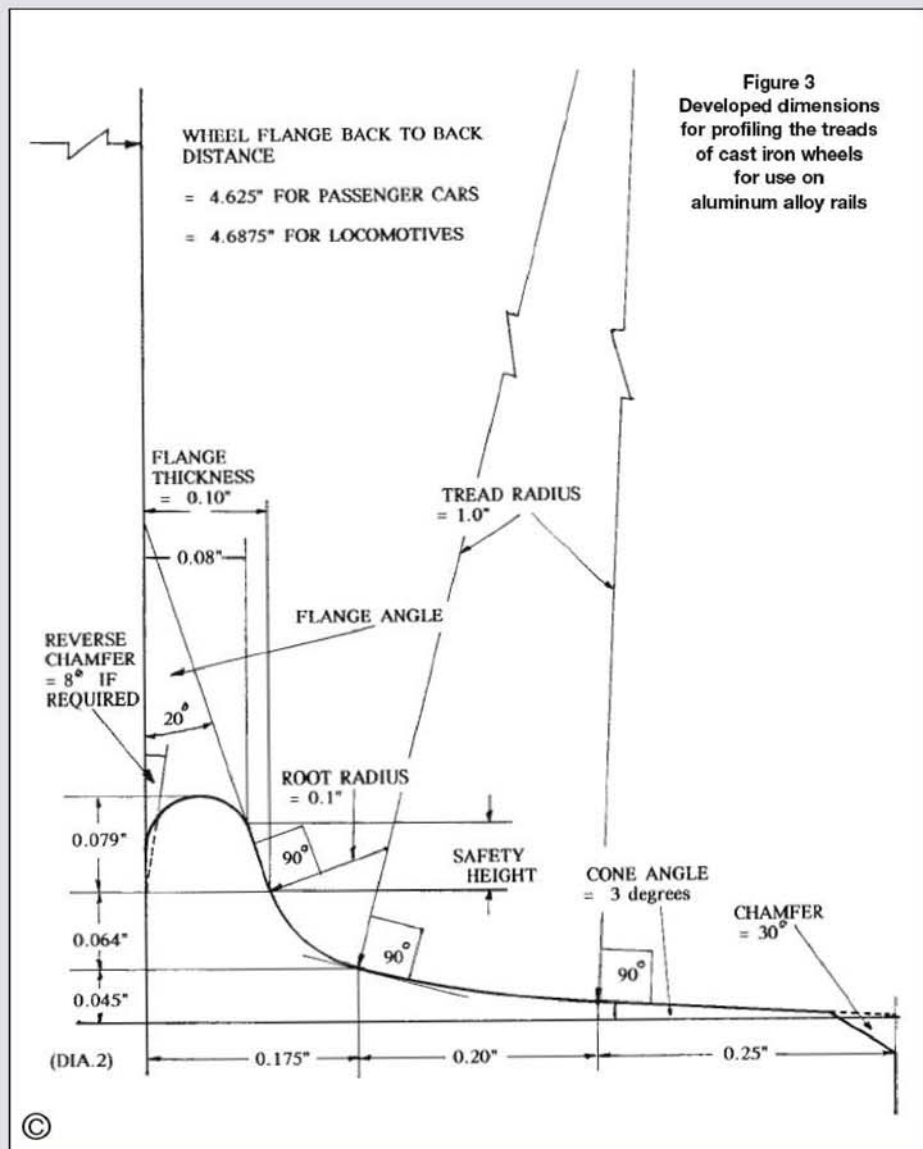
The curvature of a wheel-tread, when impressed by a load onto a rail causes metal to be displaced in both the wheel and the rail. The amount of displacement will depend upon sufficient stress being produced by the displaced metal to support the load. The metal that has been displaced in both wheel and rail will result in a finite area of contact between the two. The area of contact for a given load will depend upon the elasticity of

both wheel and rail. If the elasticity of the wheel is higher than that of the rail, more metal will be displaced in the rail-head than the wheel tyre and vice versa.

Now, metal is incompressible; under high stress it behaves rather like a fluid. If some fluid is displaced, it will have to move somewhere else. The same happens with metal. If a piece of metal is hit hard enough with, say, the ball end of a hammer, you will find a depression (dent). A check with a straight edge will reveal that the displaced metal appears as a raised rim around the depression. This displacement is permanent, and is known as a permanent set. The reason why this can occur is that any metal subjected to an increasing stress will at some point cease to return to its original shape when the stress is removed. This point is referred to as the yield point and different metals have different yield points. Thus, we should always ensure that the working stresses are well below the yield point of the metals in use.

We have seen how a curved surface, when impressed upon a flat surface, causes metal to be displaced. This displacement is often referred to as 'hydrostatic distortion'. I have drawn two much exaggerated sketches (fig 4) of a wheel in contact with a rail having different combinations of elasticity.

In fig 4, sketch 1, it may be seen that, for a given stress level, assumed to be proportional to the depth of metal displacement 'S', little or no metal has been displaced in the wheel. However, the metal displaced in the rail appears as a hump, or raised portion, each side of the wheel. The humps are in contact with the wheel surface, and as the wheel rolls along the rail it will appear to push down both the leading hump and the rail.



i.e. the wheel appears to be rolling uphill at a mean gradient of deg. where $\tan = H/L$. In simplistic terms, the effort required to do this may be referred to as rolling resistance.

Now, let us look at fig 4, sketch 2, where the elastic properties of both wheel and rail are similar. It may be seen that the radius of curvature of that part of the wheel rim in contact with the rail has increased. If the maximum stress level indicated by 'S' remains the same, the hydrostatic distortion will increase, and this means that the wheel and rail will have a greater load bearing capability. Because the contact patch length is longer and the maximum stress level 'S' remain the same, the slope ($\tan = H/L$) will be less, and the rolling resistance will also be less.

Alternatively, if the load in both cases remains the same, then the hydrostatic distortion will be similar, hence the maximum stress level 'S' will be less and again the slope ($\tan = H/L$) is also less. So, again, the rolling resistance will be less. Whichever way you look at it, matched elasticities of wheel and rail offer the lowest rolling resistance, and lower rolling resistance means less wear.

It would appear that there are two ways of reducing the steepness of displaced metal (humps). The first is to match the elasticities of wheel tyre and rail-head, and the second is to increase the radius of our wheels. Not only does this reduce the rolling resistance, but it also

reduces the fatigue stresses and the wear.

Reference to a table of metal elasticities indicates that cast iron wheels and aluminium alloy rail are a reasonable match, and that steel wheels and steel rails are also a reasonable match. The use of any other combination, away from matched elasticities, will result in a penalty to pay.

Of course, if wheel loading is very light, then the stress levels will also be light, and the metal displacement, including humps, will be very small. Under these conditions, mixed elasticities may be acceptable. However, the real culprits are the heavily loaded, small-diameter wheels of passenger cars. So, we ought to pay particular attention to the choice of metals, their elastic properties, and the diameter of the wheels for use with heavy loads.

Some may find this last item difficult to believe. Well, I have designed and built some passenger cars weighing nearly 200 pounds each, and the rolling resistance is only a few ounces on aluminium alloy railed track. Also, there is very little difference between straights and curves because the flanges do not touch the rail sides. Now, when rolling round a curve, conventional wheel-sets cause a swaging on the side of the rail-head. If this persists, the rail-head can become severely distorted, as many of us have found out.

Super-elevation, or cant, is often applied in order to negate the effects of centrifugal forces. However, this is only at its optimum at one particular speed, and for most of the time vehicles

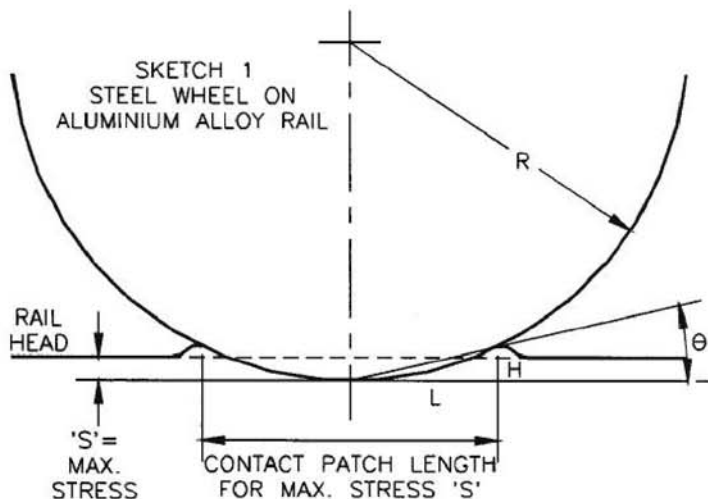
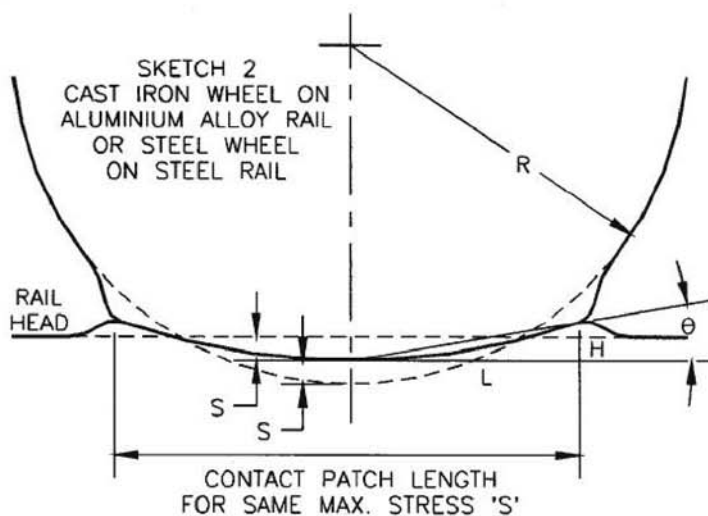


Figure 4 Hydrostatic distortion at contact between wheel and rail



©

will be travelling at different speeds. At slow speeds, gravity pulls the rolling stock against the inside rail, and the resultant flange-to-rail friction slows the train. This makes it hard to pull away from a standstill when on a curve.

Creep forces

When braking or accelerating, tangential stresses are set up between wheel and rail. If these continue to increase, there are two things that can happen. The first is that a phenomenon occurs, called (by dynamicists) creep. This has been described as apparent slip without loss of adhesion. It is a very slow and smooth differential movement, and it only persists over a short range of stress levels. If these stress levels are exceeded, then breakaway, or slipping, occurs. When the stress levels are reduced sufficiently, wheel-to-rail adhesion will be allowed to re-occur. Railway dynamicists refer to this as 'slip/stick action', and creep occurs between the slip and the stick situations. I have carried out static tests to observe this phenomenon of creep. It is quite definite, and persists for a very small stress range.

Let us examine the contact area between the wheel and the rail. Because both wheel and rail surfaces are curved, the shape of the contact area tends to be circular or oval. The highest stress occurs in the middle of this area because the metal displacement is at its greatest, and it gradually reduces towards the edges and beyond. We call

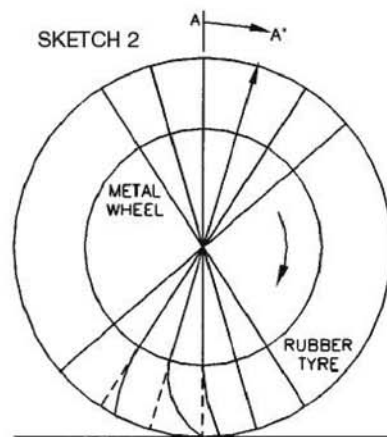
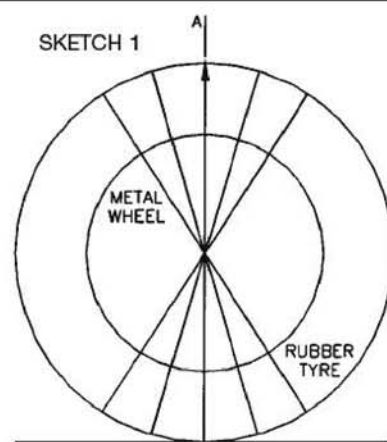
this the stress gradient. This is due to the effects of hydrostatic displacement. We may infer then, that the ability to adhere (or resist a tangential force) will vary across the contact area or patch. The greatest adhesion occurs in the centre, and the least at the edges. As the tangential forces increase, the tangential stresses at the point of contact also increase, and the shape of the contact area will also change. There will come a point where the stresses are too great for the outside edges of the contact area to maintain their adhesion and a differential movement will occur. Because the centre of the contact area may still have sufficient adhesion to resist the tangential forces, these remaining tangential forces will cause a tangential displacement of metal in both wheel rim and rail-head due to the elastic property of the metals. Then, as the wheel continues to roll, the stresses will be relaxed behind the wheel and the leading part of the contact area now becomes stressed. In effect, the elastic properties of both wheel and rail allow, by a very small amount, the wheel to over- or under-rotate, compared with its theoretical rotation speed, depending upon whether traction or braking is being applied. This apparent slip without loss of adhesion is termed 'creep'. In full size this creep can be detected and automatic compensation applied, for both traction and braking, by momentarily reducing the traction or braking force being applied.

Any contamination on the rail head or the wheel tread will affect the adhesion at the contact patch. Sand particles tend to embed into the metal surfaces and will increase the ability to resist tangential forces. However, oil, water, leaves, etc., tend to act as a separating film, preventing full metal-to-metal contact. This is especially so under dynamic (rolling) conditions. Static tests I have made indicate that a contamination film tends to separate, and metal-to-metal contact recurs. However, when a wheel is rolling, the time interval available to separate the contaminating layer is too short for wheel to rail contact to be re-established.

Some of us may find the above a trifle difficult to assimilate. Well, let us imagine a wheel with a tyre made of rubber as in fig 5, sketch 1. The radial lines marked on the tyre indicate the position of the unstressed rubber at rest. But, in fig 5, sketch 2, the traction forces cause displacement of the rubber at the contact area, and this displacement is released behind the wheel. Thus, the wheel appears to rotate faster than the theoretical contact diameter ought to allow.

Because appreciable tangential forces are needed at the points of contact between wheels and rails, it is essential to maintain a steady contact force at all times to prevent breakaway. This is extremely difficult to maintain on our miniature tracks unless a suitable suspension system is employed.

●To be continued.



©

Figure 5 Creep forces



The model of the 18 pounder QF gun built by the author. The term QF (quick firing) denotes the use of a brass cartridge case for the propellant charge.



The wheels of the full size gun were constructed from a combination of pressings and timber and the model closely follows this approach.

18pdr QUICK FIRING GUN

David Wilcox introduces his model of this famous artillery piece.

●Part I

The 18 pounder QF (Quick Firing) gun was the archetypal classic field piece of the First World War, QF denoting the use of a brass cartridge case for the propellant charge. Between 1904, when it was introduced into service, and 1918, over 10,000 'equipments' had been built. It was the standard equipment for the Royal Field Artillery while its smaller brother, the 13 pounder (which was very similar in design), was the standard equipment of the Royal Horse Artillery.

The 18 pounder was born out of the inadequacies of British artillery which were demonstrated in the Boer War of 1899 to 1901 in the face of superior French and German designed guns in the hands of the Boers. Committees met at the conclusion of the war and recommended an amalgam of designs proposed by the Royal Gun Factory, Vickers and Elswick.

The outcome was a wire wound gun of 3.3in. calibre with a single motion interrupted screw breech and percussion firing gear. The carriage was a simple pole trail type with top carriage traverse, hydraulic recoil control and spring recuperation (known as a hydro-spring system). Later marks of gun had pneumatic recuperation.

Due to the trail pattern, maximum elevation was 16deg. giving a range of 6500 yards. The standard projectile was a shrapnel shell, which was given a muzzle-velocity of 1615 feet per second. The top carriage could be traversed 4deg. right and left. The gun detachment numbered ten men.

Plans

General arrangement drawings (plan and side-elevation only) may be obtained from the Rotunda Museum of Artillery at Woolwich. However, since this gun is constructionally more complicated than it looks, other more detailed drawings are needed and some can be found in the *Gun Handbook*. This can be seen in the Imperial War Museum Library and copies of drawings made. Supplementary drawings have also been prepared by the author. In addition it is essential to take a large number of photographs of the details of the gun; there are examples at the IWM, the Rotunda, and at Fort Nelson, Fareham. Before making a start, it is important to understand how the gun is constructed and how it works since this is not entirely evident from viewing the weapon, and for this reason a fairly full description follows.

The model was built to a scale of 1:15 or 0.8in. to the foot and any drawings obtained may be simply re-scaled by means of an enlarging/reducing photocopier using a key dimension such as the diameter of a wheel as a reference.

General description

The gun essentially comprises the trail, top carriage, axletree, wheels, brake system, shield, cradle with barrel, breech, buffer and recuperator, elevating and traversing mechanisms, and the sighting system.

Trail

The trail is a tube of 5in. dia. and fixed to it are a number of bands or brackets serving various purposes: anchorage for the shield, axletree connecting bracket, traversing bracket, brake band and also to provide a rear anchorage for the tensile stays, locking band, spade bracket with lifting handles, and finally the tow eye.

Axletree

This is a forged steel tube, square in cross section in the centre but tapering to form axle arms for the wheels. Brackets are clamped inboard of the axle arms to provide supports for the shield and attachment for the front ends of the tensile stays. As revealed in the photographs, the axletree fits into a connecting bracket or yoke on the tubular trail and also into the rectangular sliding bearings on either side of the top carriage, the outer surfaces of the sliding bearings being convex to a radius drawn on the centre of the trail connecting bracket.

Concave curved flanges are pinned to either side of the axletree and these interface with the convex curved bearing surfaces, permitting the

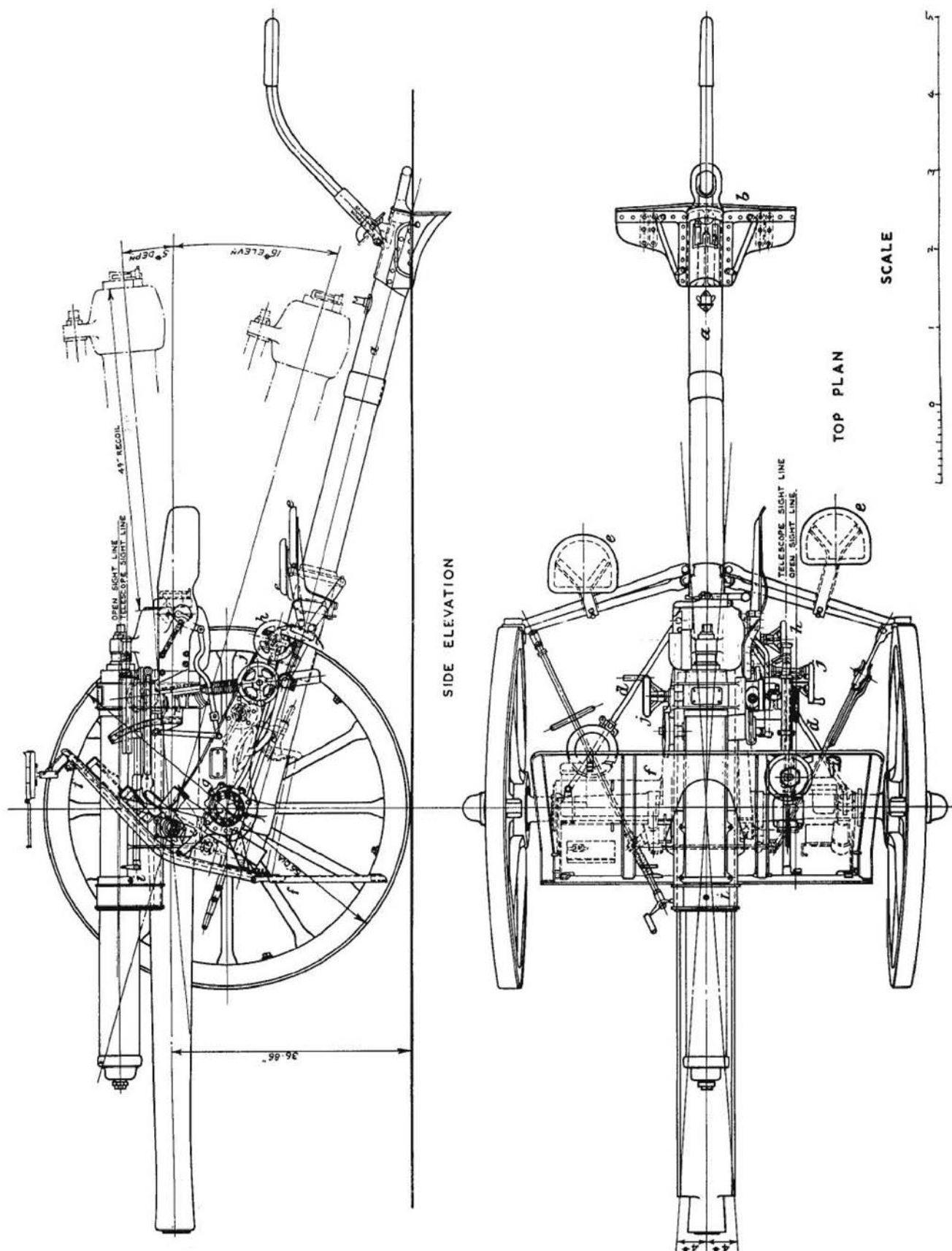


The rear of the finished model. The details incorporated into the full size weapon make this a relatively complex model to build.



A three-quarter front view of the model without its shield. The provision for allowing the barrel to slide in its mounts upon recoil can be seen.

CARRIAGE FIELD, Q.F. 18 PR. MARK I





Top view of the carriage showing the method of attachment of the trail yoke to the axletree. Note the curved flanges to permit traversing.



Above: The underside of the carriage.

Below: Details of the brake linkage on the model.

top carriage to traverse with respect to the trail. There is no central pivot bearing as such. The flanges also provide hinge points for the brake bell cranks.

Wheels

The wheels are 2nd Class C pattern No. 45, are 4ft. 8in. dia. and have a 3in. wide steel tyre.

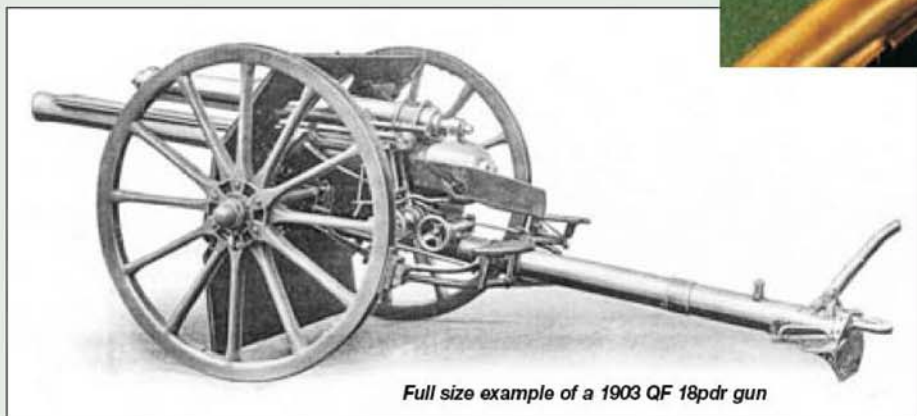
Brakes

The mechanism shown in the drawing is of the swinging arm type and consists of two short steel arms pivoted at their inner ends to lugs on either side of the band on the trail. Cast iron brake blocks on the outer ends of the arms bear against the

wheel tyres. The brakes are operated by a system of actuating rods, bell crank levers and a cranked handle working a screw in a nut. There is a quick release lever in the left hand, actuating rod.

Top carriage

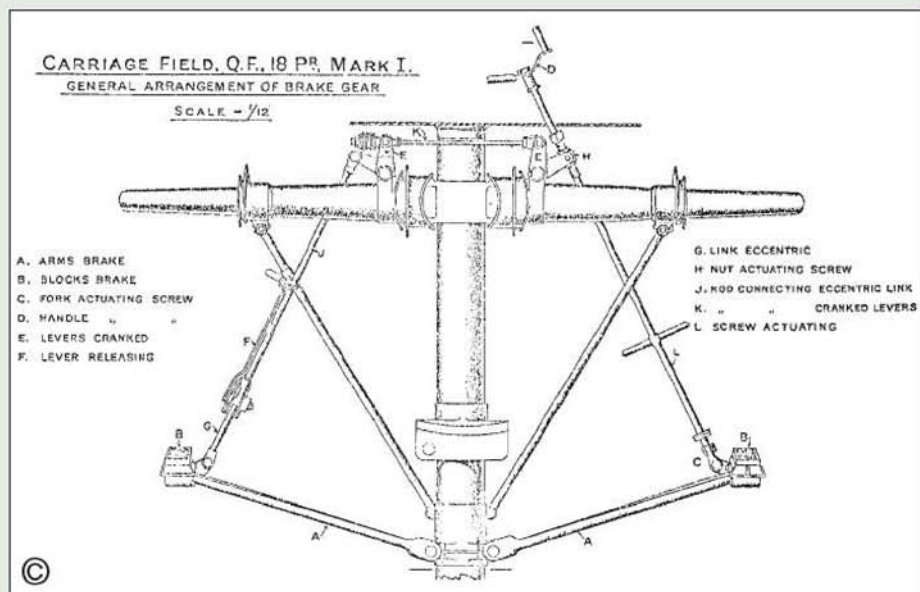
This consists of two flanged side brackets or cheeks riveted to front, centre and rear



Full size example of a 1903 QF 18pdr gun

transoms. Trunnion bearings are riveted to the sides to support the cradle trunnions which are secured by sliding cap squares retained by pins. In each cheek, a sliding bracket is riveted into a rectangular aperture to form the bearing between the top carriage and the axletree. The traversing bracket is riveted to the rear end of the top carriage; a cylindrical bracket is riveted to the left hand cheek to provide the support bearing for the lower portion of the elevating gear. The cradle travelling clamp lies between the two cheeks.

●To be continued.



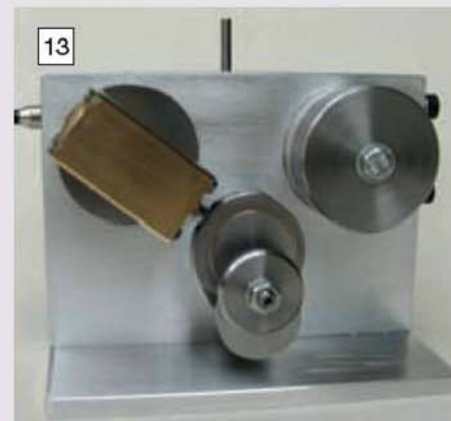
A view of the breech of a full size gun on display in the Rotunda Museum at Woolwich.



The first centre pivot engine (T3) shown against its reflection in a mirror.



Test engine T3 running with a steadying finger applied to keep everything steady for the camera.



Test engine T4 is a modified form of the third test engine, half a V-twin engine and double acting.

OSCILLATING ENGINES SOME REFLECTIONS

Colin Pape

continues with development work on his fascinating little engines.

●Part III continued from page 199
(M.E. 4189, 21 February 2003)

The V-twin was going to use two double acting cylinders. For quite a while I had thought that to be double acting the cylinders must be of the centre-pivot type, so the third engine (T3) shown in photo 11 was built to test a centre pivot design. It is a single acting engine but it has the general layout of a double acting engine. It was my intention to convert the cylinder on this engine to double acting.

In this engine I could have moved the cylinder closer to the crankshaft but because of the ultimate objective I wanted to retain similar basic dimensions everywhere, and the option to install the straight-line crank. This engine uses a bigger port face than the end-pivot engine because the same basic port face will be used when the engine is converted to double acting. With the double acting version there will be ports at each end of the cylinder.

The main parts of this engine are shown in figs 6 and 7. The centre pivot is attached to the one-piece cylinder block by screwing its end in tightly against the shoulder. The shoulder on the pivot provides support to keep the pivot perpendicular to the cylinder face. A recess in the port face accommodates this shoulder. The cylinders are shorter but thicker than the end-pivot cylinders. The cylinder is bored nearer to the outer surface than to the port face to provide more metal for the pivot attachment. The centre pivot design showed itself to be capable of doing the job. The pivot was strong and kept the cylinder flat against the port face.

The main dimensions of this engine are:

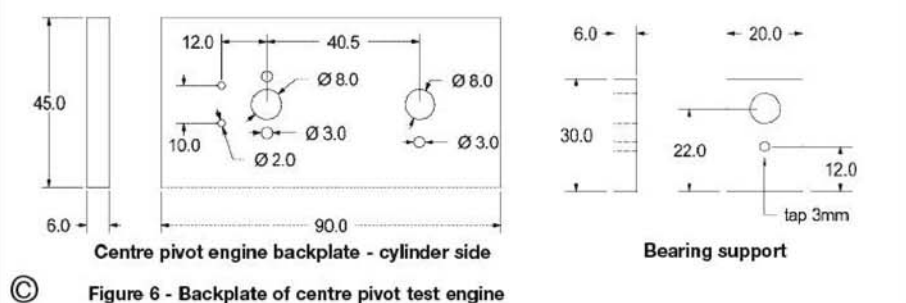
Stroke: 14mm

Bore: 13mm

Distance pivot to shaft: 40.5mm

Angular motion: 19.91deg.

The engine runs very well indeed. It is difficult to tell but I think it runs faster than the second engine. Photograph 12 shows this engine running. The recess in the port face centre hole is to allow

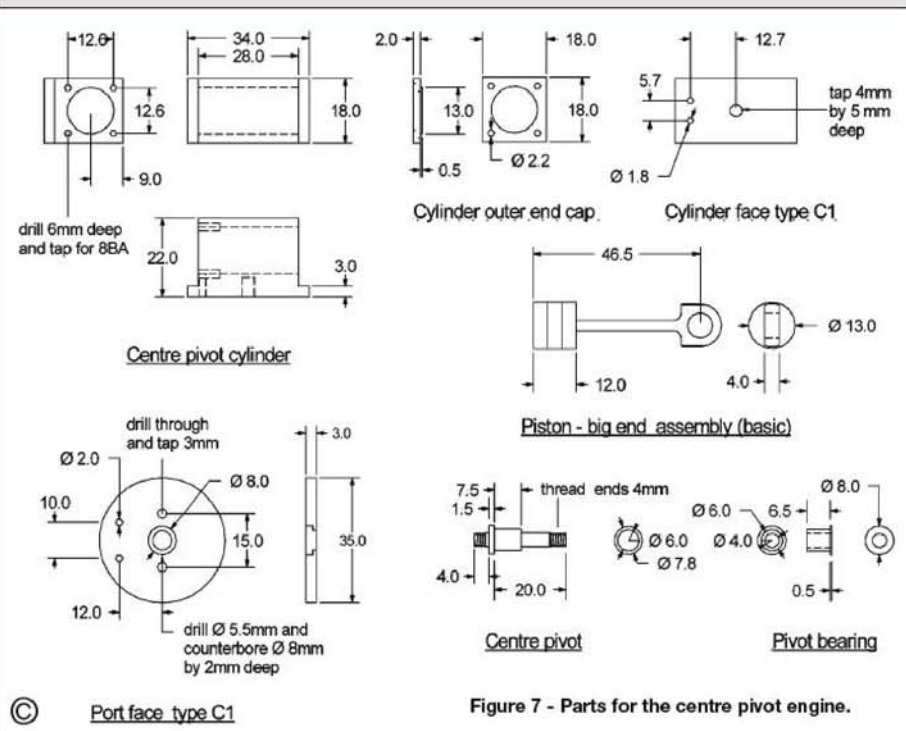


© Figure 6 - Backplate of centre pivot test engine

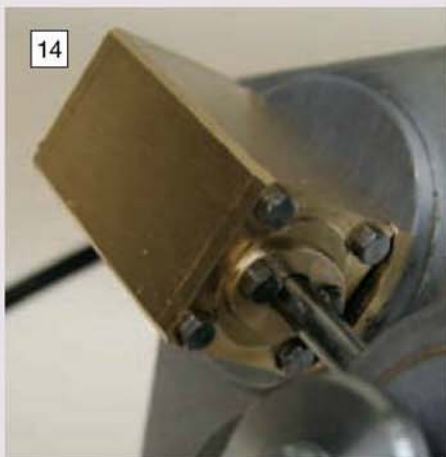
the port face to accommodate the shoulder on the pivot and for the port face to be located on the protruding bearing. This ensures that this port face does not interfere with the turning pivot. This engine can easily be converted into a double acting version but the piston and big end have to be made as separate pieces.

Fourth engine - T4

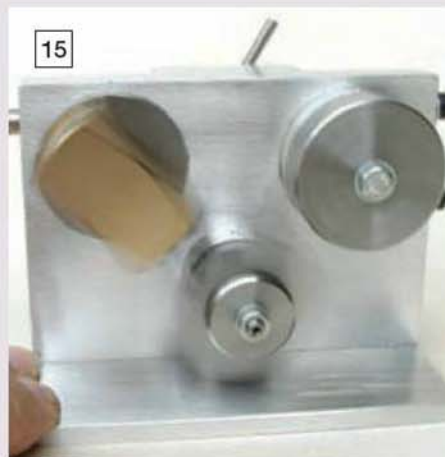
The purpose of T4 was to test the double acting cylinder. I had intended to convert the third engine into a double acting engine but things seemed to be going well so I skipped this step and went to the V-twin layout. The engine is shown in photo 13 which shows half of the



© Figure 7 - Parts for the centre pivot engine.



14
It was necessary to close off the inboard end of the T4 engine cylinder with a stuffing box to make it double acting.



15
Engine T4 running. The cylinder ports necessary to make the engine a full V-twin are covered by the circular plate on the right.



16
The full V-twin posed in front of a mirror to show both sides simultaneously.

future V-twin but the half in question is basically the centre pivot engine. The port face for the second cylinder has been covered.

A few changes were required to the simple centre pivot engine and needed testing. The most important was a means to close the previously open inboard end of the cylinder and the provision of a stuffing box for the piston rod. The closed end is shown in photo 14. The space required for these parts was allowed for in the centre pivot test engine design so that the same general geometry and piston assemblies could be used. The port face now has a set of ports for each end of the cylinder and the cylinder has holes at each end.

Either crankshaft may be used in a single cylinder configuration. Incidentally, these parts may be applied to any of the preceding engines because allowance was made in their design for the space required at the crankshaft end of the cylinder. In my test, only the straight-line crankshaft was used because only this crankshaft can be used in the V-twin.



17
The V-twin running. The fifth engine to be built, this was an adaptation of engine T4.

The piston/ big end assemblies cannot be made as one piece for a double acting engine. It must be possible to pass the connecting rod through the end cover and stuffing box components. The piston is drilled co-axially to accept the connecting rod. The connecting rod is secured by means of a Loctite type adhesive. It is screwed into the big

end, tightly to the shoulder. On assembly, the exact dimension shown on the drawing must be obtained. Any adjustment has to be obtained by machining the connecting rod (or making a longer one!).

I bonded the connecting rod to the piston and left the connection to the big end as a tight screw fit. Any tendency for the joint to come unscrewed would be visible. It was tempting to make use of the stuffing box system to incorporate a linear bearing that would act on the piston rod and help the piston to turn the cylinder. This would have allowed a greatly reduced piston length, a reduced cylinder length and the associated benefits of a closer pivot to the crankshaft, etc. On the other hand this would have meant a whole new geometry and I wanted to keep the seal as simple as possible. I wanted to use an O-ring, and these are not meant to absorb side loads. The main dimensions of this engine are:

- 1: Generally as for the centre pivot.
- 2: The V angle is 90 degrees.
- 3: The double acting cylinder is a single acting cylinder with the inner face closed by an end plate with a stuffing box and an extra set of port holes. Overall dimensions are the same.

The drawings for the main double acting parts are shown in fig 8.

Dream engine No. 1 Penultimate engine

I think that at this point I should list the objectives upon which I had decided for the dream machine. I wanted to build a practical engine suitable for general use, especially in situations where an operator might not be at hand to make adjustments or give the flywheel a push. As in a radio controlled boat for example.

- 1: The engine should be able to run on compressed air or steam.
- 2: The engine should be self-starting from whatever rest position and able to be easily controlled for speed and direction.
- 3: The engine must be compact.

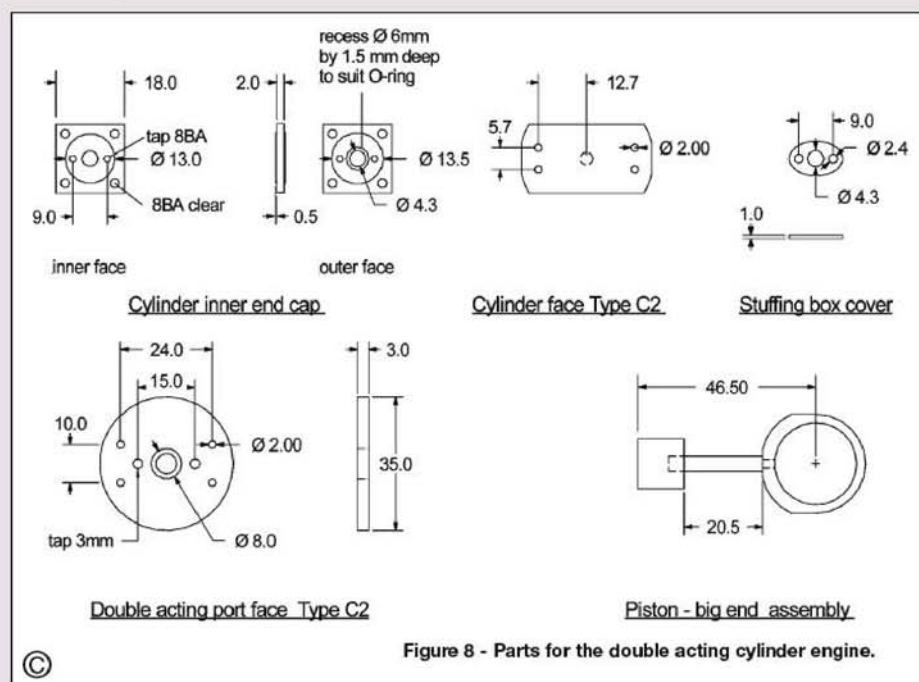
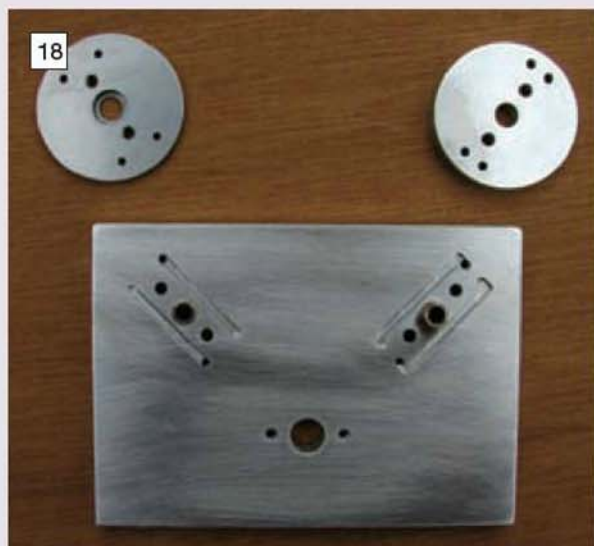
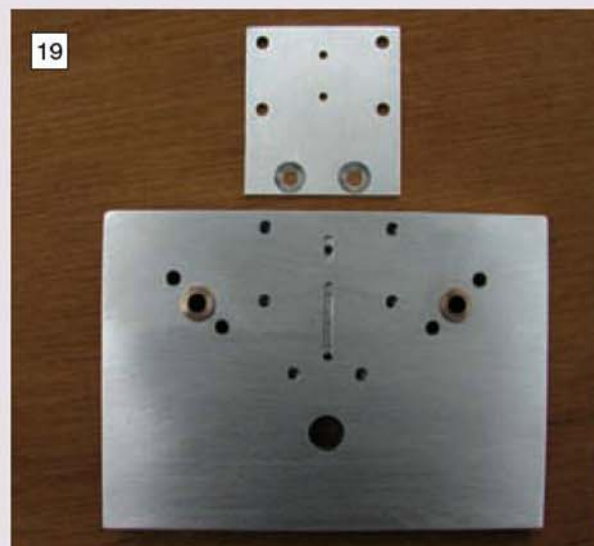


Figure 8 - Parts for the double acting cylinder engine.



Left: Front view of the V-twin engine finished back plate showing the slots machined into the surface and the cover plates.



Right: Rear view of the V-twin engine back plate. The distortion is not in the plates but is a trick of the camera lens.

- 4: The engine should be easy to build.
- 5: The engine should be easy to keep clean and maintain.
- 6: The engine was supposed to be a V-four.

Most readers know that almost any machine can be self-starting if it has been stopped in the right position. Only a few machines will self start in any position. As far as I know it is not possible to guarantee self-starting in any single cylinder engine or in any single acting twin.

Self-starting normally begins with three-cylinder engines which can have a power stroke every 120 degrees. I have never experimented with three-cylinder engines but I think that for small engines, four cylinders offer a more reliable solution. With double acting, a twin-cylinder engine can effectively become a four-cylinder engine but it has only two big ends. If the twin is in an opposed cylinder configuration with the crankshaft offsets 180deg. apart, it can only give a push to the crank every 180deg. and it cannot start by itself.

With a double acting twin in a 90deg. V configuration, the pistons can give a push every 90deg. because the V itself gives a 90deg. offset. There is always one piston pushing on the crankshaft and for almost all of the time there are two. This sort of engine can start itself, an approach which looked very promising. If it was not exactly the four-cylinder dream engine, it was very close. I called it the Penultimate engine.

All the bits and pieces had now been tested, except the V-configuration. So now the first engine to be designed actually became the fifth engine to be built (or at least it is number four and a half). I took the T4 engine and added another cylinder. This engine is shown in **photo 16**.

The engine described here is double acting, self-starting and runs in either direction. It is not a model engine insofar as it is not a model of anything. It has been designed to be just a small, useful power unit. It meets all the original objectives except one: it does not have four cylinders. The engine uses the following features:



The V-twin cylinder assemblies and port faces. The double port system adopted for this engine can be clearly seen.

1: Internal plumbing. All the plumbing from the inlet connector to the exhaust to atmosphere is internal and none of it is visible.

The implementation is quite straightforward. The back plate is used to provide the entire inlet and exhaust plumbing. Each port face now needs two sets of holes. Slots are machined in the front surface of the back plate to allow the two sets of port face holes to be connected. The port face pieces cover these slots. Two long straight holes are drilled from one edge of the back plate to make two internal passageways for the connections between the left-hand and right-hand cylinders. Holes drilled into these passageways from the front and rear surfaces provide communication between the port faces and the reverse-throttle block.

The outer ends of these two passageways are closed off but the reverse block could be mounted on this edge and then the passageways could be used directly and there would be no plugged ends.

Photographs 18 and 19 show the surface slots and the parts that will cover them. The centre holes of the port face pieces are actually machined in the same way but one is shown reversed. The smaller section allows the port face to be precisely located because it fits on the protruding bearing. The larger section accommodates the shoulder in the pivot. The back plate is not really barrel shaped, it is just that I got a bit too close with my camera in trying to pick up all the detail!

The two internal holes are quite long and are beyond the reach of an ordinary 3mm drill. Of

course, these holes could be drilled from both edges to meet in the middle but this means more plugged ends. I do not have any long series drills and I do not know what is the longest 3mm drill available so I used a DIY approach. I drilled as far as I could with a 3.4mm drill. I chose this because it is the size I use for tapping 4mm holes and I was going to tap the ends of these holes. Then I took a spare 3mm drill and lengthened it by silver-soldering its end into a piece of 1/8in. silver steel rod. I ended up with a 110mm long drill which did the job well. I drilled very

carefully and cleaned out the chips often. I have included a description of how I made this drill later in the article.

A benefit of the hidden plumbing is the fact that it helps to meet the objective for a clean engine. The engine was designed to have a dirty side and a clean side. The clean side has just a flywheel with a power take off, a reversing block and the spring retainers for the cylinder pivots. The other side has the moving parts and the lubrication points and the leaks. Even so it is pretty easily wiped over. Nowhere do any pipes or unions get in the way of cleaning.

2: Double ports and mirrors. The double port system is used for the cylinders. Because each cylinder is double acting it needs an inlet and exhaust port at each end. With the double port approach this means that each cylinder and each port face now has four holes. The port layout is different for each cylinder and also for each port face. This allows the mirror idea to be put in practice. **Photograph 20** shows the mirror cylinders with their matching port faces.

In the photo it can be seen that the pivot in one cylinder is longer than in the other. This is because one cylinder is mounted on a riser.

The other features of this penultimate engine, including its straight line crankshaft and reversing valve and throttle will be discussed and illustrated in the next part of this series.

●To be continued.



The great wheels assembled with their clicks and springs together with the intermediate arbor and winding key.



A front view of the clock movement assembled for testing prior to fixing the barrels to their arbors and other final adjustments.

MONTH GOING REGULATOR CLOCK

Peter Heimann

continues his description, starting with a trial assembly of the parts made so far.

●Part V continued from page 196
(M.E. 4189, 21 February 2003)

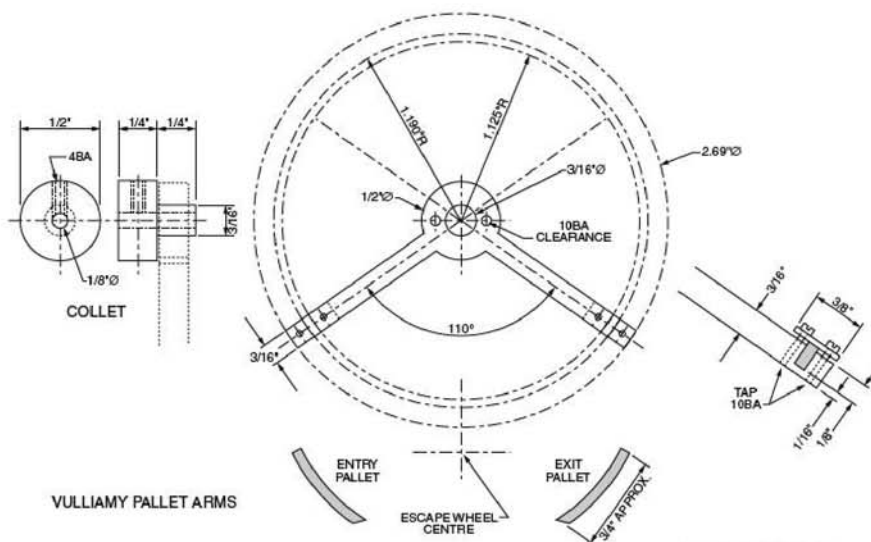
To complete the barrel assembly, the great wheels are now fitted with their ratchet clicks and springs, shown on drawing 7 (M.E. 4187, 24 January 2003). Photo 11 shows the completed assemblies, as well as the intermediate wheel on its arbor. The click spring is cut from ordinary 16 gauge brass sheet and well hammered to harden it.

The click itself is steel; its shape and position are self-explanatory. The 5BA steel holding screw fits in a tapped hole in the great wheel. In addition, it has a shallow steel locknut fitted on the reverse. This nut shows in photo 11, as does the completed assembly. Refer to the sections shown on drawings 5 and 6 for positioning the barrels onto their arbors but do not apply Loctite yet.

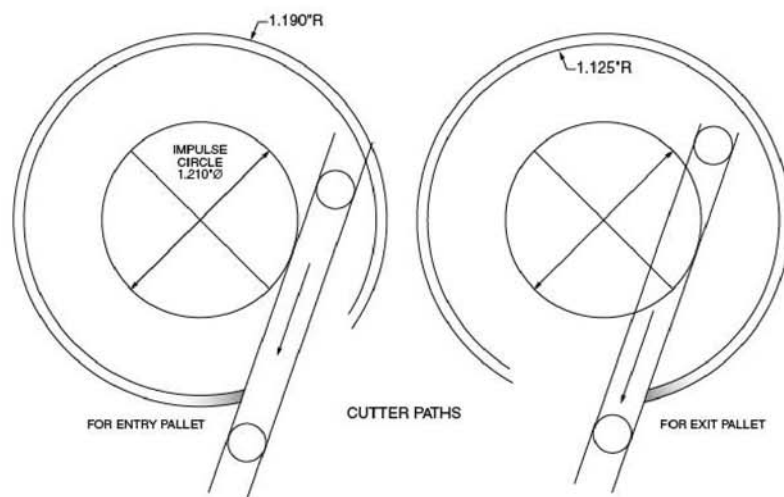
I suggest that a complete trial assembly is now indicated to ensure everything will line up, mesh correctly and turn smoothly. Should there be any problems, methodically trace and eliminate them. Photographs 12 and 13 show the assembled movement, although the crutch and motion work have, in this case, also been fitted. Only when you are 100% sure that all is well, Loctite the barrels to their arbors, tighten the ratchet wheel collet grub screws and Loctite the wheels/pinions in their respective positions on the arbors.

I find it best to position all components 'dry' and mark the arbor with a narrow ribbon of masking tape. The components can then be removed and the arbors held in a chuck or the vice with the end of the jaws flush with the back of the collet. This creates a positive stop against which to locate the collets/pinions after applying Loctite.

All steel screws should be 'blued' by heating and quenching in oil. There are quite a number of these so if you decide to carry this out indoors,



DRAWING 10





15
The completed crutch assembly, the pallet arbor and pallet frame awaiting assembly into the clock.



16
Another view of the back of the movement showing the crutch in position. Time to see if there is some life in the movement!

nibs themselves until the polishing is finished — it is much easier to handle the bigger piece.

An alternative method would be to machine a complete ring on the lathe, 1.125in bore x 1.190in. outer diameter and cut the impulse angles by hand using impulse circle discs as guides, as previously mentioned. I have also tried using straight lengths, sawn and filed from gauge plate and bent to the correct shape. This is quite possible if you get satisfaction from using all your bench skills. In fact, a more traditional design of dead beat escapement is completely carved out of a single piece of gauge plate. The snag with that method is the requirement for extremely accurate marking out. Final adjustment is only achieved by continuous trial and error, polishing off minute amounts from the acting faces. I admire the skill and patience involved but prefer the engineering approach described. Photograph 14 also shows a completed assembly.

Setting the escapement action

The moment of truth is now upon us. Assemble the components as shown on drawing 10 so that the impulse faces of the nibs are approximately 1.300in. apart. The collet should face the front. It can be located on the previously manufactured arbor in such a position that the pallet nibs are central over the escape wheel teeth. As the pallet frame is fixed to the collet by means of screws, it can of course be removed without trouble, if necessary. However, an advantage of the skeletonised front plate is that one can access the pallet nib clamping screws to adjust as required.

The objective is to adjust the nibs methodically and equally so that when one tooth of the wheel is released by one pallet, another tooth is arrested. The amount of 'lock' on to the left curved area should be about 0.020in. from the edge of the impulse face. Adjustment of height by means of the eccentric bushes will equalise the lock between both sides. On no account must the escape wheel teeth lock on to the impulse faces. At the other extreme, excessive lock is not good and will waste energy.

If this is your first 'dead beat' experience, you may not get things right first time. The reason is that as movement of the pallet nibs is radial, the tiniest adjustment will appear to have a quite disproportionate effect. It must be impossible for the escapement wheel to revolve more than half a tooth (one second) at a time in a clockwise direction without locking alternately against entry and exit locking (not impulse) faces. The tips of the

escape wheel teeth sliding along the angular impulse faces of the pallet nibs after unlocking create impulse to the pendulum crutch. This will be described in the next section. There will be further adjustment when the crutch is fitted and finally when the pendulum is in place, so do not worry unduly at this stage. Simply ensure that with gentle finger manipulation the escape wheels and pallets behave as described.

Crutch and beat adjuster

The crutch and beat adjustment arrangement is detailed on drawing 11 here. It is manufactured from brass with the exception of the pendulum fork pins which can conveniently be made of 1/8in. dia. silver-steel. The 1/2in. dia. collet is soft-soldered or Loctited to the beat adjusting plate. The latter has two 1/4 x 1/4 x 3/16in. blocks silver-soldered to its top corners as shown. These should be drilled and tapped 6BA and temporarily aligned with a piece of 6BA studding prior to soldering. The long body has a small block silver-soldered to its top. The two adjusting screws passing through either side of the beat plate blocks will bear against this crutch block to provide adjustment.

A 1/2in. dia. clamping washer fits onto the collet spigot. Tapping size 10BA holes are drilled through all the components together. The holes in the beat plate collet are tapped, while the holes in the body and washer are opened out clearance. In addition, the holes in the long body are elongated slightly to allow movement. Very little movement is required for fine adjustment only, as both the crutch collet and the pallet collet are locked to the arbor by grub screws, thus allowing coarse adjustment. Again, although one 4BA grub screw is generally sufficient, as shown on the drawing, I suggest that two, say 5 or 6BA screws will be better and avoid the need for hard tightening. The ends of the screws will be blunt because we want to use the 'friction fit ability' for setting up.

The pendulum rod fork at the base of the crutch is locked in optimum position with a 5BA screw and locknut. The rod is likely to be 6mm dia. and eventually, a free sliding fit without play is desired here. If the fit is too tight, this can stop the clock, and if too sloppy, it wastes energy thus affecting time keeping. Even on enormous tower clocks, this aspect is often found to be the cause of trouble, usually cured by a spot of oil. Photograph 15 shows the completed crutch assembly, its arbor and another view of the pallet frame. Photograph 16 is a view onto the back of the movement where the crutch is clearly shown.

The pallet arbor can now be removed which, of course, only requires taking out the back eccentric bush. Fit the crutch assembly and replace. Stand the movement on a level surface. Apply gentle clockwise finger pressure to one of the great wheels and see if the crutch (acting as a very short pendulum) wants to impulse. If not, carefully rotate either the pallet frame assembly or the crutch assembly on their common arbor by slacking off the grub screws to a friction fit. We are searching for an even beat — the first sign of life in your handiwork! Even when you have got the movement to beat evenly, with the crutch deputising for the pendulum, further adjustment will be required. We will deal with this aspect when setting up for testing. Do be careful that the escape wheel teeth 'lock' onto the respective radial pallet surfaces before sliding over the impulse faces. Slight adjustment of the eccentric bushes should help to equalise the 'lock' on both pallets. A satisfactory action at this stage is a huge step in the right direction. Although there is a lot more work ahead, you do know that the movement is going to run.

●To be continued.

DIVIDERS TIP

A good pair of dividers is indispensable for marking out radii and circles. Probably the best type for light, accurate work is the traditional screw adjusted round-legged, spring-bow pattern. Light and sensitive, and easy to keep sharp by lightly stoning the points, this type seems to appear less often in tool catalogues. Customers are usually offered the alternative form of dividers with flat legs. While no doubt adequate, this latter pattern seems clumsy and insensitive compared to the elegant round legged type.

An alternative for those seeking a pair of easily adjusted dividers that are light and pleasant to use is the traditional draftsman's version. These have very sharp, replaceable points which can be removed for stoning up should they become damaged.

With the advent of CAD packages, draftsman's instruments can usually be picked up cheaply in junk shops and at car boot sales. Look out for good quality instruments with well made pivots and undamaged adjusting screws.

Neil Read

KEITH'S COLUMN



Keith Wilson

describes his cylinder design for this project and offers advice as to how to machine them.

●Part XV continued from page 211
(M.E. 4189, 21 February 2003)

The not-so-well-known but famous astronaut Michael Collins once wrote that it was a good thing for any man to exert himself to the limit — and beyond on occasions. Arthur C. Clarke's second law is to the effect that the only way to discover the limits of the possible is by trying to go beyond them into the impossible. Arthur is a Great Western fan (see *Rendezvous with Rama* for verification) and he knew all about me when I was living in Devon but, as he explained in a subsequent letter, when he passed near my house he could not think of a good excuse to drop in.

Having done some name-dropping, I should perhaps mention that Michael Collins was the 'third man' in charge of Apollo 11's Command Module *Columbia* while Neil Armstrong and Edwin 'Buzz' Aldrin landed on the moon in the Lunar Module *Eagle*. Michael Collins must have been the loneliest man the world had known up to that time, for when behind the moon he was utterly cut off from human contact for about five hours at a time.

I have felt something of the extension towards this limit with the cylinder design for this locomotive for, as I have mentioned before, the drawings are somewhat sketchy and do not always agree one view with another. In the same vein, it is not easy to determine the 'inside' features from photographs of the outside. On top of this, it is important for the job to be 'makeable' without

too much impossibility. (Oh yes, I have seen one or two such drawings in my time!)

It would have been nice to use cylinders like those for my Saint and 47 designs, viz., three castings instead of two, but this would have spoiled the appearance of the engine. With the Saint/47 design the extra bits are all hidden under the valance and hanging plates; our American colonies put the insides on the outside, so the three-casting system would stick out like a sore thumb.

From study of the photograph of the prototype, the cylinders look to me as if they are high performance units with the valve head over the ends of the working portion of the cylinder; thus steam passages were as short as possible. They are also fairly wide. Both these characteristics show up well.

The observant reader will note the two sighting plugs into the steam chest. These are for setting the valves, slightly more difficult in full-size, and a matter of personal opinion for us. I used them once on one engine — I forget which one, so I cannot recall if they were much use. There are methods of setting valves that do not require these items.

I tried to design-in exhaust passages outside the steam passages (as in modern practice) to get said steam passages shorter, with obvious advantage, but could not see how to manage this without distorting the appearance creating nigh-impossible machining problems (for us). So the usual drilled steam passages will have to suffice; they should

be adequate for normal use. The outside exhaust passages show up in the first photograph, but they would be a bit tricky for patterns and moulding, and I do not believe that performance would be improved.

I get the impression however (and I may be wrong here), that the designers of the original were unaware of the big advantage of large steam chests, for there is clearly plenty of room for them and it would have cost nothing to put them in.

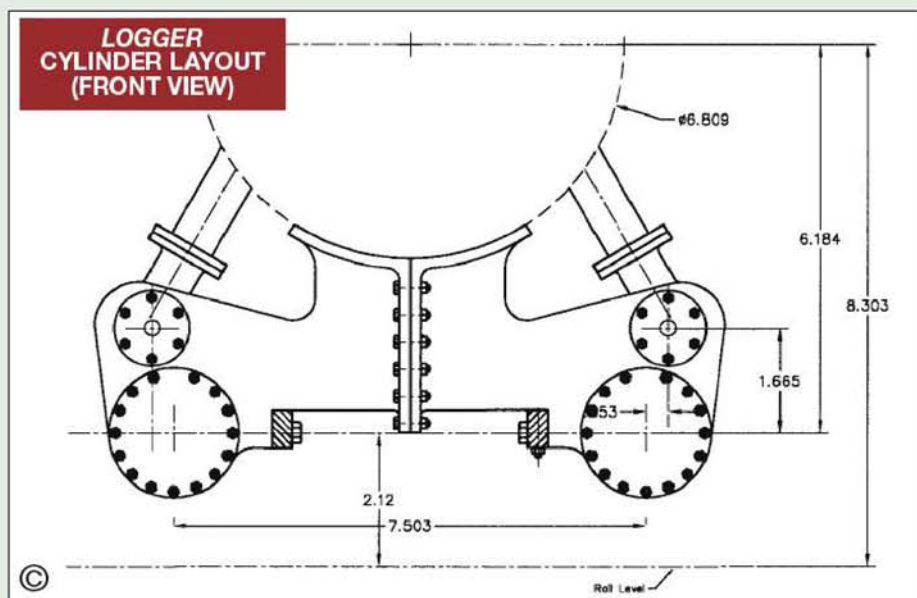
Our old 'frenemy' (friend and enemy) square-cube works for us here, for cylinder volume decreases with the cube of the scale factor. H' on the h' other 'and, the area of the passages decreases only as the square, so in theory at least ours should not be inferior in any way, still permitting of speeds far in excess of any allowable track speed. (A record run which I once witnessed was 31mph by a *Highlander*; I believe there was once a 35 by a single wheeler. I do *not* fancy trying it myself, but assure you that I have been driven at little short of this speed on 7 1/2in. gauge in Los Angeles in 1979, and I can say without fear of contradiction that it feels more like 200mph from track level!

Machining

I have not yet used two-block cylinders of this type so cannot write from experience as to how to machine them, but I have one or two suggestions that will probably help. Begin by machining the mating parts of the blocks, getting them flat. Mark out and drill the holes in the webs, using

LOGGER & SLOGGER AMERICAN TYPE 2-8-2 LOCOMOTIVES for 5in. and 7 1/4in. gauges

Wilson's Words of Wisdom:
*There is no-one so outrageously
indignant and self-righteous
as a pedestrian who has had his
careless attempt at suicide foiled
by the alertness of a driver.*



jig-boring methods if possible. It is hardly possible to 'spot through' the four holes along the bottom, so it might be needful to make these a bit larger than clearance, but by all means spot through the ones at the sides. They don't have to seal more than exhaust pressure. Use bolts for these holes, not hex. headed setscrews. The difference is that bolts are not threaded all the way up to the head, and will be a firmer fit acting as dowels. If it comes to the crunch, turn your own bolts to 'mike' tolerances and fit them into reamed holes in the blocks. It is very important that the blocks can be dismantled and replaced exactly. To this end, I suggest opening out two matching pairs of holes to exactly $\frac{1}{4}$ in. diameter (I suggest the top holes on each side) to accommodate two nice fat dowel pins. These may be purchased as dowel pins, or can be made from silver-steel, the former being preferable.

Next, I suggest the mounting surfaces where the assembly is fixed to the frames. Do the mounting surfaces for the draincocks at the same setting. This fixing needs to be fairly hefty, but of course weakens the frames — ain't no way round this. Eventually of course the two big struts from pilot beam (buffing plate to us Limeys) to smokebox will help, and in any case there is no vertical thrust in front of the cylinders, so we only expect to see buffing thrusts (mainly horizontal).

The actual fixing is by means of some 2BA bolts upwards through the frames into the cylinder blocks, or in this case studs in the blocks would be better. Make sure you spot through for these, and tap through the holes in the frames. Else *certes*, you will get studs pointing in marginally different directions.

This reminds me of a case in a machine for the Atomic power station at Sizewell. The draughtsman

working on certain hydraulic rams insisted that it would be possible to get two blocks that had to match precisely drilled by jig-boring methods. Against my better judgement I allowed this, and later wished I hadn't, for of course they most certainly didn't. It took quite a bit of hasty part-making to correct this.

In my opinion, these studs would probably not really be adequate, but it is possible to get some $\frac{1}{4}$ in. bolts through the frames in the other plane, where there is much more room. To spot these through, each cylinder half in turn must be mounted by these studs and spotting through done by a long drill through the opposite frames. No long drill? Turn the stub end of a $\frac{1}{4}$ in. drill down to $\frac{5}{32}$ in. dia., drill a $\frac{5}{32}$ hole in the end of a piece of $\frac{1}{4}$ in. steel and silver-braze them together. Result: long drill. I have accumulated many 'long drills' over the years; they occasionally become indispensable. There are some cut-outs in the bottom flange shown on the block drawings to allow for this operation.

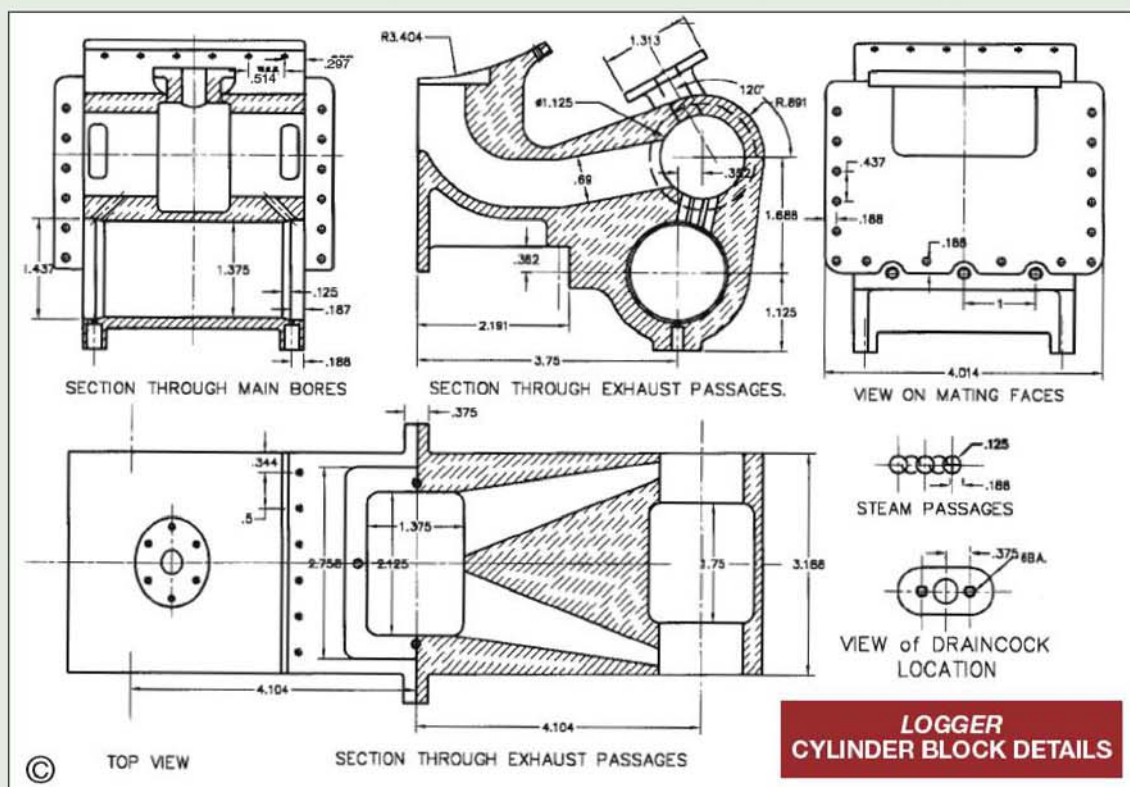
With the block re-assembled, cleaning up the front faces comes next. It is important that the two separated front faces be co-planar, or in simpler words match as if one plain plane.

If not possible to machine both bores while connected, then they may be separated and bored individually. Take care to do the rear face of each cylinder at the same setting as boring, for it is most important that the face be dead true with the bores. The front face is not quite so critical but don't be too far out. If you have access to a big enough lathe and you clamp the front face to the flat surface of a sufficiently large faceplate, then the bores must come out square with the front face. With no access to such a lathe, then possibly a good boring head on a milling machine might well suffice. Note the larger diameter at each end of the bores, this is most important at the front end and considerably less so at the back. The bore for the steam chest is done in the same way; it is of great importance that the two parts of this bore are dead concentric. To this end, if a reamer of the right size is not entirely impossible, then ream it in one fell swoop. The ideal is a floating adjustable reamer. Costly but excellent.

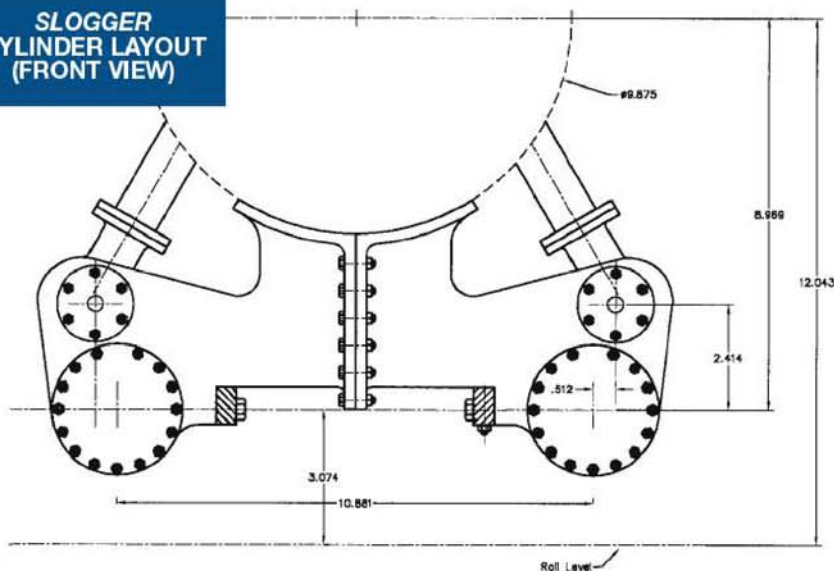
As I have mentioned before, honing is a must. To finish by boring and reaming gets you a finish within about 0.001in., but honing will get you both within 0.0001 inch. Leave an 'egg-shell' finish which retains oil and seems to last better than a polish.

It can be amazing just what devices and methods can be made by the owners of alert minds. I recall reading in a book of 'dingbats' how some good folk made a miniature high-energy cyclotron for experimental work on plant breeding, mainly out of oddments rather than super-posh parts. Does the mind boggle?

The steam passages may be as I have shewn, or left as just three holes; a jig to fit into the end of



SLOGGER CYLINDER LAYOUT (FRONT VIEW)



the bores will be needed for this. To make the 5-hole type, drill the first three and plug them with pressed-in mild steel pins. Then carefully drill the two extra holes and push out what is left of the pins. I am not sure what effect this will have on performance, for I have not tried both types, but I believe the 3-hole one will be adequate for permissible speeds.

I have shown an enlarged steam chest, for this greatly improves cylinder performance. If there is a cylinder full of steam at boiler pressure awaiting admission, then when the port opens the immediate pressure drop is less. This results either in equal performance with much smaller steam pipes, or improved performance with normal steam pipes.

The drilling of the steam bosses into the steam chests is straightforward, as is drilling of the holes at the very bottom for draincocks. Incidentally, if these four mounting faces are machined accurately, they make good location parts for other machining operations.

An interesting point is that, as on the big GWR cylinders, the input of steam is not dead central into the steam chests. This gives a swirling effect to the steam which aids flow. Machining of the curved seating for the smokebox and the cut-away for the blastpipe may well be done last.

It will not be possible to 'spot through' when fitting the smokebox to its saddle, but I have a trick or two to assist.

In the last part of *Logger* (M.E. 4189, 21 February 2003), two identical drawings were published; my error. Having been used to some button pressing to get the 5in. version, I did not notice that there were no dimensions shown. So reduction by

0.6895 followed by expansion from A5 to A4 (1.4) brings it back to a virtually identical drawing, apart of course from the titles — sorry.

Correction and a Paradox resolved

A close friend has drawn my attention to a misleading part of my recent comments on boilerplate thickness. As stated in the article, the result comes out as 1in. for the first example and 0.6in. for the second. It is not likely to fool anyone, for the one thing that 'ours' is lacking is a supply of fools. However, I thought it best to mention the matter.

M. J. H. Ellis in *Letters to a Grandson* (M.E. 4189, 21 February 2003) asks for the explanation of the working of the injector, to wit: "Where does the energy come from?"

There is no real problem. In each gram of steam there are 539 calories of latent (hidden) heat, due to the molecular form of the steam,

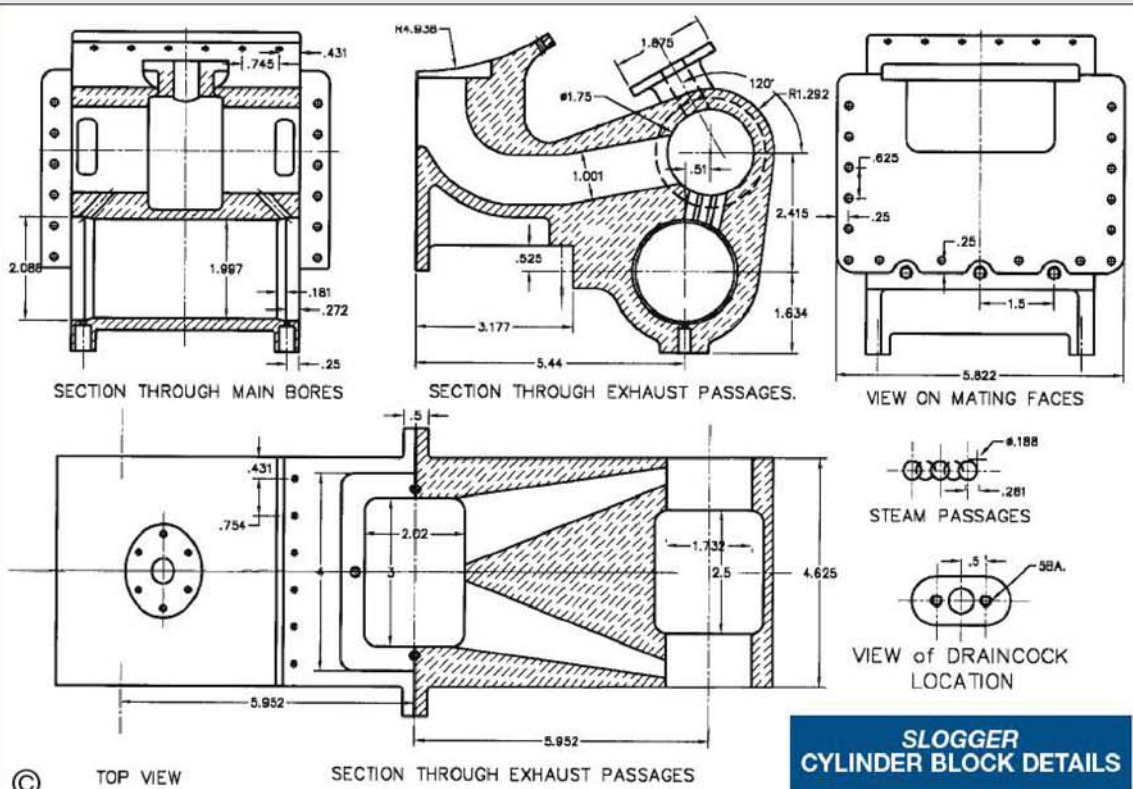
which incidentally is now H₂O. On passing through the water space and into the combining cone, obviously the steam condenses into water, admittedly hot.

But, assuming that this water starts off at about 20deg., then to get it up to boiling point takes only 80 calories. So there is energy to spare. Even though 1 gram of steam does not necessarily condense for 1 gram of water, there is still plenty of energy, now no longer in the form of latent heat, which has to go somewhere. The combining cone converts this to a high velocity but low-pressure jet which 'jumps the gap' 'twixt combining and delivery cones. The delivery cone, being (apart from the very beginning) a divergent cone, the high velocity jet is drastically retarded with the result that, due to the principle of the conservation of energy, up goes the pressure. In the extreme, 1psi of steam will work against 150psi boiler pressure, so there is lots to spare.

The overall state is such that the whole system loses energy; anyone who has run an injector on a low fire will confirm the rapid drop in boiler pressure. The loss of energy through cooling of pipes plus injector (all by radiation) is only about 2%, quite minor, so the energy required to operate an injector comes from a lowering of energy in the whole system.

It is rather on a par with those who claim that evolution is impossible because it violates certain laws of thermodynamics; they do not appreciate that said law (the Second) applies only to a closed system. In other words, energy from the Sun is more than enough. As a minor point, said solar energy also produces food in the way of plant life, upon which some 99.9% of life on this planet depends.

●To be continued.



SLOGGER CYLINDER BLOCK DETAILS



Barry Jordan with his display of miniature machine tools at a model engineering exhibition. Barry has already won several major awards.

the machining size scale. These projects exhibit jewel-like precision and stress the skill of the operator over the size and expense of the machinery used to build them. It is the hope of the Foundation that by recognising the achievements of these individuals, it will bring attention to the hobby of miniature machining and encourage a new generation of people to learn and enjoy the skills of working with machine tools and making things of precision and beauty. These winners have contributed not just one or two good projects, but rather a lifetime of achievement that includes the mastery of many aspects of metalworking skills.

Because of the excellent craftsmanship, attention to detail and large volume of excellent work, Joe Martin has decided to select Barry Jordan as the 2003 'Metalworking Craftsman of the Year' for the Joe Martin Foundation for Exceptional Craftsmanship. The award will take place on April 26, 2003 at the North American Model Engineering Society exposition in Detroit, Michigan where Barry will receive an award plaque and a cheque for \$1000. He will also be displaying some of his model machines to an American audience for the first time. Barry's superb work can be enjoyed on the web by visiting the Joe Martin Foundation's Internet Museum of Craftsmanship at <http://www.CraftsmanshipMuseum.com>

METALWORKING CRAFTSMAN OF THE YEAR 2003

Barry Jordan

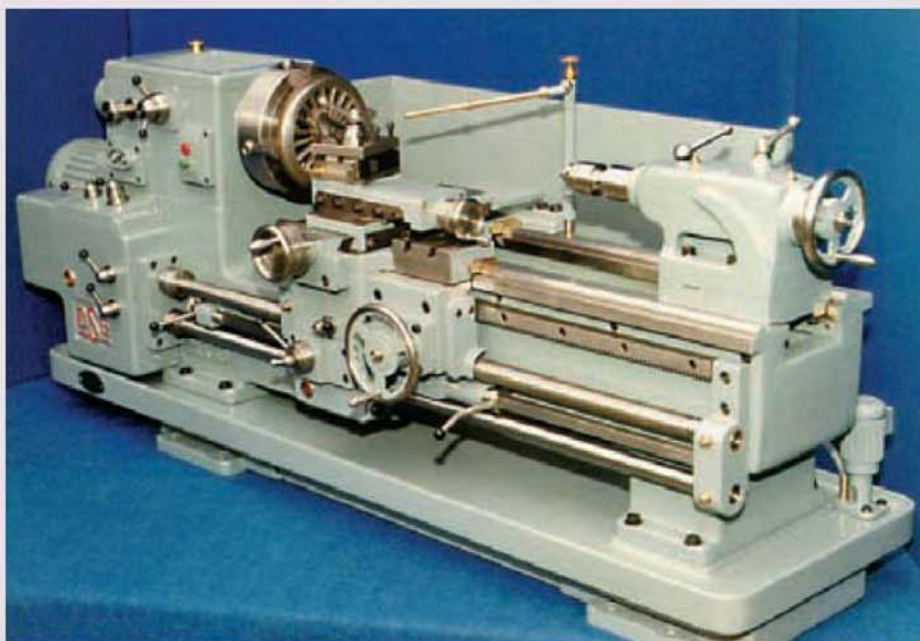
of Derby is the first English winner of this prestigious prize awarded annually by the Joe Martin Foundation for Exceptional Craftsmanship.

Joe Martin is a lifelong modeller, toolmaker and President of a company that manufactures miniature machine tools. The Joe Martin Foundation was established purely to reward craftsmanship, and the brand of tools used to build the projects in no way influences the choice of the winner. Barry Jordan is the seventh person to receive the Martin Foundation award and the first from England. Preceding him are Jerry Kieffer (1997, USA), Alan Ingersol (1998, USA), Wilhelm Huxhold (1999, Canada), William R. Smith (2000, USA), George Luhrs (2001, USA) and Young C. Park (2002, USA). All are superb craftsmen in various areas of miniature metalworking.

The purpose of the award is to bring attention to those who have attained a level of craftsmanship that is recognised by all who see it to be 'head and shoulders above' similar work in a particular area. The award also specialises in rewarding those who work at the small end of

About the winner

Barry Jordan's models first came to the Foundation's attention after an article about his 1:5 scale Bridgeport mill, and the tiny rotary table that led to it, appeared in the December 1997 issue of *Model Engineers' Workshop*. The Foundation's first winner of the Metalworking Craftsman of the Year award, Jerry Kieffer, attended a model engineering exhibition in England and got to see Barry's models first hand.



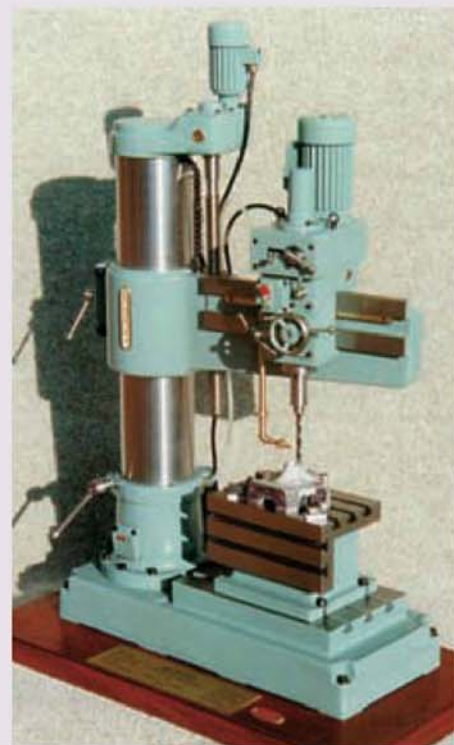
Dean Smith and Grace Type 2148 heavy duty gap bed lathe in 1:5 scale. This working miniature was made between 8 March and 11 October 2000 from cast iron billet and aluminium alloy stock. Dean Smith and Grace sales literature was used along with a study of a full size machine courtesy of English Electric Lincoln and Royal Ordnance Westcott in the design of this highly detailed working miniature.



The 1:5 scale Bridgeport mill and machine vice. Barry's first complete project won many awards and was finished just in time for Bridgeport's 100th anniversary in 1997. Fully functional, no castings are used in Barry's models, even parts that look like castings are machined from solid stock.



After seeing Jerry Kieffer's miniature models, Barry was inspired to build a smaller version of the Bridgeport. This 1:14 scale model is also functional, although Barry prefers to work in the larger 1:5 scale because his models are able to function more like the originals in that size.



Barry's 1:5 scale Archdale MH50 radial arm drilling machine stands 26in. tall and was based on measurement of the full size machine. It was made between 24 May and 28 August 1998 from cast iron billet, aluminium alloy and mild steel stock without the use of any castings.

Over the years the Foundation have followed his progress as he turns out machine after machine, each to the same superb level of quality and detail. In addition to their quality, what impressed Jerry most about Barry's machines was the fact that they all work. These are more than models, they are working miniature machines capable of doing the same jobs as their full size prototypes but in a smaller scale. Although it would be impossible to tell from the

finished models, no castings were used in their production. All parts are machined from billets of solid metal.

Barry J. Jordan was born in Derby, England in 1945. He left Joseph Wright Art School at 15, and secured an apprenticeship with the Rolls-Royce Aero Engine Division Derby in the Experimental Department. After developing a range of Ultrasonic Crack Detection equipment used in non-destructive testing, he formed his own company in 1977 to manufacture this equipment.

In 1994, Barry was diagnosed with an inoperable brain tumour. Fearing the worst, he sold the business to Rolls-Royce and Associates, bought a Myford Super 7 lathe, a Raglan milling machine, built himself a workshop and went back to his boyhood love of model engineering. Fortunately, his tumour has responded well to medication and he is still turning out wonderful models from his home workshop.

His first project was a 1in. scale *Minnie* traction engine. Then, looking for a theme different from the normal models seen at all international

exhibitions, he decided to start making miniature classic machine tools. In 1997, he produced his first; the award winning 1:5 scale Bridgeport BRJ mill. This model took 'Best in Show' at Harrogate England in 1998 and has gone on to win many other awards in the UK. Barry is now working on his eleventh miniature machine, the Swedish made Tricept 805 five-axis machining centre — quite a challenge! He says that his hobby has been part of his therapy.



The size of this 1:5 scale Warco hobby drilling machine can be gauged by the UK £1 coin.



1:5 scale Qualters & Smith Sawmaster 6in. power hacksaw (6 January - 11 March 1999).



Barry's 1:5 scale Mark 1 Clarkson tool and cutter stands 14in. high and was completed between 24 November 1997 and 18 March 1998. It is made from cast iron billet, aluminium alloy section and mild steel stock without the use of castings.



Boring the ball race recess in the back plate. The part is held by means of a turning spigot.



Machining the gear cover plate in the vertical slide. Note the wooden packing at the bottom end.



Les Chenery

moves on to making the back plate and gear cover for his fine miniature engine.

●Part III continued from page 187
(M.E. 4189, 21 February 2003)

Hold the back plate by the turning spigot in a 3-jaw chuck. The spigot has a 50/50 chance of being square with the rear face of the casting depending on what sort of day the foundry man has had. If it is not square, hold the opposite side in the 3-jaw chuck by the large boss and true up the spigot, taking off the least amount possible. Turn around in the chuck and, leaving the 0.625in. dia. hole in the centre until the last operation, slowly face across the casting to the starting dimension of 0.200in., the thinnest part of the plate, leaving the bosses on the rear of the plate to be reduced to size later.

Turn the 1.750in. dia. boss down to the 0.350in. measurement, and the 30deg. angle plus ball race recess with the 0.010in. relief. Then bore out the 0.625in. dia. central hole, remove the casting from the chuck and cut off the spigot. If your chuck runs true the casting can be held on the 1.750in. dia., otherwise a mandrel will have to be used to face across the bosses on the rear face.

Remove the casting from the chuck. Make a small spigot for centring up the casting with the gear cover casting. The spigot can be a piece of 0.625in. dia. brass rod with a small protrusion of 0.218in. dia. x 0.625in. long. Carefully mark out the gear centres on the rear of the back plate and then drill right through the two lower holes with a 1/8in. dia. drill. These holes are for spotting

through onto the gear cover when in place. At this point the gear cover will have been faced and the holes in the lugs drilled. Also, the 0.218in. dia. hole in the triangular boss and the hole in the boss below it should be drilled 1/8in. diameter.

Hold the two castings together, place the spigot in the top two holes, swing the gear cover around until the lugs align with the lugs on the back plate and clamp the two castings together with a toolmaker's clamp; spot through the lugs onto the back plate. The two 1/8in. holes in the back plate can be used to spot onto the gear cover face and the 1/8in. hole in the round boss on the gear cover to spot the gear centre on the back plate.

Separate the castings and drill the holes in the back plate, tapping, reaming and counterboring as per the drawings. The 0.281in. dia. blind hole can be left with just a reaming size drilled hole and then reamed in conjunction with the gear cover when screwed together.

Gear cover

Grip in a 4-jaw chuck by the bracket with the face as square as possible in both planes and face lightly across to the starting dimension of 0.281in. over the top bolting lug. Remove the casting from the chuck and clamp onto the vertical slide with two small clamps, making sure the casting is square in the vertical plane by holding an engineer's square on the top of the slide and against the side of the bracket. Ensure that the vertical slide is square to the chuck and face the oil pump flange down to size with a 7/16in. dia. long series end mill held in the 3-jaw chuck. Run the cutter over the end face of the bracket to size and the triangular boss face and circular boss below it to their own measurements. The casting

may have to be turned upside down on the slide to machine these two bosses. Remove from the slide; mark out the 0.218in. reamed hole in the round boss, drill this hole 1/8in. dia., drill and ream the hole in the triangular boss. Drill and spot face the holes in the lugs. Do not spot face the hole in the oil pump flange at the bottom.

The casting can now be offered up to the back plate casting and the various holes spotted and drilled. Unclamp the castings and, with the castings squared up in both planes in a vice, the gear centres can be drilled and reamed and the large 0.875in. dia. counterbores machined, along with the 0.562in. counterbore at the top, all to the same depth. The centre one of the large gear counterbores must be counterbored to 0.437in. dia. to the measurements on the drawings to clear the nut on the end of the camshaft.

The oil pump bottom gear centre will have to be marked out on the face of the flange then drilled and reamed; the two 0.350in. dia. holes counterbored to the same depth and a 0.281 dia. cutter passed through the centre between them at the same depth. Scribe a line through the centre of the two counterbored holes, carry it on around the outside edge of the casting for the centres of the oil way holes, and drill and tap these holes as per drawing. The two 8BA tapped holes can be blocked with small grub screws later.

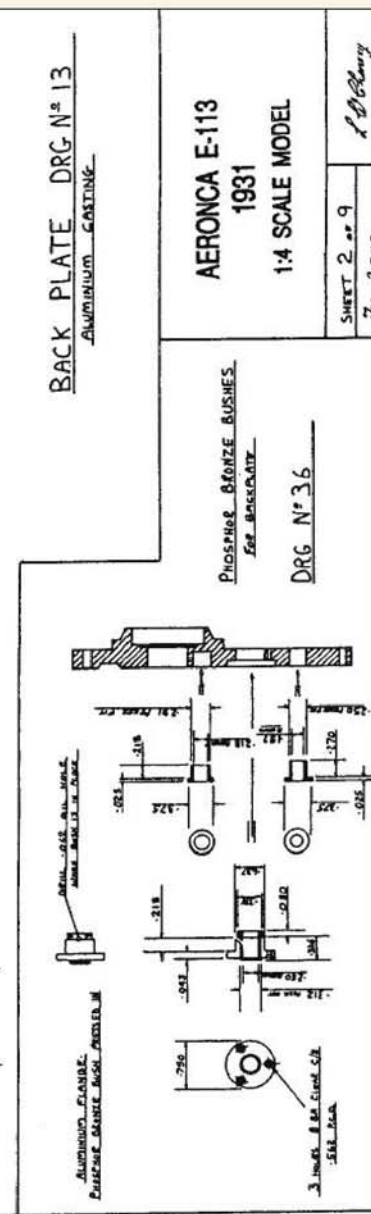
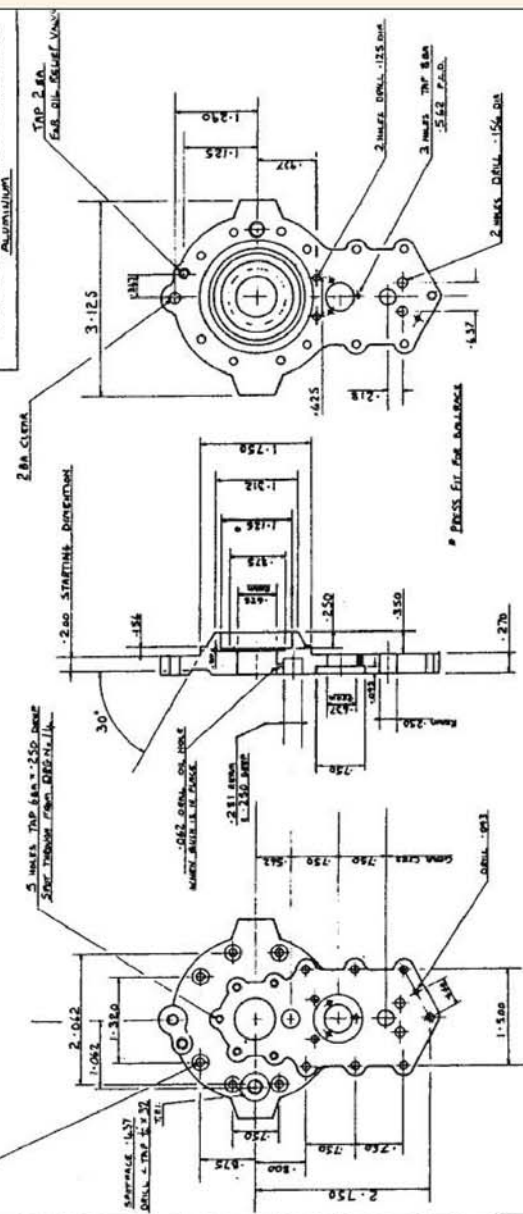
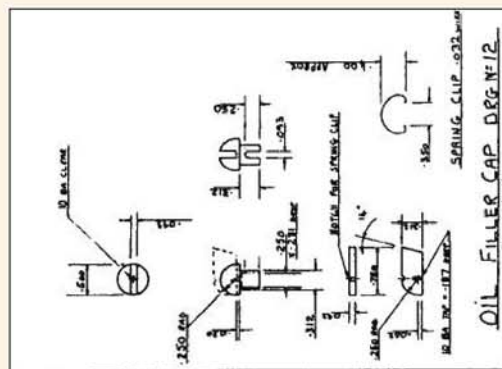
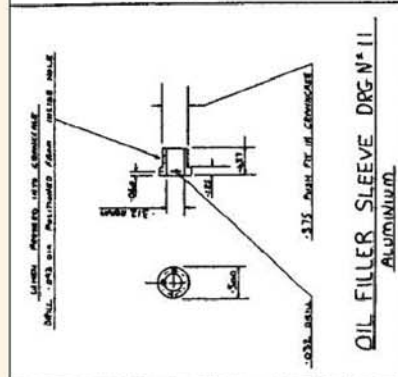
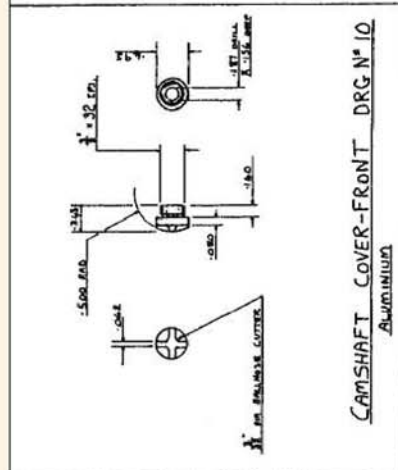
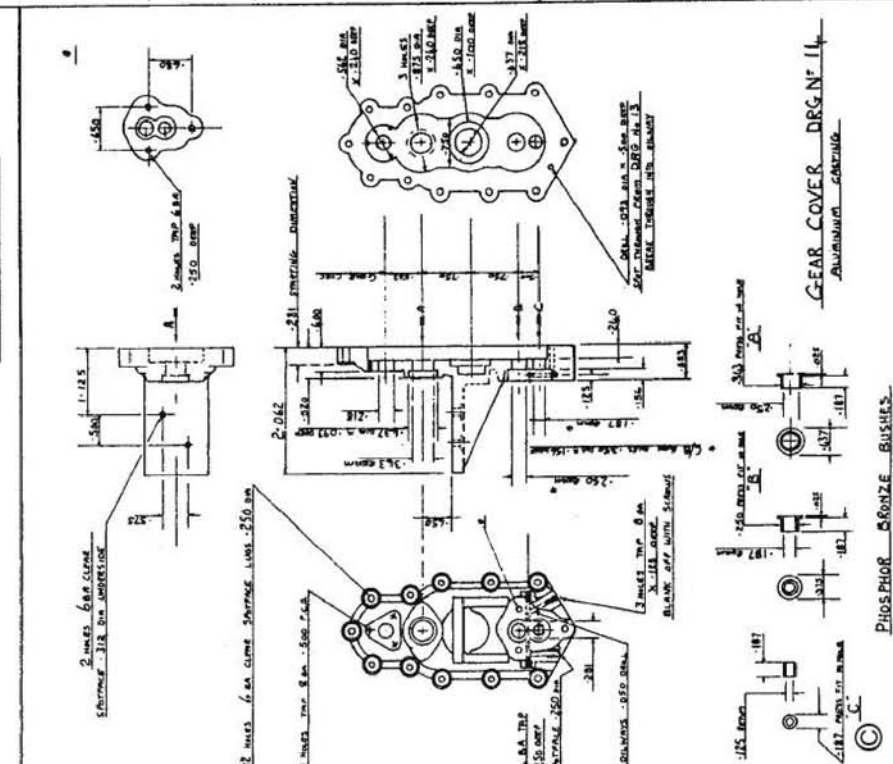
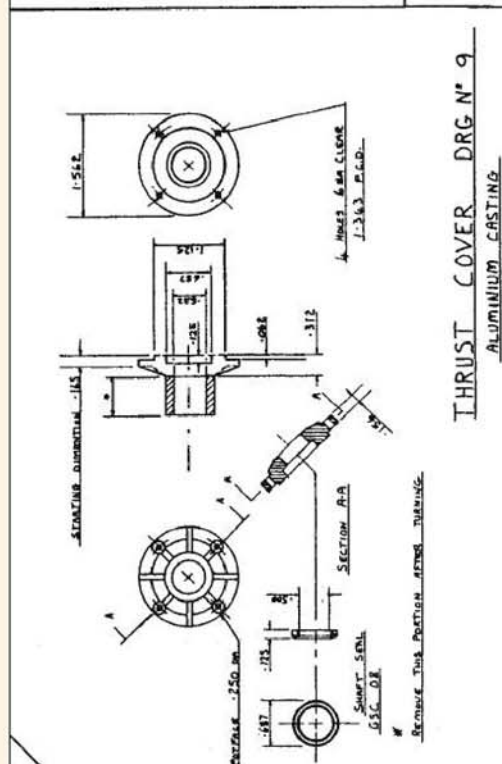
From the spotted 3/32in. dia. hole in the back plate, drill to break into the angled oil way at the bottom. Check that all holes are aligned and clear from the sump to the pump. The pump cover can be faced and the three screw holes marked out and drilled. Place in position and with a 6BA screw in the bottom hole spot the other holes and drill and tap into the flange. With the cover screwed in position on the flange spot through from the gear cover casting. Remove the cover and drill and ream the holes for the bushes. The three tapped holes in the triangular boss can be spotted from the oil jet body.

The crankshaft and further details of the machining processes will appear in the next article in this series.

●To be continued.

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.



Anthony Mount

discusses his choice of a new lathe and begins work on getting it to meet his exacting requirements.

●Part I

For some time I wished I had a larger lathe. My trusty Myford ML7R has given sterling service, but I began to feel the desire for something a little bigger; I suppose we are never satisfied. I started with a little 1 $\frac{3}{4}$ in. centre height Perris lathe, then moved on to a 3 $\frac{5}{8}$ in. centre height Portass PD5 and so to the Myford ML7R with which I thought I had reached the end of my search, but over the years I began to think I wanted something a little beefier.

I saw the Warco BH600 at an exhibition. It was not much longer than the Myford, only 150mm, but it was a more substantial machine all round. I had a chat with Roger Warren of Warco but, typically, I took a long time to make up my mind. Not long afterwards I was staying close by the Warco works and made arrangements to visit to take another look at the lathe in their showrooms. A gap bed version of the machine had just arrived.

This seemed to be the lathe for me, so I bit the bullet and ordered one. A week or so later, a Warco lorry drew up outside my house and in came the lathe. With access a bit tight, the Warco guys did a great job of getting it in. When they had gone, I stood in the workshop and surveyed the monster standing against the wall. Not long after, once I had become accustomed to it, it seemed to have shrunk considerably and become part of my setup. Fully working, the lathe had been tested by Warco, but I always like to examine a new machine all over and check it for slide adjustments and the like.

Over a period of time I have made several modifications which I think have improved the machine. As there are a good many of these lathes 'out there' I thought other readers might be interested. Some of the modifications are very simple, others may seem a little more complicated.

I have found the Warco BH600G to be a good, sound machine which is accurate and easy to use. It runs quietly and does not take up an excessive amount of workshop space. However, as with any machine, it pays to check everything over and to carry out a little 'fine-tuning'.

Nearly all the dimensions given in the following notes are in metric units because the lathe has been built to metric standards — except, that is, for the 8tpi lead screw and the 2 $\frac{1}{4}$ in. x 8tpi spindle nose with its 58mm diameter register. Is this a standard? I noticed the same thread on a 5C collet device.

Photograph 1 shows the lathe to be solidly built with a massive cast iron bed with (hardened) V-ways. It has 150mm centre height, a removable gap piece and will accept 600mm between centres. The spindle is bored 36mm diameter.

One of my reasons for choosing this particular lathe was that it features a screwed spindle nose. I frequently change the chucks when working on my designs, so much time is saved compared with using machines with chucks secured with four bolts. A Camlock spindle nose would have been even better, but this arrangement does not seem to be available for this machine.

Another reason for my choice is that the drive



The Author's well set up and accurate Warco BH600G centre lathe which is the subject of this series of articles.

FINE TUNING A WARCO BH600G LATHE

is by V-belt. I prefer this type of drive which I feel is smoother than gear drive and less liable to lead to a smash up, especially as I run my lathes with fairly slack belts. I prefer belt slip rather than break something and, as the work I do does not require the removal of large amounts of metal at full power, slack belts are not a problem.

I thought long and hard before buying the machine, weighing up the pros and cons of owning an imported lathe rather than a home-built one. But the cost differential was so great that it was difficult to come to any other conclusion. With the BH600G you also get a complete machine with chucks and steadies as standard, not as extras which with home-built machines would increase the price even further.

I did consider a second-hand lathe, but unless we know its history, we have no idea what might have happened to it in the hands of its previous owner(s). If it is an industrial machine, why are the company getting rid of it? It could well be because it is worn out!

Of course, quality is an important consideration and price is not everything. Overall, the machine is well built, its accuracy is good as is the quality of the machined surfaces. It is not necessary to check on some of the fitting, as I shall reveal in due course. It is a nice looking machine and although the colour does not affect its function, it is painted in a shade of green which I particularly like for machine tools.

Obviously the first jobs are to set the machine level, and to check that the lathe is lined up correctly. It is then possible to check out each item separately.

Tailstock

I shall start with the tailstock which will spend much of its life being slid up and down the lathe bed, so I took a look at its lubrication in the base. In fact, as with most lathes, there was none. This was remedied by milling a shallow groove along the flat underside using a ball nose cutter set to an angle (**photo 2**). A hole was then drilled up into the base and another in from the side to connect with it. This last was counterbored and a press

button oiler pushed in. These little oilers are available as spares from Warco. The same was done on the other side of the tailstock except that no groove was required; the hole was drilled in the bottom of the V-groove.

Now whenever the lathe is used, a quick squirt with the oil gun has the tailstock gliding along on a film of oil. Incidentally, use proper slideway oil, you will notice the difference.

The saddle has rubber scrapers either side to sweep away the swarf, so why not the tailstock? I made up four rubber scrapers from sheet rubber and screwed them on. This led me to think about the tailstock barrel which is often showered with swarf, so I pushed an O-ring over the front of the barrel and held it in place by means of a shouldered ring fixed to the front of the tailstock with three Allen cap head screws.

A small but helpful item is to slip a short length of rubber tube over the pins at the far side of the tailstock. When the clamping levers fall, they now bump on the rubber covered pins quietly instead of falling onto them with a crash.

I also took a skim off the clamp plate casting rebates to true them up and to obtain a uniform clamping effect. The same can be done to the fixed steady clamping plate.

Saddle

While nicely fitted, the saddle was, however, a little tight in operation, so I tried adjusting the gib strip at the rear but it was still somewhat more tight than I preferred. As I could use the lathe with a slightly tight saddle, I left it for a while and carried on with other things. The solution came when I fitted new dials, of which more later. I should have realised what was the matter when I tried turning the adjustable dial. It was a bit stiff, a condition which I assumed to be due to strong spring.

In fact, the dial was just wide enough for me to be able to turn it, but it caused sufficient friction to inhibit movements of the saddle. I made the new dial the nominal 25mm wide which just locked everything up. On removing 0.2mm (0.008in.) the dial was easy to turn and the saddle moved just right, smooth but with just a hint of drag.



2
Machining an oil groove in the base of the tailstock to improve lubrication between the tailstock and the lathe bed.



3
Machining the oil groove in the underside of the cross-slide. A small ball nosed cutter was used for this operation and that on the tailstock base.

Close inspection of the rubber scrapers revealed that they were not sitting squarely. When removed, it was possible to see from the imprint left by the screw heads whether the holes were in line with the screws. Where they were not, attention with a punch to elongate the holes rectified the situation. A leatherworker's punch which resembles a pair of pliers with a star wheel is ideal for this job. On re-fitting, the rubbers sat snugly on the guide ways.

The saddle lock comprises a block between the underside of the V-way and the saddle, secured by means of a hexagon bolt. A step machined in the block accommodates the difference

in level between the underside of the guide way and saddle. However, it did not line up very well and the step in the block was excessive. The step was reduced and a groove machined between the two steps to turn the block into a bridge piece. I discovered that the block was prone to twist on tightening, so it was re-machined, this time with a 1mm wide tongue to fit in the gap between the back edge of the apron and the front shear of the lathe bed to prevent the block from twisting.

I did not relish the prospect of having to pick up a spanner every time I wanted to lock the saddle; a solution is to replace the bolt with a lever. It would have looked best fitted with a ball handle, but since there are no other ball handles on the lathe, this would have been out of place. So I made it in the form of a truncated cone and tapered handle to match the other handles on the lathe, and as the others were chemically blacked, this new one was treated to match. Now the saddle is locked with a simple flick of a lever which was positioned to lock just where I wanted by adjusting the thickness of the spacing washer.

The saddle is secured to the apron by means of two large Allen screws and two roll pins. I wanted to see what was going on in the apron and hoped to be able to slide the apron and saddle apart without dismantling the whole thing. Removing the Allen screws was easy enough, but not so the roll pins which I drilled out in the end using a carbide-tipped drill. This effort was all in vain as the gear drive to the cross-slide only allows about 30mm movement either side before it fouls. So, to get inside I will have to dismantle the saddle, apron, lead screw and drive shafts. I was not in the mood for all this at the time — maybe some other day.

However, there was a consolation; as I was using a drill slightly smaller in diameter than the roll pin, most of the latter came out as swarf or as a very thin tube but the bottom bit fell



4
Machining an extra T-slot on the cross-slide to give more scope for fitting a vertical slide, dividing head or rear tool post.

through into the bottom of the apron. To fish this fragment out, the saddle handwheel was removed with its spindle to give access to the bottom of the apron, a job which I needed to do anyway to fit the new dial. A small torch and a pair of tweezers soon had the remains of the roll pin out.

The torch revealed that, as at the bottom of the quick-change gearbox, machining dust had not been completely removed. As this was not very easy to get at, I decided that I needed some suction, so the workshop vacuum cleaner was pressed into service. A piece of 8mm dia. plastic tube was fixed to the main suction tube with some sticky tape and the 'gunge' sucked out. I should add that the vacuum cleaner can deal with liquids.

On further close examination, the gears seemed a bit dry; the puzzle is how in fact can they be lubricated? A smear of grease could be put in on the end of a finger. However, having just drilled out the roll pin I now had a hole approximately over the gears. So a sprung oiler was made up with a short piece of brass, a spring and a ball bearing to mimic an existing oiler. A length of 4mm diameter copper tube was fixed to the bottom of the oiler and bent at an angle towards the pinion on the end of the handwheel shaft. A squirt of oil will now drip on this gear and thereby be distributed to the other gears.

While peering inside the apron I also came across another *in situ* copper tube running along the top inside of the apron, but I could not see from whence it comes or where it goes.

Cross-slide

The cross-slide was fine and worked smoothly. The gib strip is tapered along its length with an adjusting screw at each end. I removed the whole slide from the machine, cleaned it and drilled additional holes in the top to take push button oilers. These can be aligned with the centre oiler that lubricates the screw. A small ball nose cutter was

used to form an angled groove across the width of the sliding areas, centred on the oil holes (photo 3).

While the slide was off the machine, the opportunity was taken to add another T-slot behind the last one. There is plenty of room for another slot which will come in handy should I wish to fit a rear tool post at some time in the future.

There would be room enough for another T-slot in front of the existing one, except that the fixing screw for the feed screw nut is in the way. A partial solution would be to machine two slots part way through the slide, stopping either side of the fixing screw.

A word on removing the cross-slide. If handle, screw and bracket are removed and the gib strip loosened, on pulling it forward to remove the slide the nut will foul the saddle. If you push it backwards to remove it, the slide will foul the splash back. You can either remove the splash back, or knock out the nut. Should you decide to knock out the nut, measure down with a depth gauge from the top face of the cross-slide to the top of the nut spigot. The spigot is a tight fit in the cross-slide and adjustment of the nut and screw in the longitudinal plane is solely by pushing the nut up or down.

Although the T-slots are little larger than those on the Myford, at 40mm they are at a very similar spacing to the Myford T-slot centres. All that was necessary was to bolt the slide to the milling machine table, set it square, mill the central slot and then come in from the side with the T-slot cutter (photo 4). The slide was re-fitted with new slide way oil and the gib adjusted so that the slide moves smoothly but with just a hint of resistance.

A couple of C-spanners (or hook spanners) will be required to adjust the cross-slide and top-slide lock nuts. While you are making C-spanners for the slides, it would be a good idea to make up a couple of much larger ones for the headstock spindle. When the time comes to change the V-belt, you will be pleased that you foresaw the need to make them. Instead of making them you could purchase them, as they are available commercially in both fixed and adjustable form, try J & L (call: 0800-663355).

The cross-slide locking lever can drop down and foul the rear V-way, causing the cross-slide to stop suddenly. A pin could be fitted in the side of the cross-slide for the lever to rest on. Also the locking lever fouls the tailstock when it is brought up close. The convenience of a lever is very useful, but I feel on balance the easy movement

of the tailstock is more important, so I have replaced the lever with an Allen set screw.

Though not strictly affecting the cross-slide itself, I made up a block to bolt to the cross-slide for mounting the dividing head and vertical slide used on the Myford. The distance from the top of the cross-slide to the centre line of the lathe on

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

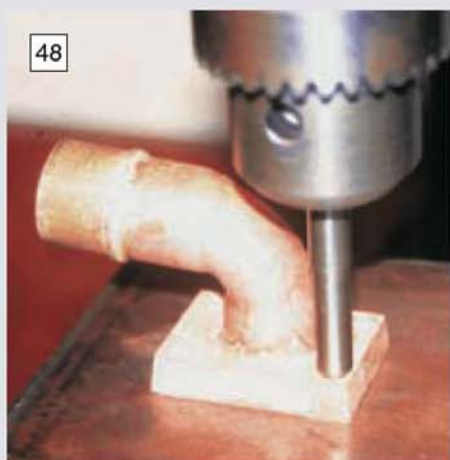
the Myford is 2¹/₁₆ inch. For the BH600G it is 3.370in. (3.370 - 2.062) = 1.308in. (33.22mm).

I made the block 114mm square, the width of

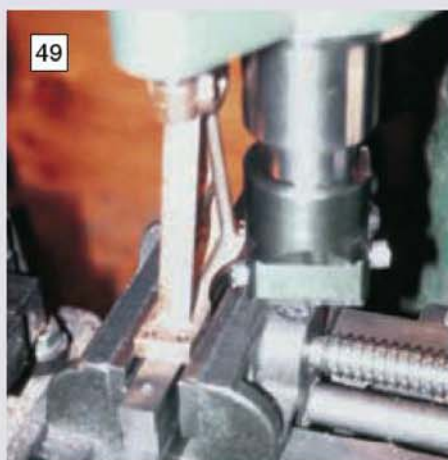
the cross-slide, and fitted a tongue to locate in one of the T-slots. This automatically sets the block square on the cross-slide. T-nuts and flush fitted Allen cap head screws fix the block to the cross-slide. The top of the block is furnished with tapped holes to take the different fittings.

●*To be continued.*

A HEINRICI HOT AIR ENGINE



48 Locating the position of the first screw hole for the chimney in the firebox wall.



49 Machining the 'A' frames for the raised area on top of the body - not necessary on my engine.



50 Finishing the power piston connecting rod end by counterboring and slitting the bearing.

Mike Thurgood

completes the work on the firebox and describes running the engine for the first time.

●*Part IX continued from page 204 (M.E. 4189, 21 February 2003)*

Shown in photo 48 is the exhaust gas elbow offered up to its mounting location. A pointed spigot is being used to locate the position for drilling and tapping the side plate for the first of the four 4BA mounting screws. This process was repeated for the other three holes. Care was needed to ensure that the elbow is aligned with the vertical axis of the firebox. Little looks worse than a skewed chimney! Perhaps not clear from photo 48, the hole for the elbow was drilled at an angle of 5deg. in its mounting block to accommodate the slope of the firebox wall so that the chimney is vertical in both planes. It transpired, for reasons to be explained later, that I had mounted this elbow on the wrong face! It was eventually remounted on another face using the same sequence of operations as described above. The redundant aperture was blanked off with a small rectangular 1.5mm stainless steel plate.

I digress here to discuss what is available as a suitable cutting lubricant for stainless steel for machining and thread cutting. For the last ten

years I have been using Tapmatic 1 for ferrous and non-ferrous metals, even on cast iron when threading and occasionally cutting in the lathe, and Tapmatic 2, which is somewhat more viscous than Tapmatic 1, for aluminium and its alloys. These cutting fluids contain moderately low boiling point liquids with corrosion inhibitors and seem to rely largely on the efficient removal of heat rather than acting as a lubricant, however, I am open to correction on this point. These fluids certainly 'smooth the run' when threading. I have not used them either for hacksawing or bandsawing because they are expensive and their use for these purposes would be very extravagant.

For a rather different purpose, I bought some key steel to remake the lower blades of my mulching machine. The original blades had become badly worn and could not be resharpened. Having no previous experience of machining key steel, on asking the question I was told that this material is machinable as supplied.

In answer to my query about machining key steel, a friend in the Western Province Live Steam Society who runs a small engineering firm near Cape Town, recommended that I try a lubricant which is supplied by FEW (French Engineering Works). I purchased a litre bottle of FEW (their brand name for it) from them and did the machining in the mill/drill, but at a very low speed of about 150rpm, using an 8mm dia., TiN-coated slot mill from a set imported from

Britain in 1998. It cut without a murmur, and I could not detect any wear on the milling cutter at the end of the job — although in this instance I did not do very much cutting work.

This cutting lubricant seems to be equally effective on stainless steel. It is the worst, most intrusive and dreadful sticky stuff I can recall ever having come across, but it is so effective that, for example, when taking light cuts on stainless steel in the lathe it actually leaves a layer behind the cutting tool! The sticky fluid also helps when hacksawing (using a bi-metal blade) through the key steel by simultaneously lubricating and removing heat from the blade teeth. I didn't attempt to bandsaw through it, however, because my larger bandsaw only has a carbon steel blade, not a bi-metal one. But I now use it when bandsawing through stainless steel.

I have also found, almost unbelievably, that applying this lubricant even helped when using a blunt bi-metal hacksaw blade to cut stainless steel. Incredible! And because of its extreme stickiness this lubricant is very economical to use and is about one third the price of the Tapmatic cutting fluids.

It seems anomalous to be referring to 'lubrication' when metal is actually being removed by a 'tearing' action! The effect is probably beneficial because it lubricates the sliding movement of the swarf across the rake face of the cutting tool at the cutting point where it is effectively torn from the parent metal at high temperature. This cutting action results

in heavy frictional forces which are maintained up to a point a little further along the cutting tool where the swarf separates from it.

The high temperature at the cutting point can also cause swarf to weld to the cutting tool and in some instances it actually erodes the edge of a tungsten carbide tipped or insert tool. A good lubricant should reduce the welding and frictional forces when turning, and hence reduce the temperature of the swarf when torn adrift from the parent metal. As a bonus, power requirements are probably also reduced. For an in-depth discussion on tool tip erosion/corrosion problems the following reading is recommended: *Modern Metal Cutting*, a Sandvik Coromant publication, first English edition 1994.

But the most important fact that I seem to have learnt when milling, albeit at a very late stage, is not to run the cutter at high surface speed. This is particularly important when using HSS milling cutters, and certainly when milling the harder metals and cast iron, otherwise the heat that is produced is not removed quickly enough from the milling cutter edges which then wear rapidly, as I have found out only too often in the past. I do not attempt to run my insert milling cutters at too high revs, either. I am sure that this FEW cutting lubricant cannot be unique, and that other equivalent fluids are available.

Just to show the set up for the job, I mention here a small task on the 'A' frames completed fairly early on. This entailed machining the inside crescent shaped cut-outs in the bars between the feet of the 'A' frames to clear the raised circular central area on the main body (see fig 4b and

photo 29, *M.E.* 4174, 9 August 2002 and 4183, 29 November 2002). No big issue as it was only necessary to provide clearance but in the event I had to use raising blocks (photo 29) and this work turned out to have been quite unnecessary!

Other constructors may not put themselves into my situation, i.e. by deciding either not to incorporate a manganese-bronze bush as shown in fig 4b, or by making a much shorter one; I have therefore included my set-up for finishing these crescents (photo 49). Note that the two 'A' frames are opposite handed for this machining operation. It was a very tight squeeze clamping the 'A' frames in the mill/drill vice because there was only about 3mm to spare for clamping against the feet, but very light cuts won the day. Alternative clamping could have been adopted, but this would have required longer to set up. It was an interesting exercise but unnecessary, as mentioned.

A number of finishing tasks were required, one being to drill oil holes for the axles and crank pins in the 'A' frames and the two crank rods. Although not so 'professional' in appearance, these oil holes were merely drilled and countersunk as I decided not to fit screwed oil caps because the engine would not be run very often. Maybe I will fit some later; who knows? The air vent valve and a plug for the water outlet hole were made next. A drawing of the former is shown in fig 6 (*M.E.* 4179, 4 October 2002) and the latter, not detailed, is similar in principle and temporary in view of later modifications.

The final task was to cut a 2mm thick Klingerite gasket to fit between the body and the stand to provide a measure of heat insulation,

although heat will obviously be conducted through the eight mounting studs.

Photograph 50 shows the countersunk oil hole in the power piston connecting rod end already drilled. But, because this time the component was mounted in a far safer way than shown previously (see photo 20, *M.E.* 4181, 1 November 2002), the opportunity was taken to counterbore the already drilled clearance hole for the socket screw head and slit through the bearing.

With all the components ready, including the firebox, the time had come to mount the body with its gasket on the firebox. The various components were then assembled. At this stage, there was no means of running water through the water jacket, however, for a short run it was not considered that this would have any detrimental effect on the engine, and it didn't! (Hope springs eternal!)

I checked that the engine ran free, lubricated the various bearings and pins with thin oil and filled the burner with methylated spirit, placed it in the firebox, lit it and closed the fire door. After about four or five minutes I turned a flywheel — remember, the displacer piston *leads* the power piston — and off it went immediately without hesitation, running perfectly freely. This was on a Friday in mid-February, 2000 and I had the engine running just in time to be ready for the next two days, Saturday and Sunday, on demonstration at a fund raising show!

On production lines for these old hot air engines what a surprise it must have been to find one, supposedly properly made, which *didn't* work first time!

●To be continued.

2¹/₂in. GAUGE COMES TO FYLDE

Alan Reid

describes a Special Event which was much enjoyed by all participants.

Saturday, 31 August 2002 was the day when the newly laid 2¹/₂in. line was put to the test at the Fylde Society of Model Engineers track site. This was the day of the Official Opening and several 2¹/₂" Gauge Society stalwarts, with families and friends, had been invited to what was meant to be an informal gathering of guests and club members; in other words a 'Fun Day'. Our aspirations had been realised weather wise, in that it was dry and even hot at times as the day progressed.

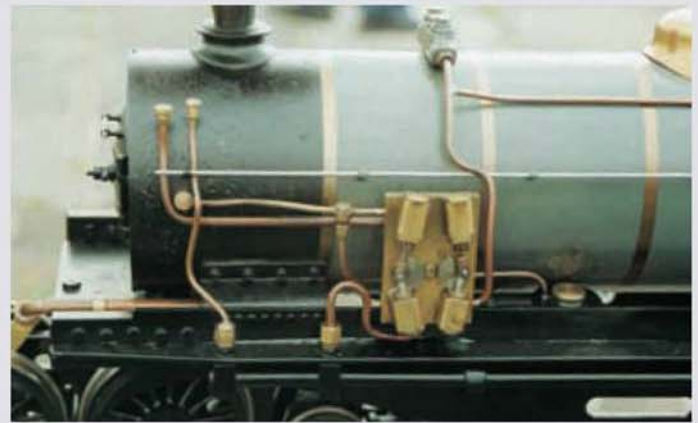
Our guests started to arrive early and considerable interest was shown by the locals as the locomotives were unloaded and assembled. I use the word 'assembled' advisedly as one locomotive was a Garratt which arrived in three pieces courtesy of Steve Eaton from Chesterfield. This locomotive is modelled on a 4-8-4 + 4-8-4 Kenya Ugandan Railways prototype. Steve also brought a much smaller 0-4-2T locomotive, *Toby*, made to his own design and fitted with a marine boiler. Peter de Salis Johnston from Stafford brought his 4-6-2



Ernest Mann cuts the ribbon at the official opening ceremony of Fylde's new 2¹/₂in gauge track.



Steve Eaton's Toby prior to steaming.



The unusual water pump arrangement on Steve Eaton's Garratt.



Peter de Salis Johnston had first lap problems!

locomotive, *Millennium Fay*, based on LBSC's *Fayette* and winner of the 2001 LBSC Memorial Bowl Competition at North London SME. Dave Ilott from Stockport brought his 2-6-0 *Dyak* but doctor's orders meant that he was temporarily unable to do any lifting or steaming of his locomotive. To complete the stable of 2 1/2in. locomotives, Norman Almond of the Fylde SME hosts brought along his 4-6-0 Southern S15.

First to be steamed was the Steve's Garratt which was soon hauling passengers; it might be said of this locomotive that 'many wheels make light work'! Steve has fitted it with a water pump made with four oscillating engines, two steam powered and two acting as water pumps. Fascinating to watch when run at full pressure, they are just a blur but clearly effective because water does go into the boiler even if the smoke

box is sprayed with a generous coating of oil which leaks from the steam side!

Next on the track was Peter's *Millennium Fay* with which he had a very interesting first lap. He complained that the driving trolley with which he had been provided seemed to be dragging and had extended his loco to the limit; could he please have another? He could, but on investigation it was discovered that only one axle of each bogie was on the rails, the other axle of each was derailed. Who says these tiny locomotives have no pulling power! The trolley had not been properly set onto the rails for him before the start of his run. Once the problem had been resolved Peter was able to drive well within the capabilities of his locomotive.

Next on the track was Norman's S15, a fine loco which came second in the LBSC Memorial Bowl Competition in 2000 at Bromsgrove. Handing over his Garratt to the care of friend Paul Wooton, Steve Eaton then steamed and drove his *Toby*. Similar in size to a *Tich* it proved to be a good steamer and just kept on going. For a beginner with limited means seeking to build a small locomotive, this design with its impressive performance should be given close consideration.

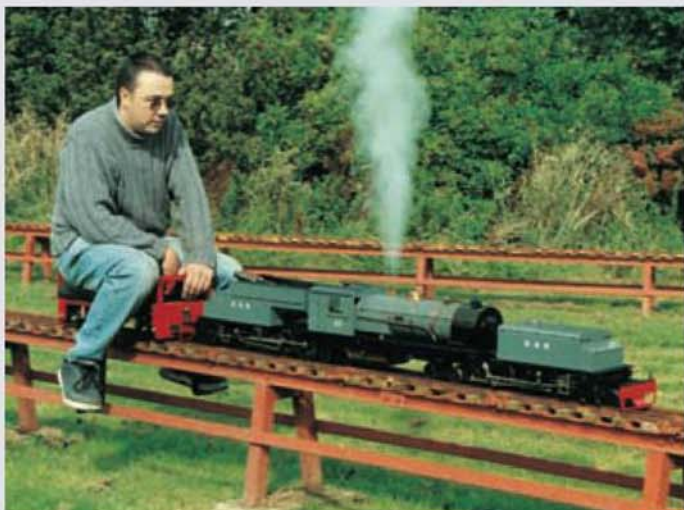
While all this activity was taking place on the track before the opening ceremony, three ladies of the home club had been very busy preparing a magnificent buffet for guests and club members alike. By way of thanks, Paul took them for a well deserved trip around the track behind Steve's Garratt. There was even a bar for those wanting something stronger than tea or pop; no, the drivers were not breathalysed — they were all deemed to be responsible types!



Steve Eaton at the regulator of Toby.

The four visiting locomotives including Dave Ilott's *Dyak* plus the 'in-house' one were lined up for a photo shoot to be followed by the Official Opening of the 2 1/2in. line by the home club's Senior Member, Ernest Mann who is well past his 90th birthday and still going strong. Ernest welcomed the visitors, congratulated Norman and the members of the club who had laid the line. The ladies were especially congratulated for the refreshments and Ernest finally cut the tape to declare the 2 1/2in. track open, thereby allowing the procession of locomotives to proceed.

Two larger home club locomotives then joined the 'miniatures' for the rest of the afternoon. The visitors expressed their pleasure in being present for the event and the home club certainly enjoyed their company. 



Steve Eaton and his Garratt on his first lap.



Norman Almond with his 4-6-0 Southern Railway S15.

CLUB CHAT

With Stan Bray

UK News

A winter of work for **Worthing DSME** involves replacement of rail and sleepers as well as repairs to the trailer used to transport the portable track. A good number of entries, mostly of a high standard, were entered for the popular annual photographic competition for the Leo Whiteside Trophy.

Members of **Reading SME** have been advised to back up the club's insurance policy with their own third party cover. The cost of doing so through the **Southern Federation MES** is very small and, in the event of an accident, it is always possible that someone might set out to allege that the member was not acting on behalf of the society at the time. Bennetts Commercial of Wokingham, a local company, has donated sufficient metal to the society for the construction of a proposed extension to the station footbridge. Two members went to the company with a cutting torch to cut the metal to length; Bennetts then kindly deliv-

ered it to the club free of charge.

The clean and tidy appearance of the Hady track site, home to **Chesterfield DMES** is largely due to a band of Wednesday Workers from Worksop. No members these, they are youngsters from the Autistic Centre who attend with their tutors and take on any task they may be asked to do. This has included digging and transporting soil as well as clearing up leaves and general tidying up. Once a task has been carefully explained in detail, they willingly set to and carry it out. Members appreciate their efforts without which many more chores would remain to be completed. As well as their track at Hady, the society also operates the railway on open days at Papplewick Pumping Station, a heritage site with preserved steam engines. The pumping station is to receive a substantial grant from the Heritage Lottery Fund. While this is mainly for structural repairs to the building, it is anticipated that a certain amount will be allocated to the railway for repairs to the track and construction of a station canopy



Visitors to the **Bristol SMEE** Exhibition last summer at **Thornbury Leisure Centre** will be pleased to know that another is to be held 15-17 August next.

and storage shed for rolling stock. There are also plans to build a visitor centre with a permanent curator/caretaker on site, which should deter the attention of vandals.

World News

South Africa

Members of **Centurion SME** are being kept busy by making good progress on improvements to their facilities which include fitting extra shelving for the library which contains a computer, and new extractor fans throughout the building. Quotes are also being obtained from local companies for tiling the floors,

fitting a safety door and installing burglar alarms. Discussions are under way concerning the possibility of building a raised track, and affiliating with the local model boating society, which will require constitutional amendments.

The close of 2002 was party time for **Rand SME**; in November the group involved in preservation of stationary engines attended one at Henley-on-Kip where numerous engines were present and working. Also on display were a number of restored vintage and veteran cars and a large display of household items of yesteryear, the sort of artefacts

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.

MARCH

- 21 **Rochdale SMEE. Video Night.** Contact Mike Foster: 01706-360849.
- 21 **Romford MEC. Rusty Titford: Cornish Pits & Pumps.** Contact Colin Hunt: 01708-709302.
- 21 **Romney Marsh MES. Video Evening.** Contact John Wimble: 01797-362295.
- 22 **Chesterfield MES. Running Day.** Contact Mike Rhodes: 01623-648676.
- 22 **Hornsby ME. Family Day - Boiler Inspection.** Contact Ted Gray: 9484-7583.
- 22 **Rotherham DMES. Exhibition.** Contact Ken Stanforth: 01709-703794.
- 22 **Steam LS of Victoria. Club Run.** Contact Graham Plaskett: (03) 9750-5022.
- 22 **Tonbridge MES. AGM.** Contact D. C. Brunning: 01732-352153.
- 22/23 **London Festival of Railway Modelling Exhibition at Alexandra Palace.** Advance booking (to 10 March 2003): Adults: £7, Children: £3.50, OAP: £6.50, Family (2+3): £19. Information and Ticket Hotline: 01778-391134.
- 23 **Basingstoke DMES. Members' Steam-Up.** Contact Ian Shanks: 01420-561741.
- 23 **Guild of Model Wheelwrights at Broomfield College, Ilkeston.** Contact Biddy Hepper: 01492-623274.
- 24 **Bedford MES. Spring Auction.** Contact Ted Jolliffe: 01234-327791.
- 24 **Hornsby ME. Meeting - Social.** Contact Ted Gray: 9484-7583.
- 25 **Chelmsford SME. Dave Carson: Talk.** Contact D. Blake: 01376-324205.
- 25 **Historical MRS (East Lancashire/North Manchester Group). Eric Robinson: Multiple Units, History & Models.** Contact John Sykes: 01706-823989.
- 25 **Surrey SME. An Evening with Bob Symes.** Contact John Cook: 020-8397-3932.
- 25 **Sutton Coldfield MES. President's Evening.** Contact Roger Timings: 0121-308-5875.
- 25 **Wigan DMES. Bits & Pieces.** Contact John Chamberlain: 01744-882255.
- 26 **Birmingham SME. AGM.** Contact John Walker: 01789-266065.
- 26 **Chingford DMEC. F. Brodie: The Watch Maker's Lathe.** Contact Martin Masterson: 0208-989-5552.
- 26 **Guildford MES. AGM.** Contact Dave Longhurst: 01428-605424.
- 26 **Historical MRS (Bedford Area). Martin Bloxham: A4 Pacifics of LNER.** Contact John Chamney: 01442-851214.
- 26 **Staines SME. Cheese and Wine.** Contact Mike Kingham: 01932-788793.
- 26 **Teesside Small Gauge Rly. Meeting.** Contact Bill Foster: 01642-710198.
- 27 **Basildon DMEG. Meeting.** Contact Malcolm Burrell: 8 The Avenue, Billericay, Essex, CM12 9HH.
- 27 **Cardiff MES. Club Chat.** Contact Trevor Jenkins: 029-2075-5568.
- 27 **Leyland SME. Geoff Baxendale: Worden Park Remembered.** Contact Mark Entwistle: 01772-422411.
- 27 **Sutton MEC. Models Old & New.** Contact Mike Dean: 0208-657-5401.
- 27 **Worthing DSME. Cyril Selby: Guess Where He's Been This Time.** Contact Bob Phillips: 01903-700642.

- 28 **Chichester DSME. Bits & Pieces.** Contact Brian Bird: 01243-542266.
- 28 **Colchester SMEE. L. Hammond: Steam Locomotive Standard Maintenance Equipment & Tools as used at Motive Power Depots.** Contact L. G. Hammond: 01376-511686.
- 28 **Hereford SME. Video Evening.** Contact John Arrowsmith: 01432-265151.
- 28 **Historical MRS (Essex Area). Alan Sibley: A Prototype for Everything.** Contact Jem Harrison, 27 Colne Place, Basildon, Essex SS16 5UZ.
- 28 **Kinver & West Midlands SME. AGM.** Contact John Campbell: 01384-891244.
- 29 **Historical MRS (Bristol Area). Cardiff 4mm Group Display & Discuss 'Dunvant Station'.** Contact Gerry Nichols: 0117-973-1862.
- 29 **Guild of Model Wheelwrights at Ridgewood School, Stourbridge.** Contact Biddy Hepper: 01492-623274.
- 29 **York City & DSME. Pat Inwood: Arterial Drainage.** Contact Ken Bateman: 01904-421445.
- 29/30 **Model Engineering & Hobbies Exhibition at Michael Herbert Hall, South Street, Wilton, Salisbury. 10am-5 pm.** Contact Peter Parrish: 01980-610346.
- 29/30 **Guild of Model Wheelwrights at Michael Herbert Hall, Wilton, Wiltshire.** Contact Biddy Hepper: 01492-623274.
- 30 **Ascot LS. Members' Steam-Up.** Contact Tony Alderman: 01932-854393.
- 30 **Cardiff MES. Steam-Up & Family Day.** Contact Trevor Jenkins: 029-2075-5568.
- 30 **Durban SME. Members' Running Day & Bring & Braai.** Contact Niall Mann: 031-7673640.
- 30 **Leighton Buzzard NG Rly. Mothering Sunday Specials.** Enquiries: 01525-373888.
- 30 **Maidstone MES. Running.** Contact Martin Parham: 01622-630298.
- 30 **MELSA. Sunday in the Park.** Contact Graham Chadbone: 07-4121-4341.
- 30 **Romney, Hythe & Dymchurch Railway. Mothering Sunday Event.** Information: 01797-362353.

APRIL

- 1 **Basingstoke DMES. Meeting.** Contact Ian Shanks: 01420-561741.
- 1 **Oxford (City of) SME. Alan Copeland: Curiosities of the Cotswolds, Part II.** Contact Chris Kelland: 01235-770836.
- 1 **Romney Marsh MES. Andy Probyn: Maxitrak Garden Railways.** Contact John Wimble: 01797-362295.
- 1 **South Durham SME. Meeting.** Contact B. Owens: 01325-721503.
- 1 **Stamford MES. Bits & Pieces.** Contact David Ash: 01780-751211.
- 1 **Surrey SME. Auction.** Contact John Cook: 020-8397-3932.
- 1 **West Wiltshire SME. AGM.** Contact R. Nev. Boulton: 01380-828101.
- 2 **Bradford MES. Peter Lowe: Abbey Light Railway.** Contact Gordon Eddison: 01943-864217.

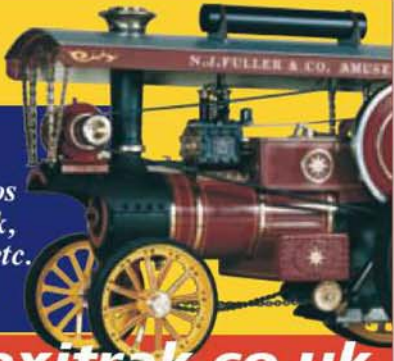
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which make one say, "Gosh, we had one of those — I really must be getting old." It was also a day for exchanges of views and an opportunity to discuss the engines present, as well as to meet old friends and have a sociable natter. Plenty of refreshments were available and it was apparently a rare sight to see someone without a drink! An entirely different type of party took place at the club headquarters a week or so later, with numerous visitors arriving with locomotives for a weekend of running on the track. Many of the guests stayed overnight in caravans and tents, virtually filling a large caravan park. The Saturday evening was devoted to a real party evening with tables carefully laid out and the premises decorated to suit the occasion. The following day was mainly set aside for the 40 or so children in attendance who were pleased to meet and receive gifts from Santa Claus.

Whether or not to build a ground level track is the subject currently being debated by members of Durban SME, most of whom like the idea but are concerned as to whether there are enough people in the society to build it. Land is almost certainly available adjacent to the present site and the local Sea Scouts who occupy another adjacent site have indicated a willingness to allow a new track to run over part of their land, thus giving curves with generous radii. The idea has much to commend it; it would mean a more stable ride, it would almost certainly encourage people to join the club, and furthermore, it would allow the society to host the National Steam Meet, which is not practical with their existing facilities. The present raised track will require complete refurbishment in a few years time, and a new ground level track could be used while work continued on the raised track.

Japan

As always, the latest copy of the *Bulletin* from the Japan Couplers Friends Club is packed with constructional information as well as reports on various events in the country. Profusely illustrated with drawings and photographs, even without any knowledge of Japanese it is possible to understand large parts of it. It appears that a group photograph of all present is invariably taken whenever a rally is held, and with many clubs now researching and recording their history this may be something that other societies might consider doing.

Canada

One committee change was voted in at the Toronto Live Steamers AGM. Secretary Jim Lee had decided it was time to retire and his place has been taken by Brian Cole of 81 Taylorwood Avenue, Bolton, Ontario, Canada L7E 1J6; tel: (905)-857-8053; e-mail brian-marioncole@sympatico.ca. The society operates a raised multi-gauge track for 2½, 3½ and 5in. gauge models at Humes Auction Farm, 9313 4th Line Road, North East of Milton, Ontario. Steaming days are scheduled for the second Sunday of each month from May to November. During the winter, meetings are held on the first Sunday of each month at the boardroom of Milton

Mall. Visitors are always welcome, those with a steam locomotive are required to present a current boiler certificate and are urged to call ahead if there is any doubt of cancellation due to weather conditions, etc.

Good progress is being made on the new British Columbia SME raised track. Having committed the plans to paper, a start was made by clearing the area through which the track was to run in order to prepare a thorough survey. The plans had to be adjusted to bring the track clear of well established trees and other obstacles. This was followed by another survey to locate where all the supports were to go and to mark the positions with stakes. Having established how many supports would be required it was then possible to calculate reasonably accurately the amount of concrete needed to make the supports. The supporting concrete piers are cast *in situ* using Sonatube as a former, the holes for them having been made with an auger, thus saving a huge amount of digging. A length of studding was set in each concrete pier by which the track bed is bolted in place once the concrete has set. So far as we are aware 20 of 34 such supports have been completed and at this rate of progress, the track should be operational in time for the summer season.

- 2 Bristol SMEE. *On the Table Evening*. Contact Trevor Chambers: 01454-415085.
- 2 Chingford DMEC. *Bits and Pieces*. Contact Martin Masterson: 0208-989-5552.
- 2 Guildford MES. *Graham Mackenzie: Shield Hall*. Contact Dave Longhurst: 01428-605424.
- 2 Hull DSME. *Ian Smith: Living With Green Arrow*. Contact Brian Rylance: 01482-647032.
- 2 Leeds SMEE. *Video Evening*. Contact Colin Abrey: 01132-649630.
- 2 Taunton ME. *Meeting*. Contact Don Martin: 01460-63162.
- 3 Cardiff MES. *Bits & Pieces*. Contact Trevor Jenkins: 029-2075-5568.
- 3 Rugby MES. *Bring and Buy*. Contact David Eadon: 01788-576956.
- 3 Sutton MEC. *Bits & Pieces*. Contact Mike Dean: 0208-657-5401.
- 4 Vale of Aylesbury MES. *Photo Competition*. Contact Clive Ellum: 01296-623433.
- 4 Rochdale SMEE. *Meeting*. Contact Mike Foster: 01706-360849.
- 4 Romford MEC. *Competition Night*. Contact Colin Hunt: 01708-709302.
- 5 Historical MRS and Institute of Railway Studies & Transport History. *The Railway Grouping 1923-47 Lecture Day at The National Railway Museum*. Tickets £15. Contact HMRS: 27 Colne Place, Basildon, Essex, SS16 5JZ.
- 5 Isle of Wight MES. *Track & Pond*. Contact Ken Stratton: 01983-760762.
- 5 National 2½in. Gauge Ass'n. *Get Together at Surrey SME*. Contact Clive Young: 01233-626455.
- 5 SM&EE. *Martin Pollard: Sandvik*. Contact David Boote: 01202-745862.
- 5/6 Dockland & E. London MES. *Running*. Contact P. M. Jonas: 01708-228510.
- 5/6 Fylde SME. *Exhibition at the Marine Hall Fleetwood*. Contact Eric Clifford: 01253-860970.
- 6 Cardiff MES. *Open Day*. Contact Trevor Jenkins: 029-2075-5568.
- 6 Frimley & Ascot LC. *Running*. Contact Bob Dowman: 01252-835042.
- 6 Harrow & Wembley SME. *Running Starts*. Contact Dr. Roger Greenwood: 020-8427-2755.
- 6 Kew Bridge Steam Museum. *Stirling Hot Air Engine Rally*. Information: 020-8568-4757.
- 6 Leyland SME. *Ground Level Running*. Contact Mark Entwistle: 01772-422411.
- 6 Nottingham SMEE. *Running*. Contact Gerry Chester: 0115-9259096.
- 6 Ottawa Valley Live Steamers. *Meeting*. Contact John Bryant: 761-1109.
- 6 Plymouth MSLS. *Start of Running Season*. Contact John Brooker: 01752-671722.
- 6 Rugby MES. *Running*. Contact David Eadon: 01788-576956.
- 6 South Durham SME. *Running*. Contact B. Owens: 01325-721503.
- 6 Steam LS of Victoria. *Running*. Contact Graham Plaskett: (03) 9750-5022.
- 6 Surrey SME. *Members' Steam-Up*. Contact John Cook: 020-8397-3932.
- 6 Talylyn Railway. *First Class for Sunday Lunch*. Enquiries: 01654-710472.
- 7 Historical MRS (London Area). *John Arkell: Railways in South East Kent*. Contact John Millbank: 0208-948-0556.
- 7 Leicester SME. *John Bailiss: Video Evening*. Contact Raymond Wallis: 0116-285-8824.
- 8 Dockland & E. London MES. *Meeting*. Contact P. M. Jonas: 01708-228510.
- 8 Romney Marsh MES. *Track Meeting*. Contact John Wimble: 01797-362295.
- 8 Sutton Coldfield MES. *John Ellis: Boiler Making*. Contact Roger Timings: 0121-308-5875.
- 9 Chingford DMEC. *John King: Gauge 1 Model Railways*. Contact Martin Masterson: 0208-989-5552.
- 9 St. Albans DMES. *AGM*. Contact Roy Verden: 01923-220590.
- 10 High Wycombe MEC. *Ron White: Rail through the Chilterns*. Contact David Savage: 01494-527402.
- 10 Leyland SME. *Visiting Guest Speaker*. Contact Mark Entwistle: 01772-422411.
- 10 Sutton MEC. *Rod Bradley: Clocks & Smaller Clocks*. Contact Mike Dean: 0208-657-5401.
- 10 Worthing DSME. *Bits & Pieces*. Contact Bob Phillips: 01903-700642.
- 11 Colchester SMEE. *C. Underhill: A Look at the Railways of India*. Contact L. G. Hammond: 01376-511886.
- 11 Hereford SME. *B. Munt: Victorian Street Entertainment*. Contact John Arrowsmith: 01432-265151.
- 11 Romford MEC. *Mike Smith: Model Stationary Engines*. Contact Colin Hunt: 01708-709302.
- 11 SM&EE. *Visit to London Fire Brigade Museum*. Contact David Boote: 01202-745862.
- 12 Leyland SME. *Junior Members' Afternoon Driving Session*. Contact Mark Entwistle: 01772-422411.
- 12 Maxitrak Owners Club. *Boiler Test Day at Staplehurst*. Contact Eric Penn: 0208-979-4335.
- 12 Reading SME. *Club Running*. Contact Graham Bustin: 01189-615450.
- 12 York City & DSME. *Ian Sparks: A Day with NRM Support Crew*. Contact Ken Bateman: 01904-421445.
- 12/13 Meridienne Exhibitions. *Large Scale Model Rail Exhibition at the Warwickshire Exhibition Centre, Fosse Way, near Leamington Spa*. 10am-5pm daily. Adults £5, Senior Citizens £4.50, Children £3, Family (2+3): £13. Enquiries: 01928-614101.
- 13 Leeds SMEE. *Running Day*. Contact Colin Abrey: 01132-649630.
- 13 Nottingham SMEE. *Running*. Contact Gerry Chester: 0115-9259096.
- 13 Sutton MEC. *Track Day*. Contact Mike Dean: 0208-657-5401.
- 13 Talylyn Railway. *First Class for Sunday Lunch*. Enquiries: 01654-710472.
- 13 Worthing DSME. *Running*. Contact Bob Phillips: 01903-700642.

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First published in 1982, this new and enlarged edition covers the design, construction and care of steel boilers in general, with formulae and data used by firms of repute. Designs of three vertical boilers are included - the Sentinel, the Caradox and a 3-inch scale version.

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WPS 5

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Sheet Metal Work

R.E. Wakeford

WPS 8

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Tubal Cain

WPS 9

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Ian Bradley

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J. Poyner

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Drills, Taps & Dies

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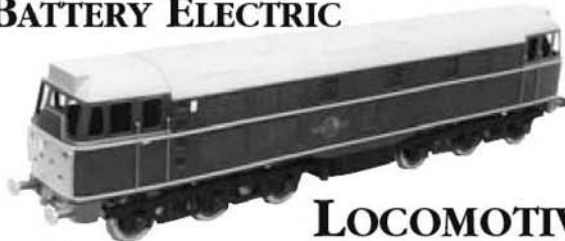
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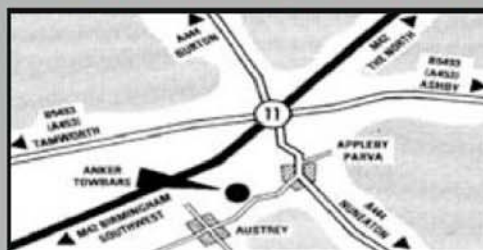
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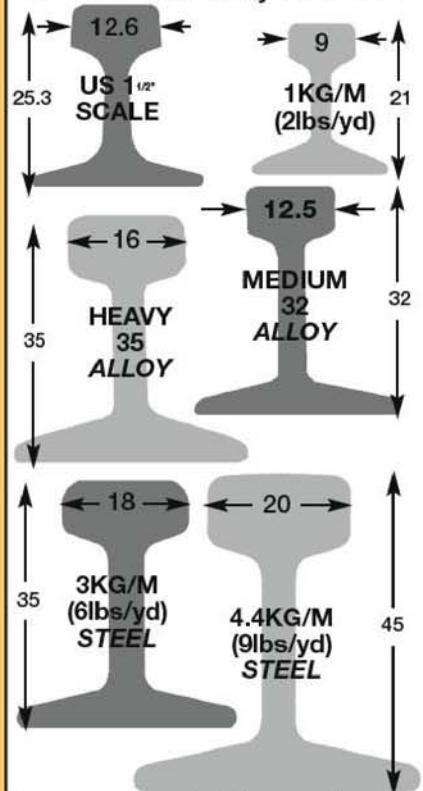
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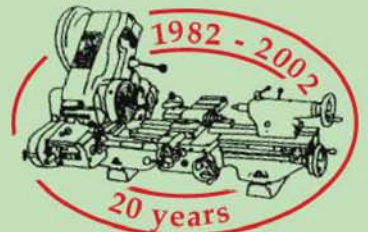
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LATHES

BOXFORD TUD 4 1/2" x 20" MK11 3 jaw chuck, cabinet stand, hand feeds	£395
BOXFORD CUD 4 1/2" x 20", changewheels, 3 jaw chuck, cabinet stand	<i>new selection just in</i> £750
BOXFORD CUD 5" x 22" MKIII, c/wheels, 3 jaw chuck, 4 way toolpost	£1,400
BOXFORD BUD 5" x 22" MKIII, c/wheels, power cross feed, T-slotted cross slide	£1,400
BOXFORD AUD 5" x 22" MKIII, gearbox, power cross feed, T. slotted cross slide, cabinet stand	<i>very nice</i> £1,625
BOXFORD AUD 5" x 30" MKIII, gearbox, power cross feed, T. slotted cross slide, cabinet stand	<i>very nice</i> £1,950
BOXFORD AUD 5" x 30" MKIII, gearbox, power cross feed, T. slotted cross slide, cabinet stand	<i>even nicer</i> £2,250
COLCHESTER CHIPMASTER 5" x 20", gearbox, variable speed, 3 jaw chuck, face plate, 4 way tool post	Just £950
COLCHESTER BANTAM 1600 model, 5" x 20", geared head, power feeds, gearbox	£1,400
COLCHESTER BANTAM 2000, 6 1/2" centre height x 30", between centres, 1 1/4" bore, 16 speeds, D13 camlock fitting, 3 & 4 jaw chucks in very nice condition	£3,250
COLCHESTER STUDENT Square head, 1500 revs / 2 speed motor model, geared head, gearbox, imp/met, power cross feed & gap bed, dual dials, 3 jaw chuck, taper turning, coolant, etc.	£2,950
COLCHESTER STUDENT 1800 6 1/2" x 40" x gap bed, 19" swing, 3 & 4 jaw chucks, Dickson tooling, taper turning, dial indicator, coolant, splash back, very nice, metric dials	£3,750
COLCHESTER TRIUMPH 2000 7 1/2" x 50" full screwcutting gearbox and power feeds, gap bed, 3 & 4 jaw chucks, Dickson tooling, faceplate etc.	<i>now</i> £4,950
HARRISON LS 4 1/2" x 24", fully toolled, complete with clutch	one of the best start up deals £950
HARRISON 140, 5 1/2" x 24", geared head, semi gearbox, 3 jaw chuck, gap bed, power feeds, clutch	£1,400
HARRISON 140, 5 1/2" x 24", geared head, gearbox, gap bed, power feeds, tooling, coolant	£1,725
HARRISON M250, 5" x 30", long bed, gearbox, power feeds, chucks, Acutrite III DRO on cross-slide, dual dials	<i>in very nice condition</i> £3,250
HARRISON M300 6" x 24", geared head, gearbox, power feeds, gap bed, 3 jaw chuck, travelling steady	<i>in very nice condition</i> £2,750
HARRISON M300 6" x 40", geared head, gearbox, power feeds, gap bed, 3 jaw & 4 jaw chucks, fixed steady	<i>in very nice condition</i> £3,450
HOBBYMAT M65 2 1/2" x 12" Screwcutting Lathe with changewheels and some tooling	£425
MYFORD ML7 3 1/2" x 19", lathe, 3 jaw chuck	<i>we have a large selection of this popular model</i> £750
MYFORD ML7B 3 1/2" x 19", gearbox, 3 jaw chuck and tooling	£1,250
MYFORD SUPER 7 3/4" x 19", changewheels, 3 jaw chuck and tooling	<i>Choice</i> £950 - £1,150
MYFORD SUPER 7, 3 1/2" x 19", 3 jaw chuck, power cross-feed	<i>Late model Choice</i>
MYFORD SUPER 7 3/4" x 31", changewheels, 3 jaw chuck and tooling	<i>Choice</i> £1,400
MYFORD SUPER 7, 3 1/2" x 31", (long bed) power cross-feed, induction hardened bed, industrial stand and doors, green machine	£2,950
MYFORD SUPER 7B 3 1/2" x 19", gearbox, 3 jaw chuck and tooling	£1,250
MYFORD SUPER 7B, 3 1/2" x 19", gearbox, Power Cross Feed, cabinet stand, tooling	£2,750
MYFORD SUPER 7B, 3 1/2" x 19", gearbox, Power Cross Feed, Hardened bed, 3 jaw chuck and tooling on stand	£3,400
excellent condition from new and NOT re-conditioned	
RAGLAN CAPSTAN 10" x 24" 6 Station Turret, cut of slide, collet chuck (lever) & collets, bar feed, variable speed, coolant	£950
SMART AND BROWN 1024 Tool-room lathe, full screwcutting gearbox and power feeds complete with 3 & 4 jaw chucks, collet set, steadies and equipment	<i>in very good condition</i> £1,500
VICEROY TDS 1 GBL 5" x 24", gearbox, power slides, 3 MT tailstock complete with fixed steady	£1,400
VICEROY TDS 1 GBL 5" x 24", gearbox, power cross feed complete with 3/4 jaw chucks, steadies, Dickson tool post, tooling, cabinet stand and	<i>A very rare imperial model at only</i> £1,950

TOO MANY LATHES TO LIST!!

MILLING MACHINES V - Vertical, H - Horizontal

ADCOCK AND SHIPLEY IES Horizontal/Vertical Head, 30" x 8" powered table and feed gears, coolant	£1,625
BOXFORD VM30 variable speed / 30 INT head, table 21 1/2" x 6" x Abwood vice and collet chuck	£1,500
BRIDGEPORT Belt head 2 speed (short motor) head, R8 powered head, gearbox table, 42" x 9" table	<i>Very nice</i> £2,250
CENTEC 2A vertical swivel head complete with small cabinet stand	£850
CENTEC 2B Horizontal, 1" arbor, table powered, 3 ph motor, single phase main motor	£725
CENTEC 2B Horizontal, quill feed 2MT head, 25" x 5" table, pedestal model	£1,400
ELLIOT '00' OMNIMILL 3 Morse taper quill universal head, 28" x 7 1/2" powered table	<i>Just In</i> £1,850
ELLIOT '00' OMNIMILL 3 Morse taper quill universal head, 28" x 7 1/2" powered table	<i>probably the best one around on the second hand market</i> Just In £2,750
ELLIOT Turret mill R8-10 speed 70-3000 rpm, table 45" x 10" (powered)	£1,500
EMCO FB2 Vertical 6 speed quill feed head 2 MT, powered 24" x 6" table, full coolant tray and cabinet stand	3 phase and does not like a converter so only £1,950
HARRISON horizontal, 31" x 8" powered table	<i>Now</i> £625
HARRISON HV 30 INT swivel head & clutch, 30" x 8" table/powered	£1,950
HARRISON Vertical 30 INT swivel head & clutch, 30" x 8" table/powered	£1,950
RAGLAN vertical mill 2 Morse taper, 2 speed motor, variable selector 175-2220 rpm, stand	£950
SIP RF30, milling/drilling machine complete with accessories	<i>new</i> £799
TOM SENIOR JUNIOR horizontal mill with a vertical head (sleeve to be made), table; 20" x 4 1/2", powered	£1,200
TOM SENIOR M1 horizontal, 25" x 6" powered table, 1" arbor	£575
TOM SENIOR M1 V/H, 25" x 6", 2 motor taper, 1" arbor	<i>Selection</i> £1,200 - £1,450
TOM SENIOR ELT MAJOR, 2 motor taper quill feed head, powered 37" x 8 1/2" table in	
VICEROY AEW vertical mill, 30 INT swivel head, powered table 34" x 8"	<i>Extremely nice condition</i> £3,200

DRILLS

ARBORA ER 25 / 25" Radial Drill speeds (8) 100-2900 RPM	<i>clean table</i> £1,425
ASQUITH 14-54 001 M2 (5mt) Radial Drill	£3,950
FOBCO 1/2" Bench, tilting table	£325
FOBCO 1/2" Pedestal drill tilting table	£345
MEDDINGS 1/2" pedestal drill	£245
MEDDINGS 2 Morse taper pedestal drills	<i>Choice</i> £275
MEDDINGS MF2 10 speed 2MT Bench 240 volts drill	£350
POLLARD CORONA Pedestal 1/2" Morse	<i>From</i> £100
SIP HDP 600B 1/2" / 2MT Bench Drill, table operated by rack, speeds; (16) 162 - 3000 rpm	<i>new</i> £175
STARTRITE Mercury 1/2" 4 speed bench drill	£225
STARTRITE Mercury 1/2" pedestal drill, 240 volts	<i>As New</i> £300
WARCO 3MT Pedestal 9 speed drill, speeds; 150-2200rpm, table operated by rack	£495

GRINDING / BUFFING

BRIELEY drill point grinder complete with cabinet stand and parts	£375
CLARKSON MKI Tool and cutter grinder complete with centres	£400
JONES AND SHIPMAN 540 Surface Grinder & Magnetic Chuck	<i>Ex College / Seen no work</i> £1850
MILFORD 12" Pedestal Grinder	£325
R.J.H. Buffing Machine, pedestal model Buffalo	£325
VICEROY Grinder, pedestal model	£145
VICEROY Buffers, pedestal models	<i>Each</i> £250

MISCELLANEOUS / FABRICATION MACHINERY

DENBIGH NO.2 FLYPRESS COMPLETE WITH BALL	<i>VERY CLEAN</i> £245
MARCO NOTCH BROACHING FIXTURE + NOTCH BROACH	£425
CLARKSON DRILL POINT GRINDING ATTACHMENT FOR CLARKSON MK1 & MK11 GRINDER	£425
HARCOS UNIVERSAL HEAD FOR TOOL AND CUTTER GRINDER	£245
MYFORD VERTICAL SLIDES JUST IN	<i>AS NEW</i> £395 / £155
MYFORD DIVIDING HEAD FOR ML7 AND SUPER 7 LATHES	<i>AS NEW</i> £675
MYFORD VHM-D MILLING ATTACHMENT FOR ML7 AND SUPER 7 LATHES	£1,400
TAYLOR HOBBS ENGRAVER MODEL K + BOX OF TOOLS AND EQUIPMENT	<i>VERY NICE</i> £425
BCA 12" HORIZONTAL / VERTICAL ROTARY TABLE	<i>JUST IN</i>
QUANTITY OF SLIPS, HEIGHT GAUGES, SQUARES, STRAIGHT EDGES, MICROMETERS, CUBES, ANGLE PLATES AND MISCELLANEOUS MEASURING TOOLS	<i>WOOD</i> £20 / <i>METAL</i> £30
COPE AND DRAGS	<i>Each</i> £5
TONGS (A VARIED SELECTION)	£345
FLAMEFAST DS 130 CERAMIC CHIP FORGE	£140
FLAMEFAST DS 100 HEARTH	£1750
BRIDGEPORT SLIDING HEAD	£425
MARCO BROACHING PRESS	<i>very nice example</i> £245
JONES AND SHIPMAN 4" x 24" bench centres	£450
TOM SENIOR slotting head	£950
STARTRITE 18-S-5 Woodworking / non ferrous bandsaw (5 speed bandsaw)	£345
DIAMOND fret saw, variable speed	£195 / £275
RJH BT 125 Fretsaw, variable speed	<i>As new</i>
SMART AND BROWN / CLARKSON H3-H5 toggle presses	<i>As new</i>
ARRAND 2MT long milling spindle	<i>New</i> £40
VERDICT CLOCKS, Long/Short Metric and Imperial models	£75
FLAMEFAST LD300 Soldering Iron Stove	£140
GRANITE 18" x 12" Surface Plate	<i>Just in</i> £425
TRIUMPH BURNER 4 Jaw Chuck	£245
TRIUMPH FACE PLATE D14	£270
JONES AND SHIPMAN Broaching Press + Stand	£375
ABB Inverter 8 1/2 hp motor, wired up	£250
SIP 7" bandsaw, horizontal & coolant	<i>new</i> £750
WELLSAW hacksaw	<i>Choice</i> £245 - £345
BRIDGEPORT high speed drilling head	<i>Now</i> £300
STARTRITE SC315D cut-off saw	£750
DUPLEX D29 toolpost grinder	£345
BOXFORD (imperial only) thread dial indicator	£65
ABWOOD 6" swivel/tilt machine vice	<i>Each</i> £345
VANCO, 1" finisher / vertical + extractor	£495
BURNERD, D14 lever collet chuck + collets	£400
BURNERD, LO lever collet chuck + collets	£400
VERTEX Dividing head	<i>new</i> £245
VERTEX 6" - 8" - 10" rotary tables	<i>good value equipment</i> <i>new from</i> £135
MYFORD ML7 / Super 7 rear tool post	<i>new</i> £40
MYFORD 2545 rear tool post	£99
MYFORD Vertical slide / fixed type (copy)	£40
LOCKWOOD QUAD HEADED 2mt Die Holder	<i>quality equipment</i> <i>new</i> £40
LOCKWOOD QUAD HEADED 3mt Die Holder	<i>quality equipment</i> <i>new</i> £40
LOCKWOOD Test Bar / 2mt Boxed	<i>quality equipment</i> <i>new</i> £39
LOCKWOOD Test Bar / 3mt Boxed	<i>quality equipment</i> <i>new</i> £42
MAGNETIC chuck - 1 1/2" x 6" fine pole	<i>Never used</i> £125
TOM SENIOR Model E pedestal stand	£150
UNION tool and cutter grinder stand	£135
HARDINGE capstan type toolpost	£175
50 INT Tooling: Selection	<i>Just in</i>
STARTRITE 352 woodworking band saw	£975
STARTRITE 14-S-5 woodworking band saw	£775
ALCOA GF 080/1 Rapid Melting Furnace	£300
MYFORD Burnerd Griptru 3 Jaw Chucks	<i>Boxed</i> £225
COLCHESTER D13 Burnerd 4 Jaw 8" light body independent chuck	<i>one off</i> £225
RJH 4" Unisher / Vertical complete with built in extraction	£625
MICROMETERS and associated measuring tools	<i>Still packaged as new</i>
POTTERY WHEELS, kilns and associated equipment	<i>Just in Cheap</i>
SPECAC Powder type press	£225
HARRISON L6 metric gearbox	<i>As is</i> £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	
Vice on own	£85
Swivel base on own	£49
SIP 1 TON MOBILE CRANE Manufactured 2000 (used just once)	<i>As new</i> £375
MITUOTOYO grade A set of slips	£245
F.J. EDWARDS 24" hole cutter	£525
Large bench vice	£770
LINK1.5 ton vehicle crane + top hat	£625
MITUOTOYO 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"	<i>Very nice from</i> £30
WEBER 1 1/2" ton mobile garage crane, late blue colour	£495
ELLIOTT 1250 STURDILL vertical head	<i>One off (rare)</i> £525
RJH inisher 4" wide belt, pedestal	£345
STEEL STOCK Just arrived	<i>to callers only</i>
ELLIOT U1 / U2 Slotting Head	£475
SWAGE BLOCKS	£125 / £145
J & S Universal grinding vice	<i>Choice</i> £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 41/2" capacity	<i>new</i> £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	<i>new, each</i> £90
ODOM Machine Bed Clamps (pair)	<i>Special</i> £24.50
HEIGHT GAUGES by Chesterman, Shardlow, Moore and Wright	<i>From</i> £95
ELLIOTT 10M Shaper, 10" stroke	£325
DIE BOXES	<i>From</i> £45
TRANSWAVE 3HP Converter	<i>new</i> £295
TRANSWAVE 5.5HP Converter	<i>new</i> £385
TRANSWAVE MT & RT rotary converters	<i>From</i> £485
CROMPTON PARKINSON 1/2 HP, resilient mount, Boxford / Myford Super 7 type motor	<i>new</i> £140



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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

MODEL ENGINEER

READER SURVEY

**PRIZES
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Model Engineer has combined forces with **Actulite** to find out a little bit more about it's loyal readers and to ensure that what we are delivering is in tandem with the needs and wants of our readership.

By completing our reader survey, you will automatically gain entry into our prize draw. 2 winners will each win a fantastic fully adjustable desk/table Actulite Polarised Natural Light Task light plus a subscription to the Highbury Nexus magazine of their choice whilst one winner will take away an Actulite Titan 2, plus a subscription to the Highbury



positioned around 2 – 3 feet off the work surface. The product is slimline in design, very tough and utilises the latest AuraT5 high frequency 6000k technology.

ABOUT THE MAGAZINE

1 How do you get to see Model Engineer?

- I am a subscriber ☐
 From newsagent – every issue ☐
 From newsagent – now and again ☐
 Club/society (please state)

 Friend ☐

2 Who else reads a copy of your magazine?

- Only Self ☐
 One or two others ☐
 Three or four others ☐
 More than four others ☐

3 How often do you respond to advertisements in the magazine?

- Never ☐
 Rarely ☐
 Sometimes ☐
 Often ☐
 Always ☐

4 SUBSCRIBERS ONLY:

- Will you renew your subscription?
 Yes ☐
 No ☐
 If no, why?



To let us know your thoughts, and be in with a chance of winning, please send your completed survey to: Model Engineer Reader Survey, Nexus House, Azalea Drive, Swanley Kent BR8 8HU.

5 If you do not currently subscribe, which of the following incentives would most likely persuade you to subscribe?

- Price discount ☐
 Free issues ☐
 Free gift (please state preference)
 Other (please state).....

6 Of the following occasional free extras, which would you prefer?

- Cover mounted gift ☐
 Free plans ☐
 Money saving offers ☐
 Competitions ☐
 Wall charts ☐
 Booklets or supplements ☐
 If the latter, which subjects would you like to see covered? (Please state).....

7 How do you rate Model Engineer magazine?

	Very good	Good	Fair	Poor
Types of article	☐	☐	☐	☐
Quality of articles	☐	☐	☐	☐
Quality of drawings	☐	☐	☐	☐
Balance between complex and simple articles	☐	☐	☐	☐
Overall quality of Model Engineer	☐	☐	☐	☐



8 How do you rate the following features?

	Very good	Good	Fair	Poor
Smoke Rings	☐	☐	☐	☐
Post Bag	☐	☐	☐	☐
Bray's Bench	☐	☐	☐	☐
Road Steam	☐	☐	☐	☐
Keith's Column	☐	☐	☐	☐
Club Chat &	☐	☐	☐	☐
Club Diary	☐	☐	☐	☐
Pete's Page	☐	☐	☐	☐
Letters to a	☐	☐	☐	☐
Grandson	☐	☐	☐	☐
Highland Railway	☐	☐	☐	☐

9 Which of the following topics would you like to see covered in future issues of Model Engineer?

Locomotives/rolling stock/railways	☐
Traction engines	☐
Electrical/electronic	☐
I/C engines	☐
Clocks	☐
Aircraft	☐
Cars	☐
Boats	☐
Tooling/processes	☐
Experiment/research	☐
Full – size engineering	☐
Rally/exhibition reports	☐
Product/trade reviews	☐
Other (please specify)	☐

10 Concerning the balance of Model Engineer (editorial/advertising), would you prefer:

More adverts	☐
More editorial	☐
Leave it as it is	☐

11 Concerning the presentation of Model Engineer, how do you rate the following?

	Excellent	Good	Fair	Poor
Text size	☐	☐	☐	☐
Design/layout	☐	☐	☐	☐
Use of colour	☐	☐	☐	☐
Paper quality	☐	☐	☐	☐
Issue size	☐	☐	☐	☐

12 What other model engineer related magazines do you read?

- 1
- 2
- 3
- 4

13 What other magazines/newspapers do you read?

- 1
- 2
- 3
- 4

14 Did you attend a model engineering related exhibition in 2002?

Yes ☐ No ☐

If 'Yes', please specify which one(s):

.....
.....

15 If 'No', which of the following was/were the reason(s)?

- Too far to travel? ☐
- Too expensive? ☐
- Other commitments? ☐
- Lack of adequate public transport? ☐
- No wish to attend? ☐
- Other (please specify)

16 Are you actively involved in one or more model engineering projects?

Yes ☐ No ☐

If 'Yes', please specify:

.....
.....

17 Do you belong to a model engineering club or society?

Yes ☐ No ☐

If 'Yes', please specify:

.....
.....



18 Do you keep your copies of Model Engineer?

Yes ☐ No ☐

If 'Yes' do you bind or have them bound into volumes?

Yes ☐ No ☐

19 What was your last major equipment purchase?

Please specify

.....
.....
.....
.....

How long ago was this?

.....
.....

20 Please list the principle machine tools held in your workshop:

.....
.....
.....
.....

ABOUT YOUR INTEREST

21 Which of the following best describes your modelling ability?

Novice ☐
Hobbyist ☐
Intermediate ☐
Skilled ☐
Professional ☐

22 How long have you been interested in modelling?

A year or less ☐
Two to four years ☐
Five to ten years ☐
Ten years + ☐
As long as I can remember ☐

23 Where do you buy most of your modelling materials and supplies?

Modelling shops ☐
Modelling clubs/societies ☐
Exhibitions/modelling events ☐
Mail order catalogue ☐
Online ☐
Other (please state).....
.....
.....

24 How much have you spent on modelling supplies and equipment in the past 12 months and how much do you expect to spend in the year ahead?

	Have bought	Will spend
Less than £50	☐	☐
£50 - £100	☐	☐
£101 - £300	☐	☐
£301 - £500	☐	☐
£501 - £1000	☐	☐
£1001 - £5000	☐	☐
£5000+	☐	☐

25 Do you have any other hobbies or interests?

If so, please state the interest:

Reading ☐
Writing ☐
Sport ☐
Betting ☐
Gardening ☐
Woodworking ☐
Music ☐
Do It Yourself ☐
Theatre/Arts ☐
Other (please state).....
No other hobbies ☐

ABOUT YOU

26 Do you have Internet access at home, work or elsewhere?

Home ☐
Work ☐
Elsewhere ☐
No access ☐

27 How old are you?

Under 25 ☐
25-34 ☐
35-44 ☐
45-54 ☐
55-64 ☐
65+ ☐

28 What is your gender?

Male ☐
Female ☐





29 What is your marital status?

- Married
Single
Widowed

30 Do you have children and grandchildren?

If so, please indicate how many:

Children:

- One
Two
Three
Four
Five or more

Grandchildren:

- One
Two
3-5
6-10
11 or more

31 What is your current work status? If retired, please also state previous role:

- Retired
Managerial Industry
Managerial Finance/Public Sector
Education
Media
Skilled
Unskilled
Student
Currently unemployed
Other (please state).....

32 What is your annual gross income?

(Please note you are not obliged to answer this question).

- Under £10,000
£10,000 – £20,000
£21,000 – £30,000
£31,000 – £40,000
Over £40,000

33 Do you drive? If so, how old (in years) is your vehicle?

- Under 2 years
2-5 years
6-9 years
10 + years
Do not drive

34 Do you plan to go on holiday in the next twelve months? If so, where is it likely to be?

- United Kingdom
Australasia
America
Asia

Europe (please state)

Actulite

Polarised Natural Light System

PRIZE DRAW COMPETITION

If you wish to be included in our prize draw, please fill in your name and address below.

All information will be treated in the strictest confidence.

Name.....

Address

.....

.....

.....

Post Code

Email

Thank you for your help in completing this questionnaire. Please return to:

Model Engineer Reader Survey,
Nexus House, Azalea Drive, Swanley Kent BR8 8HU.

CLOSING DATE FOR RECEIPT OF QUESTIONNAIRES IS 23 MAY 2003

Please tick the box if you do not wish to receive further information from Highbury House Communications PLC ☐

Please tick the box if you do not wish to receive further information from 3rd party companies approved by us ☐

