MODEL ENGINEER

Vol. 187 No. 4161

25 January - 7 February 2002 £2.10

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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.nexusonline.com
Nexus Special Interests is a wholly owned subsidiary of Highbury House Communications plc.

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Phone: 01353-654422; Fax: 01353-654400
email: wss@wyvernnet.co.uk
Rates for 26 issues (annual), 13 issues (six months):
UK: £54.60 (annual) £27.30 (six months);
Europe: £69.00 (annual), £34.50 (six months);
ROW Airmail: £74.50 (annual), £37.25 (six months);
US Airmail: $113.50 (annual), $56.75 (six months).
Cheques payable to 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. Usps 011099.
US Subscription Agent: Wise Owl Worldwide Services, 1926 S. Pacific Coast Highway, Suite 204, Redondo Beach, CA90277-6145, USA. Phone: 310 944-5033; Fax 310 944-9963.
Visa/MC/Discover accepted.
Canadian Distribution by Gordon & Gotch Periodicals (Toll free 1-800-438-5005).
Model Engineer is published fortnightly.

FOR ENTHUSIASTS · BY ENTHUSIASTS ·
HIGHBURY NEXUS

ISSN 0026-7325

IN THIS ISSUE

● Vol. 187 No. 4161 25 January 2002 ●

On the cover ...

Seen here restored and in steam in the Power Hall at Manchester's Museum of Science & Industry, this tandem compound condensing engine once powered Firgrove Mill alongside the Rochdale Canal and was owned by R. Barnes & Co. who produced cotton yarn and flannelette sheets. Originally built by J. & W. McNaught whose foundry was only some half a mile distant from the mill, the engine was delivered to the site by barge. Admission to the Museum is free and a visit is highly recommended. *See also page 612 in this issue.*

(Photograph by Mike Chrisp)

SMOKE RINGS
With the Editors

Gordon Read

Alan Bourne writes:

"It is with great sadness that we have to record the death of Gordon Read on 6 December 2001, just a few days after his 77th birthday. Born in Washington, Co. Durham, a 'Geordie' and proud of it, he was a valued contributer to M.E. *for a number of years, not only with constructional items but also in the* Postbag *columns.*

"At the age of 18, he joined the Royal Navy as a radio operator on 17 January 1942. His practical abilities and knowledge of electronics soon had him transferred to radar and sonar maintenance duties. In this capacity he saw active service on Russian convoys, secondment on Special Services missions, and a period to the end of hostilities in the Malaysian theatre of war. Gordon's last overseas posting in Malta was with his wife and young son and ended in the late 1950s. He finished his time as an instructor at the HMS Colinwood Shore Establishment, Fareham and left on 14 October 1968 after 26 years and 9 months service. He then became a technical author at Marconi Space and Defence Systems, Portsmouth. Before retiring in 1984 he moved to Plessey at Havant for 11 years as senior author and Manager of the Technical Publications Department. He could read and converse fluently in Russian, French, German and Malay.

"The making and flying of model aircraft began during his time in the Navy. A Stirling cycle hot air engine from about these times is still in working order. Another absorbing interest was with Formula one and vintage cars; a 1958 ex-rally Volvo stands in the garage.

"Of his many contributions to M.E., *regular readers will remember his articles on using the CZ metal bender and his Ni-Cad battery discharger. He built a Hypp clock which hangs on the living room wall and keeps quite good time. Many smaller items which he made could be seen in the loan section at M.E. Exhibitions. Other projects have included a lathe saddle travel, digital read-out system and a 3-phase 12 volt, 9 amp alternator, both 'visitor interactive' working models in the 1998 M.E. Exhibition. The alternator required special rotor stampings. Typical of Gordon, theoretical and practical design and build was from scratch.*

"Two unfinished projects remain: a medication dispenser which uses several logic elements, a reflective opto-head, two small gear boxes and 6 volt drive motors, and a side-by-side 2-cylinder 2-stroke petrol engine to be mounted on a common base with the alternator and so become its prime mover.

"In all projects, simplicity of design was his watch-word. He possessed a great fund of knowledge on many and varied subjects. It is probable that the less than careful reader would read his letters and articles for M.E. *and completely miss the more subtle and very dry gems of humour contained therein.*

"His keen interest in local affairs led him to membership of his local Parish Council and at the time of his death had been its Chairman for several years.

"Gordon did not suffer fools gladly. Those who were privileged to know him are aware of their loss."

Gordon Read 1924-2001

Museum of Science and Industry

Just before Christmas, my wife Jean and I stayed with our daughter Jacky and son-in law Stephen in Manchester. We took the opportunity to spend a couple of hours in the Power Hall of Manchester Museum of Science and Industry and were most impressed. Readers within reach of this fine collection, admission to which is free, certainly have much to enjoy, including the aroma of steam and hot oil! That's my excuse for the images on the cover and page 612 of this issue.

Wembley venue for the London Model Engineering Exhibition

Too late for inclusion in these notes in the previous issue (*M.E.* 4160, scheduled for publication 24 December and copies of which were delivered to me 21 December, so hopefully this issue will be out in time for the following reminder to be useful) Chris Deith called to ask us to emphasise to our readers that the London Model Engineering Exhibition, sponsored by TEE Publishing and Meridienne Exhibitions, will be held at Wembley Exhibition Centre this year and *not* at Picketts Lock, its previous home.

Only to well aware that despite every effort to publicise changes in venue, we have had disgruntled visitors arriving at previous halls when our own Model Engineer Exhibition moved from Wembley to Olympia, then from Olympia to Alexandra Palace and from Alexandra Palace to Sandown Park Exhibition Centre, I have every sympathy with Chris Deith's concern and, in the hope that this issue reaches readers in time, am happy to emphasise here the change of venue for his event at Wembley Exhibition Centre which will take place 25, 26 and 27 January.

Tennant wheels

Mr Horner in North Yorkshire called recently to ask if we knew of a supplier of the correct wheel castings for *Tennant*, Martin Evans' last locomotive design in 5in. gauge. While I know that several of these locomotives are under construction, I am not aware that any of our regular advertisers have such castings available, but I am sure that one builder told me he was making arrangements to obtain appropriate castings.

Regrettably I kept no record of that conversation, so if anyone is able to assist Mr Horner, I am sure he would be particularly pleased, and any information sent to this office will be forwarded without delay.

Netta in 1¼in. gauge

Mr Lloyd in West Glamorgan has written seeking a set of drawings for LBSC's *Netta* in 1¼in. gauge. Listed as LO94 in previous issues of the Highbury-Nexus Plans Service catalogue, they seem neither to be available from this source or X-List Plans which, we were originally given to understand when the Plans Service was 'streamlined', held all the drawings between them.

The reality of the situation is that many drawings no longer seem to be available, so if any reader can assist Mr Lloyd, I am sure he would be particularly pleased, and any information for him sent to this office will be forwarded without delay.

Brighton ModelWorld Exhibition

Now in its 25th year and currently organised by The Brighton Centre and the Sussex Railway Modellers, this popular annual event is scheduled for 15-17 February 2002.

Attractions include a fleet of large radio controlled trucks and lorries from the International Model Transport Group, Hot Rods from the National Model Hot Rod Association and a Robot Wars display, with several big names present. Model railways, model boats, model ships, model aircraft and model engineering displays will be accompanied by many other items of particular appeal for youngsters, and a model race track will be available for anyone to try their skill. The exhibition will be well supported by the trade; transport films will be shown for the first time for several years and there will be prize draw.

Brighton ModelWorld Exhibition will be open Friday to Sunday 15-17 February 10am-5.30pm daily. Admission: Adults: £5; Concessions £3; Family: £15. Contact Wendy Walton at the Brighton Centre for further general information (call 01273-292646) or visit **www.brightonmodelworld.com** for latest news and details of the event.

The M.E. Editorial Office

Regrettably, with the re-arrangement last year of the Highbury-Nexus office at Swanley, some items sent by post to Nexus House have not reached me. While not perhaps by return of post, all correspondence is acknowledged and a lack of such acknowledgement may be an indication of non-arrival. To avoid the inevitable delay and possibility of material becoming mislaid in the otherwise circuitous route between Swanley and Hertfordshire/Northamptonshire/Bedfordshire, readers may prefer to send letters direct to the Model Engineer Editorial Office, PO Box 310, Hemel Hempstead, Hertfordshire HP3 8AX; fax: 01442-269366.

Readers should also be aware that working remote from the Highbury-Nexus office, neither Neil, Kelvin or I have direct access to personnel based at Swanley and Ely. Departments to deal with Advertising, Marketing and Reader Services are at Swanley in Kent (01322-660070) while Subscriptions are dealt with at Ely in Cambridgeshire (01353-654422). Queries relating to these matters should be directed accordingly.

While on the subject, in order to deal with technical queries adequately, readers are urged to put them in writing and *not* to expect intricate technical matters to be dealt with by telephone.

POST BAG

Drilling for tapping

SIRS, - As another Grandad, may I add a little to the *Letters to a Grandson* (*M.E.* 4156, 16 November 2001) regarding tapping drill sizes?

When I was doing my Drawing Office training, we were given a figure of 75% of full thread depth as a satisfactory basis for calculating the size of tapping drills. This horrified me and I generally work on 80% to 85%, depending on the material involved and drill sizes available.

As well as being cut by the tap, malleable materials, especially aluminium, copper and brass and to a lesser extent mild steel, are all swaged by the action of tapping. This leads to a nominal say 80% thread depth, becoming 85% or more. Try to get too near 100% thread depth and disaster will strike, however careful you are — no rocket science is involved!

When our company produced its first metric threads, our chief inspector wanted to pronounce them 'scrap': as the saying goes, a double-decker bus could be driven through the gaps! However, the brand new gauges indicated that they were within tolerance, and so did the master gauges used to check the shop gauges. I share Grandad's jaundiced view of BSI and International Standards.

I have a little booklet produced 30 or more years ago by the Dormer Company which makes twist drills and reamers; it carries some very useful information and may still be available, after all they *do* know a little about the subject!

P. Ineson, Leicestershire.

Wartime model Lancaster

SIRS, - Peter Spenlove-Spenlove's brief article describing his first model, which was published some time ago (*M.E.* 4113, 11 February 2000) was interesting, particularly in that it reminded me of how I spent some of my wartime hours, which may be of interest to other readers.

The American B17 Flying Fortresses used to fly in quite large formations. One of these formations flew into thick cloud in which two collided and crashed near Woodend in Northamptonshire. Next day I was off on my bike to hunt for fragments of Perspex. The nose of the B17 is of parabolic form with a thick circular rim cemented onto the 1/4in. thick nose form. This rim is bolted onto the airframe. I was lucky and found some pieces of the 1/2in. thick Perspex rim.

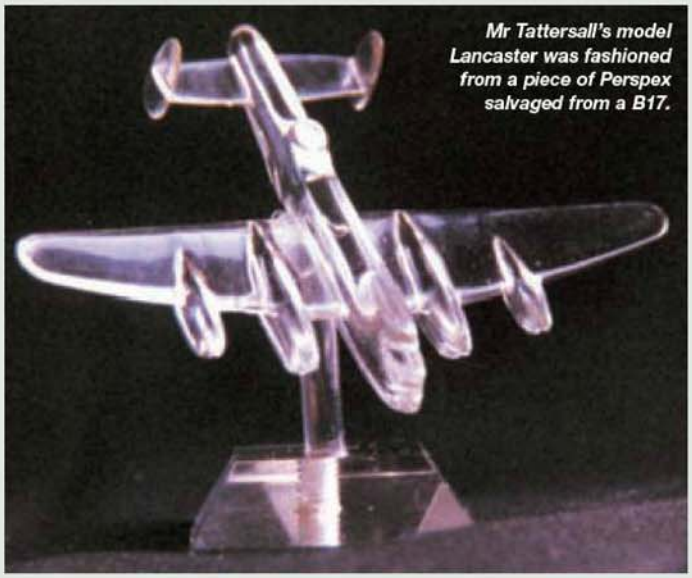
Very keen on engineering, I was 18 at the time and engaged on important war work. I worked 12-hour shifts setting six Conomatics (four-spindle automatic lathes). The Battle of Britain was raging and Hitler was planning to invade Britain. I was in the Home Guard and had to take my turn doing night duty, manning a telephone exchange. The calls with which I had to deal were not very frequent and I don't take very kindly to boredom. So, armed with a piece of B17 Perspex, a small clamp, a 6in. saw blade ground down on its back to 0.010in. wide, half a dozen small files, a scriber, and a small pair of dividers, I made a small model of a Lancaster bomber.

The Lancaster was very new in those days; I had only seen one. However, I did have an aircraft spotter's book with some good scale silhouette drawings in it. During the war these books were quite commonplace to help people to recognize both our own and enemy aircraft.

When the model reached its final shape I smoothed it with powdered pumice and water on pieces of 4 x 2in. rifle pull-through cloth, an exellent non-scratch cleaning material. I wrapped the polishing cloth around a few narrow pieces of softwood easily whittled to shape using a penknife. The final finish was obtained by using Brasso on the pull-through cloth.

I also made a small Perspex stand on which the Lancaster clipped for display and include a photograph herewith, which I have to admit was not the easiest to obtain.

L. Tattersall, Northumberland.



Mr Tattersall's model Lancaster was fashioned from a piece of Perspex salvaged from a B17.

Hindley steam lorry

SIRS, - I read Martin Wallis' introduction to the Savage steam lorry with considerable interest as it may have a historical link with my own project. From very scant surviving information and photographs, I am attempting to design and build a model of the 2-3 ton steam-lorries built by E. S. Hindley & Sons, of Bourton, near Gillingham in Dorset.

These wagons were chain-driven from a vertical engine set between the seats and attached to the rear of the boiler. The boiler, patented by Hindley, was of locomotive form but with a circular-section firebox which extended well above the top of the barrel. The latter was thus always full of water, to protect the tubes or crown-plate from running dry when the vehicle was on a steep hill. Firing was through a top-fed 'stoking-shoot' *(sic)*.

Commercial Motor magazine reviewers rated the smaller Hindley lorries very highly for their simplicity and manoeuvrability.

Hindleys also built 5 and 7 ton capacity all-geared undertypes superficially resembling the Savage undertype, but again with Hindley's patent boiler. Pickfords bought a fleet of these with sprung box-van bodies for furniture moving. The 'Colonial' was a heavy-duty 7-tonner built for export. It had larger wheels and water-tank, a simple vertical boiler and a traction-engine style forecarriage instead of a leaf-sprung axle although, like all Hindley lorries, it still had Ackermann steering.

Hindley's brochures provide a revealing insight into contemporary life. They bore a photograph of a 'Colonial' wagon in India, loaded high with cotton bales and several labourers. The caption innocently tells us that the lorry was *"being driven by natives."* The idea that the common herd could learn to drive must have been novel in 1905, as the brochure also claimed that the 1 1/2-3 ton 'Light Delivery Van' was so simple *"any man of ordinary intelligence"* could learn to drive it in only a few hours.

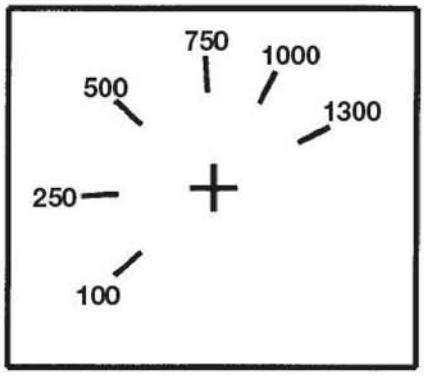
My project was inspired by a contemporary photograph of the 3 ton tipping-wagon in the *Dorset Year Book, 1977* (published by the Society of Dorset Men). The wagon, in the livery of a local Mr. Maloney's business, sported a banner proclaiming that its excessive-looking load of coal was to be given away to the local poor. It was photographed prior to taking part in Gillingham Carnival. On the mate's seat is Mr. Maloney, wearing his 'Sunday Best' and the sort of well-fed physique and expression of benign gravitas which were suitably dignified for the event and times. The driver stands to the front, one hand on the bunker rim above him and grinning cheerily at the camera.

Less well-dressed than him, and bearing a Mona Lisa-esque look suggesting he was shy in the presence of his elders and betters, the young mate stands rigidly holding a coal-shovel (short-handled to suit the top-fired boiler). Behind the vehicle is a labourer who appears very unsure that he should be photographed in such august company. As is common in Edwardian photographs, the 'men of ordinary intelligence' here have the gaunt, rather drawn look Kate Moss might envy but which resulted from years of hard physical work on adequate but limited diets. There was nothing romantic about driving steam vehicles in their commercial years, but at least Mr. Maloney had bought the optional canopy for his Hindley lorry.

Hindley's collapsed in the depression following WWI, not the Great Depression of later years. One informant in my research thought that Savages bought a lot of Hindley assets, but whether this is correct, or what Savages may have acquired, I do not know. Given the two companies' products lines, despite the Savage wagon being a competitor with Hindley in 1907 and having its own (Musker) origins, it is possible that my informant was right.

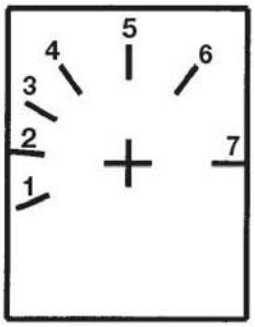
If any of your contributors on Savages' products can shed any light on this question, or still better, supply information on the vehicles themselves, I would be very pleased. I have a feeling that I have amassed most of the surviving Hindley material, chiefly contemporary trade-magazine reviews and advertising, but I live in hope that a set of Hindley drawings may be slumbering somewhere!

I know of no surviving Hindley vehicles, but at least four Hindley plant steam-engines are preserved. A large horizontal engine is on display, turned by an electric motor in 'Brewers' Quay' (formerly the Devenish Brewery and now a museum, bar and shopping arcade) in Weymouth. It accompanies a smaller



SPEEDS (RPM)	
LOW	HIGH
100	200
250	500
500	1000
750	1500
1000	2000
1300	2600

CHESTER CONQUEST MILL/DRILL



	SPEEDS (RPM) LOW	HIGH
1	100	200
2	300	600
3	500	1000
4	700	1400
5	1000	2000
6	1270	2540
7	1470	2940

CLARKE CL300M

To fit behind dials, cut out centre hole on both to 13mm dia.

Mr McLatchie's calibrated speed dials.

horizontal engine by another manufacturer. A small inverted-vertical engine, also ex-brewery, stands in Sherborne or Shaftesbury Museum. A few years ago a pair of Hindley's enclosed vertical high-speed engines rescued from the derelict South Georgia whaling-station arrived at the agricultural museum at Breamore House (near Ringwood, Hampshire).

Nigel Graham, Dorset.

Sweet Sixteen

SIRS, - I am building Rex Tingey's model traction engine *Sweet Sixteen* as described in his book *Projects for the Unimat.*

I have a problem with the orientation and fixing of the Steam Block to the boiler and would greatly appreciate any assistance which other builders of this attractive project may be able to provide.

For interest, I have made a separate milling table which is 8in. long with an 11in. cross-slide for my Unimat 3 lathe.

J. O. H. Snell, Warwickshire.

Blown fuses

SIRS, - With reference to Mr. McLatchie's letter (*M.E.* 4156, 16 November 2001) about two years ago I bought a Chester Conquest lathe model 300 which is identical to Mr. Latchie's machine. I too was bedevilled by blown fuses and, eight months later, the control panel gave up the ghost.

After repair by Chester UK, I was still plagued by fuses blowing until 12 months later when I had to return the panel for repair which, although out of warranty, Chester kindly rebuilt free of charge. Upon refitting I changed the speed control from high to low despite taking 0.025in. cuts.

Even in low speed I find that the machine has ample speed and I have had no further trouble with blown fuses. I hope this will solve Mr. Latchie's problem.

J. R. Hislop, Cheshire.

Variable speed unit calibration

SIRS – As an update to my letter relating to variable speed units published in *Postbag* (*M.E.* 4156, 16 November 2001) I can now report that I have since purchased a digital tachometer and have measured the spindle speeds of my Chester Conquest mill/drill and Clarke CL300M lathe.

For the benefit of fellow readers, I have prepared and include herewith dials with speed markings which can be photocopied, cut out and placed behind the speed control knob of either or both machines to give an indication of approximate spindle speeds. Hopefully, this is much better than attempting to guess the speed when using a variable speed control unit.

The calibrations are for when the machines are set to low gear. When the lever is set to high gear, the speeds should be doubled from those shown.

The dials are printed here actual size, and the markings can be transferred to clear adhesive-backed plastic film which will permit the original markings to remain visible.

I hope they will be of use to other owners of these machines.

G. McLatchie, Strathclyde.

Check and check again

SIRS, - On reading Peter Lewis' article, *General Steam Navigation* (*M.E.* 4155, 21 September 2001) it seemed to me to be one measurement disaster after another! My heart went out to him. I remember building *Lady Stephanie* and no matter how often I checked my work I had to add a 3/4in. spacer to allow the beam to swing clear of all else.

And more recently, having purchased a plan and a kit of castings and materials, I found that a piece of 3/16in. diameter mild steel for a shaft was supposed to fit a bearing with the instruction to *"drill 5mm."* Luckily I had 'miked' the stock before wasting precious time.

A word to beginners: check, check and check again, especially as we convert to metric.

A. K. Tulloch, Scotland.

Water cooled smokeboxes

SIRS, - Mr W. O. P. Willis in his letter (*M.E.* 4157, 30 November 2001) proposes the use of water cooled smokeboxes to enhance the efficiency of a locomotive boiler by *"some 10-15%"*. I am afraid that in the real world such savings are just not available.

Heat transfer from combustion gases to water and steam falls into two categories: radiation and convection. Radiation varies as the fourth power of the temperature and in practice takes place virtually only in the firebox where the incandescent mass of the fire loses heat through the firebox walls and crown. Convection varies in proportion to temperature difference between gases and metal surface and thus is the ruling factor in the transfer of heat in the boiler tubes. In a locomotive boiler, probably in excess of 80% of the heat transfer is accomplished within the firebox, leaving only a modest job for the tube bundle to do.

In order to extract more of the heat which otherwise escapes in the flue gases, it is necessary to install a very large heat transfer surface, such as that to be found in the economiser of an industrial boiler. In our context this is impracticable and bears no relationship to the small surface area of a smokebox. were that to be water jacketed.

If you are looking for more efficient working, the following are effective ways to try:

1: Use injector feed only; feed-pumps waste energy.

2: Arrange for the fire to run with the ideal (stoichiometric) proportion of oxygen. Excess oxygen means that the fire has to heat up more air which in turn detracts from boiler efficiency; too little oxygen leads to the production of carbon monoxide and smoke and the effect on boiler efficiency is far worse even than running with excess oxygen.

Over the years many designers have tried devices to improve efficiency. Smokebox feed water heaters have been in vogue, but those which have stood the test of time include the brick arch and combustion chamber, reinforcing what I alluded to above, namely that firebox design is the key to good efficiency.

D. A. G. Brown, Rutland.

Masonry drills

SIRS, - In reply to Keith Wilson and others who have written on the subject, when I referred to the use of a slot at the ends of the spring, I was not thinking of springs which are nearly flat, as in the case of Keith's brake van, but in general where locomotive springs are sometimes radiused quite markedly, as for *Tennant*, my last locomotive article.

Mr. Smith seems to have missed my point which was that the ordinary carbide-tipped drill is intended for making holes in walls and is therefore hardly suitable for use when building a model. Correspondents may discuss solid carbide drills and titanium coatings, but how many model engineers could afford to buy these? Especially for quite a short job.

Martin Evans, West Sussex.

Settling down

SIRS, - The letter from B. W. Mills (M.E. 4157,) in which he mentioned that he is building a Jubilee clock has reminded me that my clock is still running on its first set of three D-size cells.

They were put into service on 16 September 2000 and from memory the impulse interval has shortened from 90 seconds to 40 seconds. The clock has settled down and keeps good time. It is a pleasure to hear the clock working in the background rather than having a quartz movement.

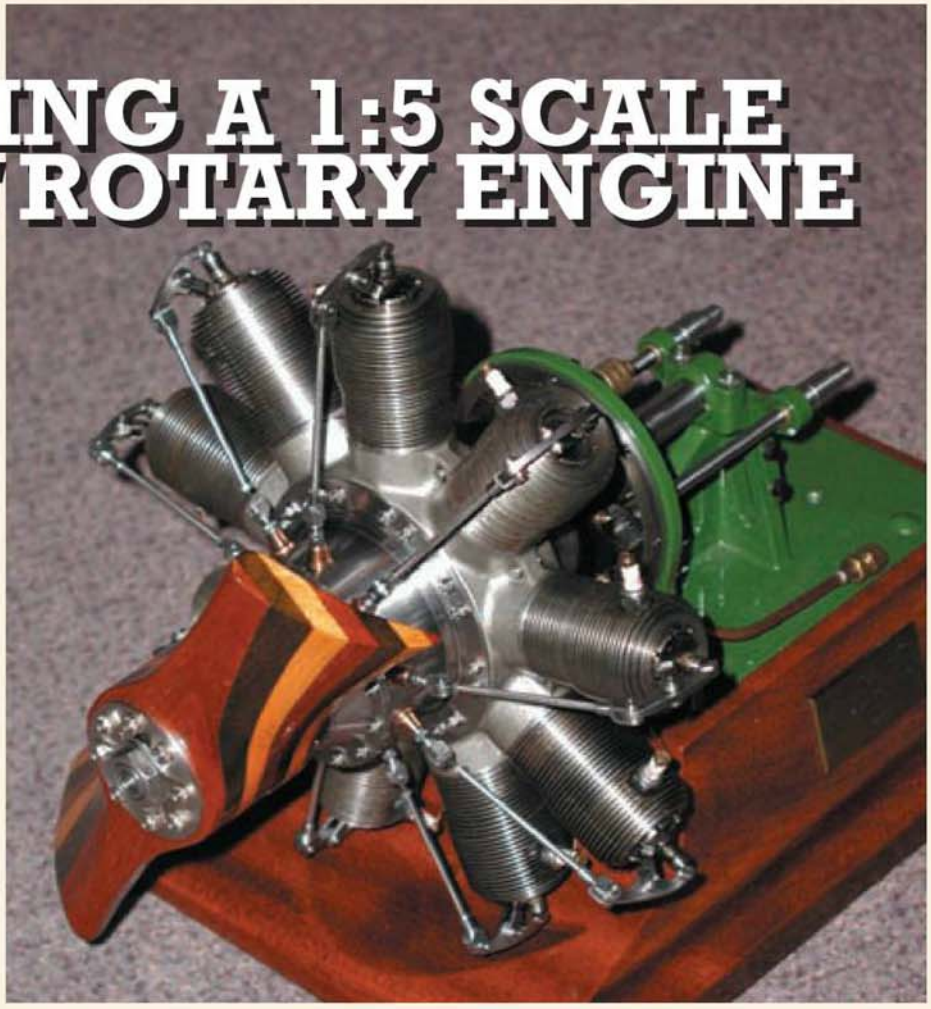
John Noakes, Hampshire.

BUILDING A 1:5 SCALE *GNOME* ROTARY ENGINE

Rowland C. Lowe

begins a detailed account of how he built this classic power plant to the design by Les Chenery.

●*Part I*



A view of the original award winning 1:5 scale Gnome rotary aero engine built by Les Chenery whose permission to reproduce his original drawings is gratefully acknowledged..

This model of the 1913 *Gnome* rotary engine was designed by Les Chenery of Edgware in Middlesex. At first the engine appears complicated but although some of the internal mechanisms are a little complex, the construction of the model is by no means as difficult as it might at first appear. While this is not a model for a beginner, anyone who has successfully completed his or her first internal combustion or slide valve steam engine can attempt it with confidence.

The list of workshop equipment required is not daunting. A screw-cutting centre lathe with a minimum centre height of 3 1/4in. is necessary to complete the model. My own models were made on a Myford Series 7 lathe. A vertical slide is also needed, but all other equipment is home-made. On completion, the maker of this model will have some useful extra workshop equipment.

The design poses three principal difficulties, as follows:

1: 'How to make it' problems connected with machining set-ups

2: Correct alignment of the two-piece crankshaft on assembly.

3: Concentricity and true alignment of all parts since the entire engine rotates around the crankshaft.

These problems are all resolved by the construction methods outlined in the following notes.

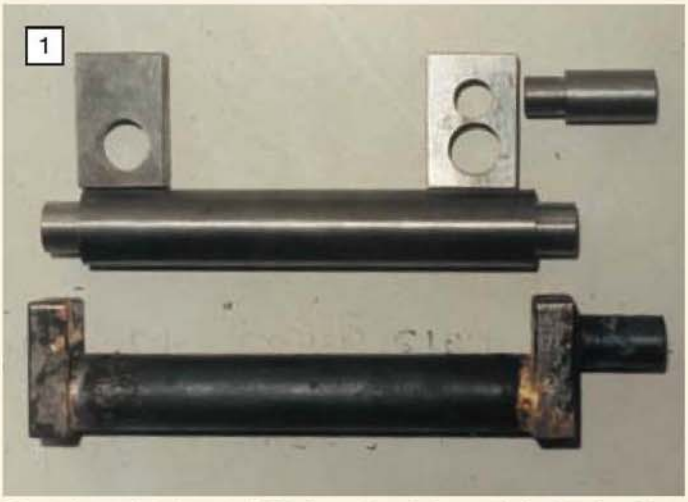
As received, the drawings include no details of the ancillary equipment including the screw-propeller, petrol and oil tanks and cocks, oil pump, mixture control valve and ignition gear. Designs and construction details for these items are also included here.

Starting on the crankshaft

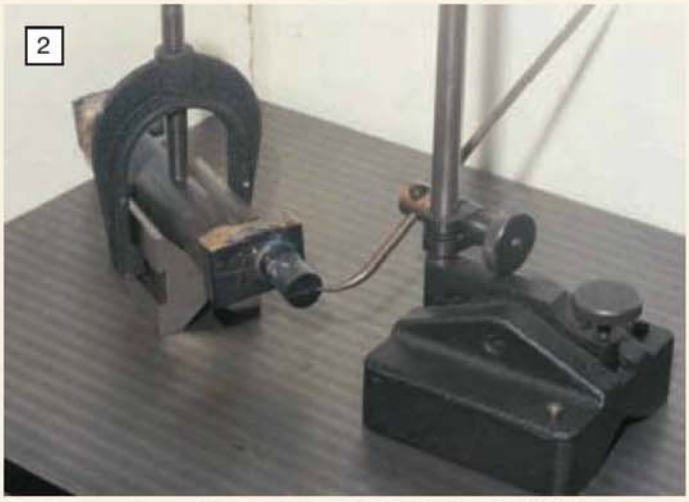
It seemed that the two most difficult parts would be the crankshaft and crankcase and, as the shaft is literally central to the whole engine this was tackled first. Following completion of these parts, life becomes much easier!

First prepare blanks for both sections as shown in **figs 1** and **2**. **Photograph 1** shows the main section before and after brazing. When brazing, remember that EN8 is a relatively high carbon steel and should therefore be allowed to cool in the hearth as slowly as possible. This also has the advantage of normalising the steel and reducing internal stresses which may cause distortion. Note that the front portion of the shaft does not require a throw piece.

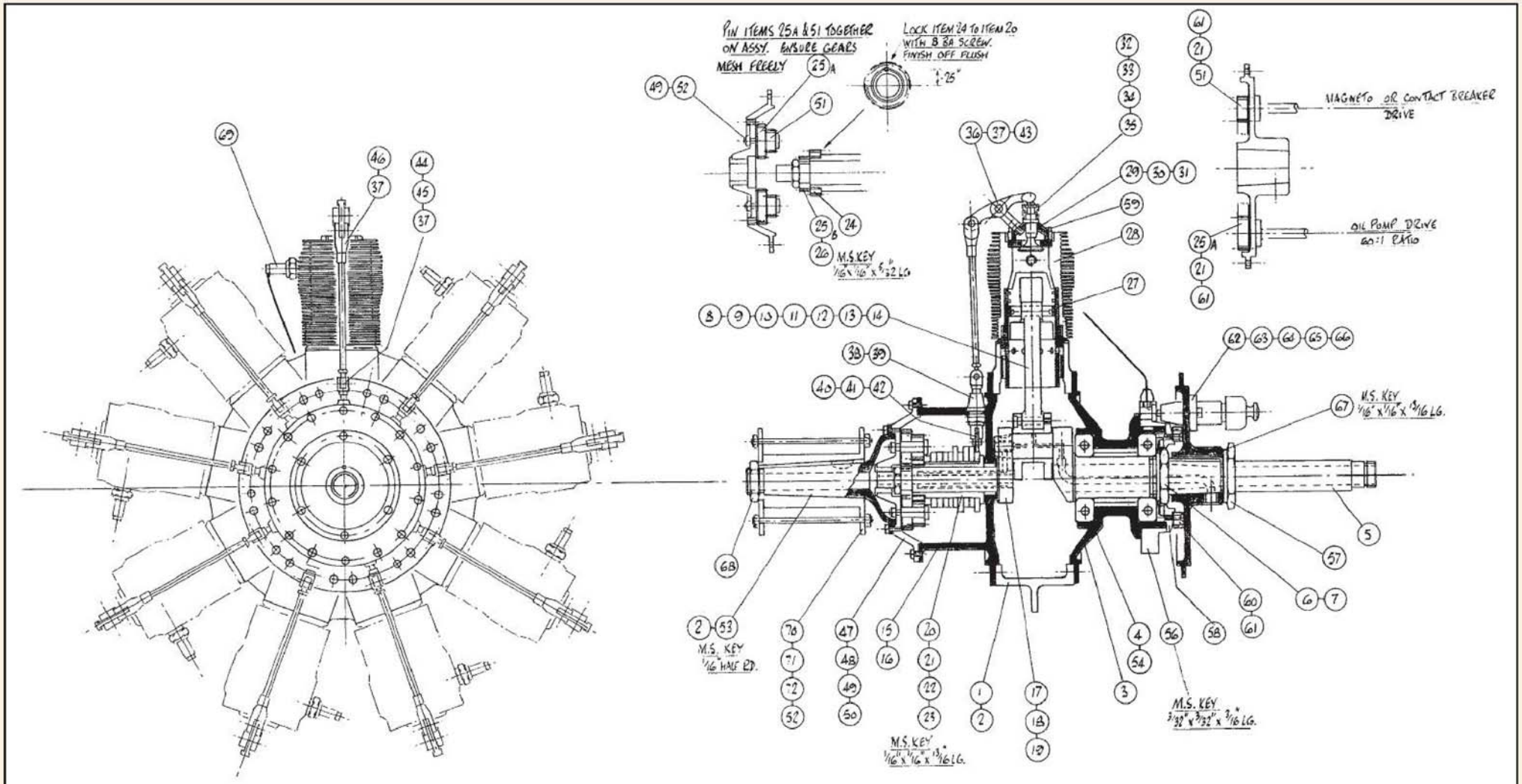
The first stage of marking out the shaft is shown in **photo 2**, with the setting out of centres. The shaft is set in a V-block with shaft and crankpin centres horizontal, and a line struck



The main crankshaft assembly is shown here before and after brazing. The steel specified for the crankshaft is EN8 and slow cooling after brazing is recommended to avoid subsequent machining problems.



The first stage in marking out the crankshaft after brazing. This is done to establish the centres of both the main shaft and the crank pin which need to be marked at both ends of the crankshaft fabrication.



ENGINE DETAILS: COMPRESSION RATIO 5:1
9 CYLINDERS. TOTAL CAPACITY 64cc
USE CASTROL R40 OIL AND 100 OCTANE FUEL
TAPPET CLEARANCE .010"-.012"
FIRING ORDER. 1.3.5.7.9.2.4.6.8.

MIXTURE IS FED BY GRAVITY INTO CRANKCASE VIA TAP AND 5/32" DIA. COPPER PIPE.

PROPELLER SIZE 22"/24" DIA.

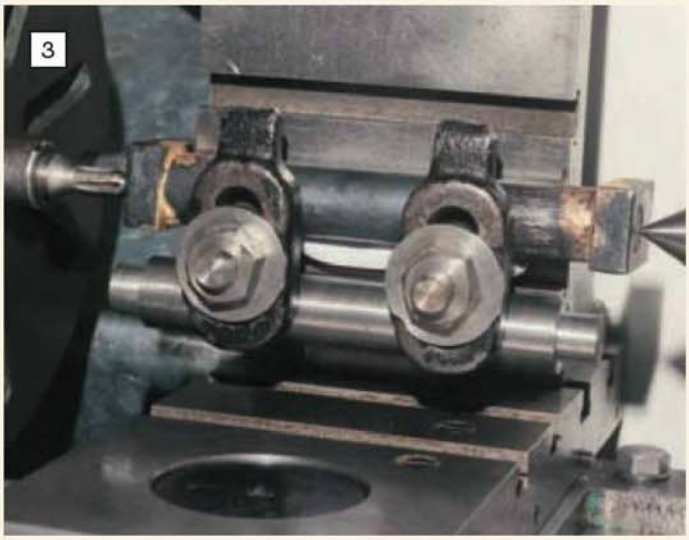
ASSEMBLY OF CAMS
FACING FRONT OF ENGINE PLACE CAMS (ITEM No 22) ON COLLAR (ITEM 23) IN THE FOLLOWING ORDER:-
A. E. F. I. B. D. G. H. C.

GEARS: S.H. MUFFETT LTD.
14/18 WOODBRIDGE PARK ROAD
TUNBRIDGE WELLS. KENT. TN4 9NH.
ENGLAND.

BEARINGS: 5/8 KLNJ. UNIVERSAL BEARINGS LTD.
103/115 HAMMERSMITH GROVE
LONDON. W.6. ENGLAND.

THE "GNOME" ROTARY AERO ENGINE
1913

Ken 7 1977



Above: picking up the marked centres on the lathe. The crankshaft is firmly clamped to the vertical slide.

Above right: drilling the centres. In this photo, the main shaft has been drilled and the lathe cross-slide moved over to allow drilling of the crank pin.

Right: the first stage of turning the crank pin; note the masking tape wrapped around both the main shaft and the jacking piece to secure the latter during machining.

across throwpiece, crankpin end of main shaft, and crankpin end. With both ends complete, the shaft is rotated 90deg. and a further line struck at the same height gauge setting to locate the main shaft centres.

The main shaft is then set up on a bracket or vertical slide as shown in **photo 3**, with the main shaft centres lined up with the lathe centres, and the crankpin centres also at centre height.

When set up, check that the feedscrew backlash is taken up in the direction of the crankpin centre, as the crank shaft throw is set by the cross-slide feedscrew. Lock the cross- and vertical slides and drill the main centre from the headstock.

Next, drill the crankpin centre as shown in **photo 4**. Without disturbing the set up on the vertical slide, unlock the cross-slide, advance it 0.500in., re-lock and drill the crankpin centre.

Still without disturbing the set-up on the vertical slide (or angle plate), remove the slide as a whole and rotate it through 180deg. to present the rear throwpiece to the headstock. Re-set between lathe centres as before, and drill the main shaft and crankpin centres as for the other end, using the cross-slide feed index to give the correct throw. This method ensures that the axes of both sets of centres are accurately aligned to give a true shaft.

The next step is to turn the crankpin and face the front of the crank web, as shown in **photo 5**. Note that a jacking piece is set up between the crankpin centres and secured by tape as a safety precaution. When the main diameter of the pin has been turned, the method of forming the taper on its end must be considered.

This is done by setting over the top-slide and cutting the taper by using the top-slide feed towards the headstock. The main difficulty here is that with the existing set up, the top-slide feed handle fouls the tailstock, and also later a matching taper will be required in the crankshaft front web. Overcoming these problems requires two of the additions for your workshop equipment, so it is now time to pause and set the crankshaft aside for a while.

●*To be continued.*

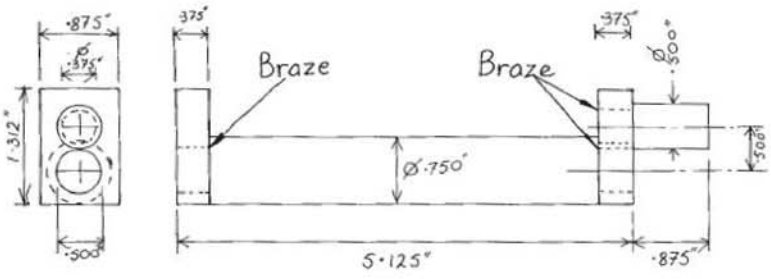
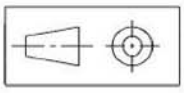


Fig 1. Main crankshaft blank.
Mat: Shaft and crankpin EN 8.
Web and throwpiece M. Steel.



FIRST ANGLE PROJECTION

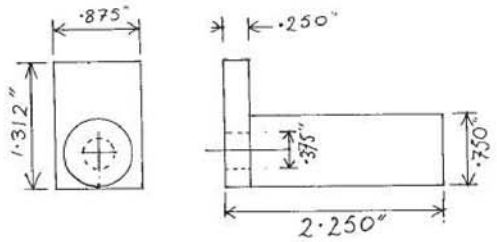
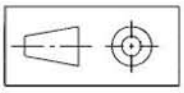


Fig 2. Crankshaft front section blank.
Mat. Shaft EN8 Web M. Steel.



FIRST ANGLE PROJECTION

Supplier

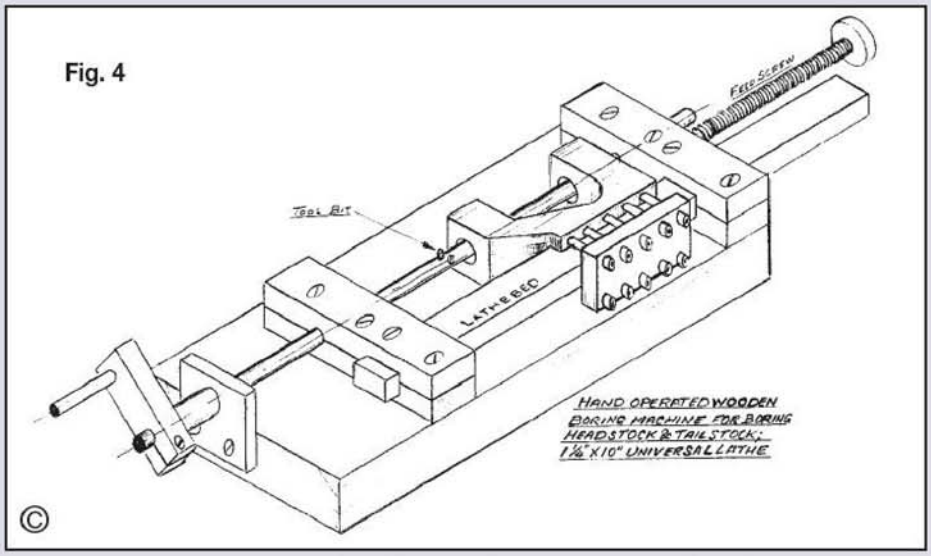
Castings and drawings for this and other engines are available from Les Chenery, 18 Orchard Grove, Edgware, Middlesex HA8 5BH; (tel: 020-895-13590).

BUILDING A MINIATURE UNIVERSAL LATHE

Colin Barter

continues his decription of the design and construction of this intriguing small but versatile lathe developed over some 40 years.

●*Part II continued from page 432 (M.E. 4159, 2001)*



With the headstock and tailstock fabrication well under way, the next stage was to bore their spindles, a job for which I made and used a wooden boring machine! My fig 4 shows the construction of this equipment. The base was cut from a thick piece of well-seasoned pine, planed very flat on its top surface; the guide/support blocks for the bed and boring bar were made of beech. A block of wood fixed to the underside of the pine baseboard served to hold the machine in the bench vice.

The guide blocks were carefully planed true and equal in thickness, and held in the correct relationship with one another and to the baseboard by the use of close fitting wood screws. These guide blocks were drilled for the boring bar and carefully filed and scraped to ensure that when the bar was assembled in the blocks it was not distorted and could be turned freely without shake.

The slots for the bed were then cut, dividers being used to measure from the boring bar to the face of each slot to ensure that the centre height was correct and that the bed was parallel to the boring bar. The boring bar was provided with a handle and was fixed so that it could be rotated freely but without endwise movement. By means of a piece of screwed studding, the bed with either the headstock or tailstock attached could be pushed past the boring tool fixed into the boring bar. The cutting tool was filed to shape from 1/16in. dia. silver-steel, hardened and tempered, then finished with a fine oilstone slip.

All this work took time as the fit in the wooden support blocks of both the bed and the boring bar had to be devoid of any slackness while not causing distortion to either component. With the headstock or tailstock mounted on the bed in their final orientation, the distance between the boring bar and the bed could not change when boring the holes, so both the headstock and tailstock holes would be in true alignment with the bed and with one another.

The boring of these two items was now undertaken. I had intended to have 1/2in. dia. bearings for the headstock and 5/16in. dia. runners and centres for the tailstock. Boring proved more difficult than I had anticipated. It was very slow, as turning the boring bar and feeding the work past the tool was by hand. With a 1/4in. dia. boring bar, heavy cuts were impossible. I had not anticipated the problem caused by swarf blocking the clearance between the boring bar and the tailstock bore. By the time satisfactory bores had been achieved in both components, the headstock bore was 0.531in. dia. and that in the tailstock was 0.343in. diameter. Silver-steel rods of these diameters were close fits in their respective bores, that in the headstock being a stiff push fit.

A temporary mandrel was made up using a length of 0.531in. dia. silver-steel. A wooden pulley, roughed out on the drilling machine, was fitted at the outer end and a block of beech, cut roughly circular, was fitted at the work end. Two steel washers served as thrust washers. By the time this had been fitted and the sharp edges removed from the bores, this temporary mandrel rotated freely but without slackness.

Simple turning

I now had a very basic lathe, complete with all the essential parts. It was mounted on the table of the drilling machine and a belt made up to fit between the motor and the mandrel. Two small tools were made up from scraps of gauge plate and turning commenced.

The block for a wooden chuck was quickly turned up, faced off and a shallow groove turned for the belt. The mandrel was reversed in the headstock and the wooden pulley turned true and two grooves turned in it for a round leather belt. The ease with which this turning was completed was very encouraging.

My next requiurement was for a pointed centre or runner for the tailstock. A point was filed on a piece of 0.343in. dia. silver-steel and a handle fitted to the outer end. The tool slide was set to an angle of 30deg. to the lathe centre line and the point was turned by hand using the tailstock as a lathe headstock. It was a bit rough but ran true, final finishing was by stoning in the drilling machine, and then it was hardened and tempered. A clamping cotter was made up using a suitable item from the 'come-in-handy-one-day-box'.

With this centre in place I used it as a thrust point on which the headstock mandrel could bear. Then, by trial and error, the tool slide was set at 90deg. to the lathe axis and the face of the wooden chuck was turned flat, at the same time truing up the end of the mandrel. By reversing the wooden chuck on the mandrel it was used as a gauge to true up the outer faces of the headstock bearings by filing and scraping. With this complete and the mandrel reassembled I felt confident that it would run true without any axial oscillations.

Turning the permanent mandrel

The headstock looked crude but in fact had the essential requirements of close fitting bearings: a truly cylindrical mandrel with minimum axial movement and adequate stiffness. I could carry on and turn some of the small items required to upgrade the lathe, or I could turn the permanent mandrel. The permanent mandrel was required and there was little point in turning the small items if this could not be done. It had to be done and done while the bearings were a good close fit. At this stage the adjusting saw cuts had not been cut.

However, before turning the mandrel, something better than the wooden pulley drive had to be contrived in order to get a better range of speeds with less belt slip. A pair of small, three-step Picador pulleys were purchased, one for the lathe and the other for the drilling machine motor. These had a maximum diameter of 2 1/4in., were grooved for round belts and bored 1/2in. diameter.

The mandrel pulley bore was easily opened out to 0.531in. dia. by turning one end of the temporary mandrel to 1/2in. dia. and a close fit in the pulley. The bore was opened out to 0.531in. dia. over half its length. Then, by reversing the mandrel in the headstock, the pulley was mounted by the enlarged bore and the remainder of the bore opened out. The face of the pulley which would run against the headstock bearing was turned flat and a 1/2in. precision steel washer was glued to the face of the headstock with epoxy resin adhesive to serve as a thrust face. With a better drive now available, turning of the permanent mandrel could be undertaken.

This was turned between centres and the first operation was to machine a centre point on one end of the temporary mandrel. A piece of silver- ▶

Above: the right-hand drawer of the two-drawer cabinet contains collets, draw tubes and two tailstock runners together with three collet blanks and a headstock centre.

Right: driver/faceplate and chucks in their fitted drawer.

steel 7/8in. dia. by 4 1/2in. long was carefully centre drilled in each end face as truly central as was possible. Drive was by the use of a wooden carrier and a wood screw in the wooden chuck. Turning proved to be more difficult than anticipated due to the limited driving capacity of a 3/16in. dia. round leather belt on a small diameter pulley, chatter, and the use of a carbon steel tool at rather high speed. Only small cuts could be taken, and by the time I had achieved the required finish on the mandrel it was about 0.0015in. undersize.

A second mandrel was machined, the final finish being achieved by the use of a lap. This was an excellent fit in the bearings. The mandrel nose was left 7/8in. dia. and the rear face was finished very smooth and flat to serve as a thrust face. With the mandrel mounted in the headstock and the Picador pulley in place, the lathe was looking quite respectable. The final operation was turning the mandrel nose true and parallel.

Tailstock work

With the fitting of the permanent mandrel, the need arose to provide means for drilling from the tailstock. There was only the centre pointed runner for the tailstock and an extra runner was required to hold a drill chuck or guide the tail ends of drills. A short piece of 3/8in. dia. brass rod was secured in the wooden chuck and a deep dimple turned in the end sufficient to support the tail of a drill. It was reversed in the chuck and turned down to fit the tailstock bore. This was used to support the tail of a 1/4in. dia. drill in the next operation. A piece of 11/32in. dia. silver-steel for a drill runner was mounted in the wooden chuck. The free end was held in a temporary steady and a dimple turned in the face. A 1/4in. dia. drill was placed between these two dimples and by holding the drill with a small tap wrench and pushing the tailstock towards the headstock, a 1/4in. dia. hole was drilled 1in. deep in the end of the runner rod.

Somewhat apprehensive about this operation, I expected the hole to run off course, but it remained true and, moreover, it was a close fit on a piece of 1/4in. dia. silver-steel. The ends of the runner rod were cleaned up and finished with a chamfer.

The next operation was to provide a female centre in the opposite end of the pointed runner, an operation facilitated by the use of the drill runner with a 1/4in. dia. centre drill mounted in the drilled hole. The tail of an Eclipse pin chuck (supplied with three small collets) was stoned down in the drilling machine to fit the 1/4in. dia. hole in the drill runner. Similarly, the shaft of a small and inexpensive drill chuck was reduced to fit the drill runner. I now had tailstock drilling facilities for drills up to 1/4in. dia. and turning facilities were much improved.

Next stage

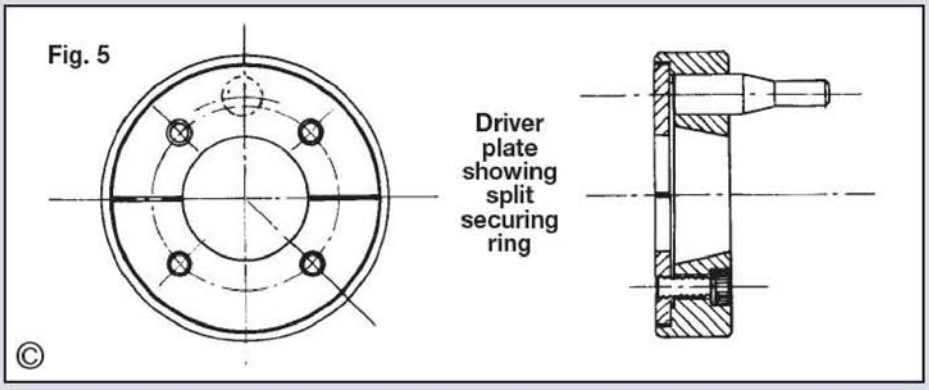
At this point I reappraised the situation. I had to make two small lubricators for the headstock, which was still in a semi-finished state. I also had to think seriously about work holding. I had given this matter little thought, but the successful completion of the lathe to its present state concentrated my thoughts on chucks and work holding. Since screw cutting was out of the question at this stage, a method of mounting a small chuck without using the usual male and female thread had to be devised.

Up to this time I had always considered collets to be a rather exotic or luxury facility but, as I thought about it, I realised that it was a simple and logical method of work holding with advantages over conventional chucks. I sketched out a collet system which I could make using the little lathe and the facilities to hand. I decided to make the collets to a form that I could achieve with confidence. Instead of the male threaded tail normally used, I decided to have a female thread thereby shortening the collet without reducing the mating surfaces in the headstock mandrel. I would not have a locating keyway as I had no means of fitting a key or cutting a keyway. The turning of the collets would not be difficult, the only problem was drilling a hole which would have to be dead true through the length of the mandrel. In any event, a hollow mandrel was a useful addition. If I could make the collets, the drawtube to go with them would present no difficulties as I proposed to build it up from separate pieces and silver-solder them together. The final form of the collet system as made is shown in **photo 4**.

Before I started on the collet system, I had to finish the headstock. The parts for the lubricators were made in brass and silver-soldered together. The headstock was dismantled, the holes for the lubricator and the bearing adjusting screws were drilled and tapped, then the saw cuts were made in the bearings by means of a small slitting saw held in the drilling machine. The outer surfaces of the headstock were finished to shape by filing then finally finished with abrasive paper. After washing all the parts in white spirit, the headstock was reassembled and mounted on the bed. I was well pleased with the final appearance.

Work on the collet system started by drilling the mandrel, first with a 3/16in. dia. drill as deep as possible. Then two spear-pointed drills were made in silver-steel, one 3/16in. dia. and the other 5/16in. diameter. So far the 3/16in. hole appeared to have run true so the hole through the bore was completed with the 3/16in. spear-point drill. Run out at the outer end appeared to be negligible.

This hole was then bored out to a close fit on the 5/16in. dia. drill for a depth of about one inch. The tail of the 5/16in. drill was supported in the tailstock by a brass bush. By holding the drill with a tap wrench it could be easily moved forwards or backwards for drilling or clearing the swarf. Drilling the larger diameter hole presented no difficulties except that it was slow due to my inability to apply sufficient pressure. In hindsight, this was probably as well because when the hole broke through it appeared to have negligible run-out. Much later, when I had a good dial test indicator, I measured the run-out at the tail end and found it to be about 0.0005 inch. I believe the care taken coupled with the low rate of feed were



The lathe in its original concept form with bed extension at left for holding in vice but before adding screwcutting facility or mounting on the two drawer cabinet. Not 100% accurate but as near as now can be acheived.

instrumental in achieving this good result.

With the hole complete, the taper seat for the collets was bored. I had no idea what angle I should use but a 30deg. included angle appeared satisfactory and the slide was set to this angle. I had no proper means of measuring the angle and, years later when I did, I found it to be just over 27 degrees.

With the taper bored I cleaned up the bore to a depth of about 1in. to ensure it was truly round and parallel. This removed about 0.0015in. of material to bring the bore to about 0.315in. diameter. I refrained from resetting the slide as I needed the angle for turning the collets. This I did between centres. Two collets were turned with their heads together. I had no centre for the bored mandrel so the temporary mandrel was refitted for this operation. The two collets were turned to size, complete with the tapers to match the taper in the permanent mandrel; they did because it was easy to use the permanent mandrel as a gauge.

A 2BA hole was tapped into the tail of one collet and, with the permanent mandrel reinstalled, this collet was held in place by means of a temporary, 2BA drawbar. The tail of the second collet was then drilled and bored out to 1/4in. x 40tpi tapping size. It was also relieved to 1/4in. dia. within the collet body. The tap was started but it was not possible to complete the tapping in the lathe. This was done in the vice taking every care to keep the tap straight. The collets were then reversed and the tail of the first collet bored out and tapped 1/4in. x 40 threads per inch. The collets were then sawn apart and each in turn was drilled and bored, one to 1/4in. dia. and the other to 5/16in. diameter. The end faces were also cleaned up. Finally, four saw cuts were made in each collet by means of a piercing saw, a slow process which produced a less than pretty result.

The next items were parts for the drawtube, which were now quickly produced and silver-soldered together. A knob was turned in mahogany and secured with Araldite. After final turning in place it was finished with three coats of varnish. The last job was to clean up the tail end of the mandrel and finish the bore with a 45deg. countersink to seat the drawtube. I now had two collets with a drawtube and a quick trial demonstrated that they held pieces of rod, if not dead true, certainly much better than I had dared to hope (within 0.0002in. TIR).

All the important work was by now complete and the next tasks were the making of various screws and tee-handled fittings to improve the general operation. With the collets available, this work was quickly completed.

Chucks and driver plate

The wooden chuck system was just adequate for smooth round bar and it worked quite well for thin or flat items that could be secured to the face of the chuck with woodscrews. Care had to be taken for it was very easy for work to move slightly during turning.

Investigating the chuck situation, I found a little 4-jaw Adept chuck to be available that was 2 1/4in. diameter. Also available was a 2in. dia. Burnerd 3-jaw or a little 3-jaw Unimat chuck. The Unimat chuck was the cheaper, so that was the one I bought, together with the little Adept chuck.

Having no screw cutting facility, I decided to mount the chucks by using a short taper and securing them by means of a plate fitting a groove in the mandrel nose. Some careful measurements and detailed layout work showed that the taper idea was viable, but the split plate securing method could only be used for the 4-jaw chuck and for a faceplate/driver plate which I intended to make. The design of the 3-jaw chuck necessitated the three holes for the mounting screws being on a pitch circle of approximately 0.713in. dia., the same as the mandrel nose. To mount the 3-jaw chuck would require the three screws to have special nuts to fit the groove plus three equi-spaced longitudinal semi-circular grooves in the mandrel nose. Alternatively, three rather odd looking screws could be made which did not look at all practical. Quite a number of years later I did make these odd screws and found them quite practical after all.

Turning the tapers in the back of the 4-jaw chuck would present no problem, but if I then turned the mandrel nose to a taper I could no longer use the wooden chuck system. All the parts for securing the chucks had to be made prior to any work on the mandrel nose. The way forward was to work to a planned procedure that would enable all the necessary machining operations to be carried out. All went to plan except the anticipated difficulty of getting the tapers to match exactly. At the end of this work I had a driver/faceplate and a 4-jaw chuck available. The 3-jaw chuck was left for later attention. **Photograph 5** shows the driver/faceplate and chucks in their fitted drawer. The driver faceplate is also shown on the drawing (**fig 5**).

Additions and improvements

The little lathe was now complete to my original concept. It had turned out better than expected and had chucks and collets. The design appeared sound, however during operation some deficiencies had become apparent as follows:

1: A lever feed tailstock device for drilling purposes was necessary.
2: Indexes were required for the feed screws in order that the depth of cut could be accurately gauged.
3: A screw-cutting facility would be very useful.

Lever feed tailstock

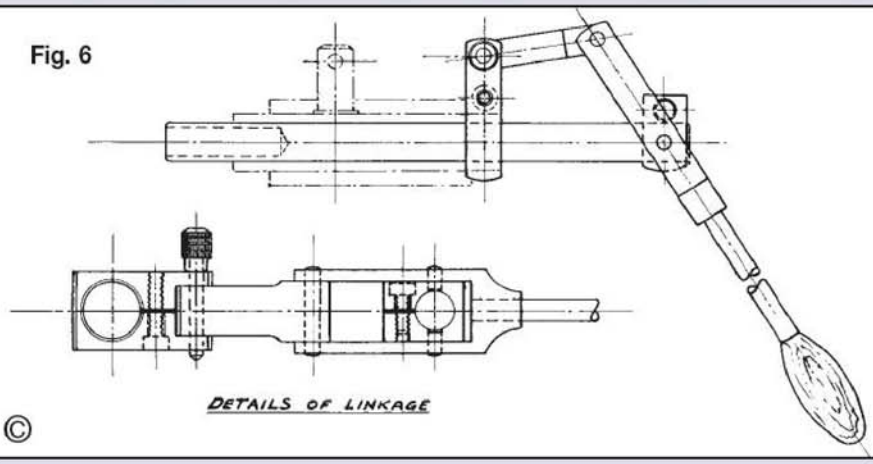
I wanted a neat and simple (easy to make) lever feed system for the tailstock. The final and best solution occurred to me as I was going to work one morning. Later, when I sketched it out, it appeared quite straightforward and easy to make. The only problem was machining a round and parallel surface on the outer end of the tailstock. In the event it proved easier than expected. The outer end of a long rod was supported by a brass bush in the tailstock bore and a little arm, with a cutting tool secured in it, was fitted to the rod. With the rod rotating, the tailstock was fed towards the cutting tool using the saddle and the outer end of the tailstock was machined cylindrical without any difficulty.

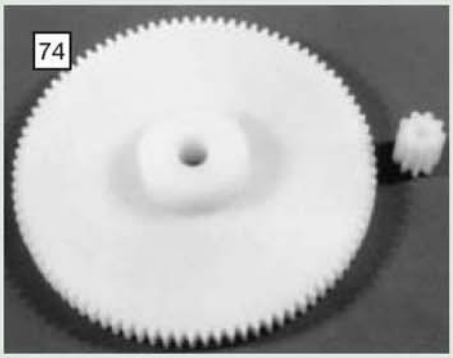
A second finishing cut was made and the job was done. An exact diameter was not required as the anchor block for the lever system was bored to suit, the tailstock being removed to allow it to be used as a gauge. **Figure 6** shows details of the lever system.

The making of the other parts proceeded smoothly as I now had the 4-jaw chuck to facilitate the machining. The only part requiring care was the marking out and drilling of the various hinge pins. When assembled, it moved smoothly and has proved to be very useful (**photo 6**).

●*To be continued.*

Fig. 6

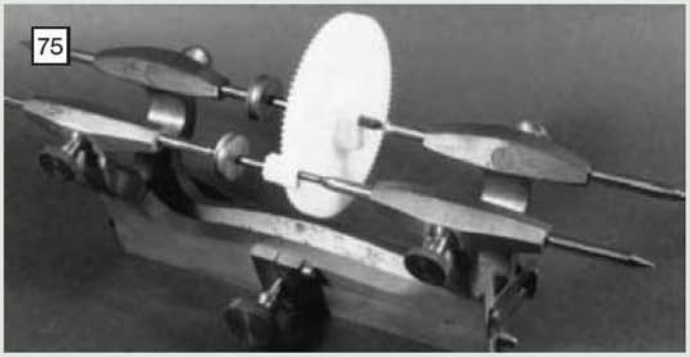




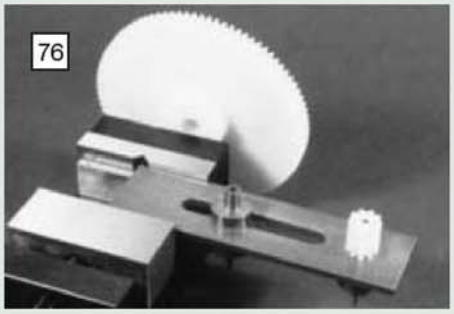
Left: Delrin gears as received from H.P.C.

Right: depthing the gears in a traditional depth tool.

Below: the Author's home-made depthing tool.



WEIGHT DRIVEN EGG TIMER



John Wilding FBHI

prepares the gears and other parts for this fascinating project.

●*Part VI continued from page (M.E. 4160, 2001)*

As explained in the first part, this project is aimed at the beginner and I have chosen to make use of standard and readily available commercial gears (**ref 1**). **Photograph 74** shows the gears as they are delivered. The larger one has a 6mm hole and a boss which is too thick, and will require to be reduced at a later stage. The pinion has a 3mm hole. The module is 0.8. The two gears are mounted on arbors which are pivoted in the plates. Clockmakers usually carry out a physical depthing test, using a special tool to establish the best and most smooth running engagement of gears; their centre-centre distance is then transferred to the clock plate for drilling the pivot holes. I shall show the tools used for this work but, because these gears are a standard product, I am able to inform the constructor that in both sets of gears (I have made two timers) the best centre distance of the gears is $1\frac{19}{32}$ inch.

In **photo 75** I illustrate the gears set up in a traditional clockmaker's depthing tool. The two gears have been mounted on tapered 'runners'. The other tool, shown in **photo 76**, is home-made and fully described in my book *Tools for the Clockmaker*. I also show the J. Malcolm Wild depthing tool based on my design but fitted with a fine adjustment (**photos 77** and **78**). The traditional tool is expensive but necessary if the gears are already mounted on their arbors as they are in traditional clockwork. My tool is more suitable when the wheels and pinions are unmounted as is the case here. However, if the constructor is willing to accept my findings, the distance stated will be found to give a good meshing. When using mine or the Wild tool it is necessary to make sleeves to fit over the upper seatings and of a suitable size to fit the inside of the wheel hole.

Marking out the plates

We start at the top. The arbor carrying the 'escape wheel' or crank pin is marked out at $1\frac{1}{2}$in. below the pendulum pivot point. That is the operating distance of the pallet arm. With the dividers set to $1\frac{19}{32}$in., an arc is scribed from the crank pin location down to give the position of the pivot hole for the larger gear and pulley (**photo 79**). The positions are carefully enlarged and the top hole can be drilled to No. 43 size and the lower one to No. 31 size. These dimensions will allow for broaching out to fit the pivots later on.

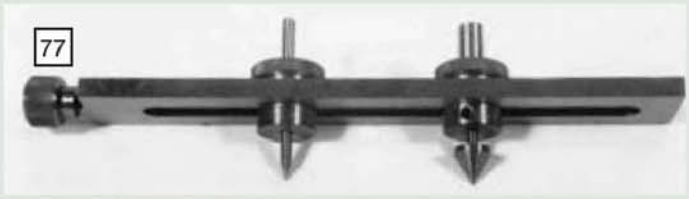
Arbors

These are dimensioned on the drawing fig 52 in the previous part (see p535, *M.E.* 4160, 2001). Care should be taken to obtain good bearing surfaces on the pivots as already explained. The lower $\frac{1}{4}$in. diameter arbor is reduced to 6mm for a short distance to fit the centre hole of this wheel.

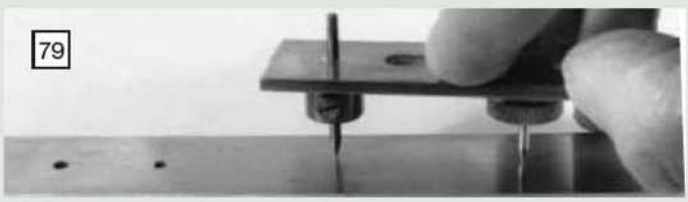
The pinion requires its centre hole to be enlarged to $\frac{5}{32}$ inch. In the absence of a range of collets, this pinion can be held in a home-made collet as shown in **photo 80**. The procedure is to chuck a short length of $\frac{1}{2}$in. brass in the 3-jaw chuck. This is drilled or bored $\frac{3}{8}$in. and, after marking its location against one of the chuck jaws, it is removed from the lathe and slit with a hacksaw. The pinion is inserted in the collet and the assembly returned to the 3-jaw chuck in the same position for drilling $\frac{5}{32}$ inch. As the pinion has nine leaves it is possible to hold it in the 3-jaw chuck with each jaw between two adjacent teeth. However, I was unhappy about this and felt that the Delrin was too soft to risk that procedure.

I did not find it necessary to use any form of adhesive for securing either the wheel or the pinion to their arbors, I just pushed them on and they were quite secure. However, I checked with the manufacturers and if it is felt that an adhesive is required then they recommend Loctite 601. **Photograph 81** shows the pinion mounted on its arbor.

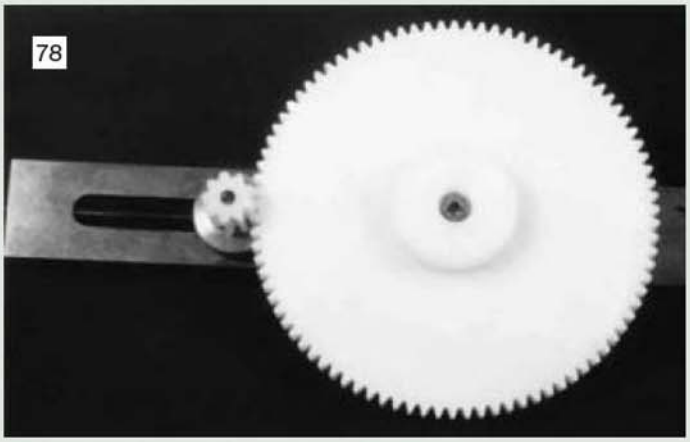
Figure 82 shows the wheel and pinion from which it will be seen that five equidistant $\frac{1}{4}$in. holes are required on a $\frac{7}{8}$in. radius in the large wheel. The circle can be marked out with a pair of compasses as shown in **photo 83**. The spacing is not critical and the positions of the holes can be stepped out with the compasses set to 1in. radius.



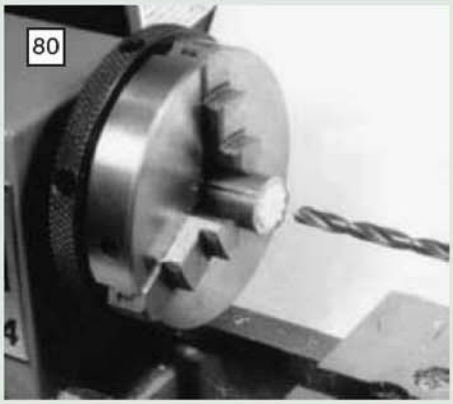
The J. M. Wild depthing tool.



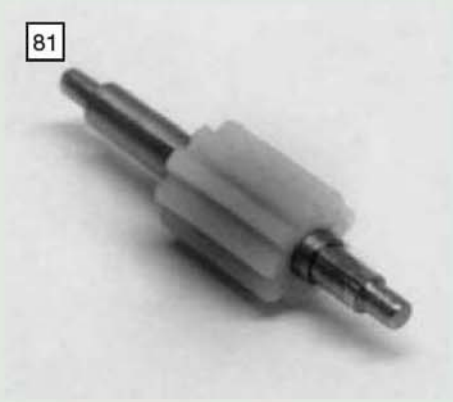
Using the home-made depthing tool to mark out a pivot hole.



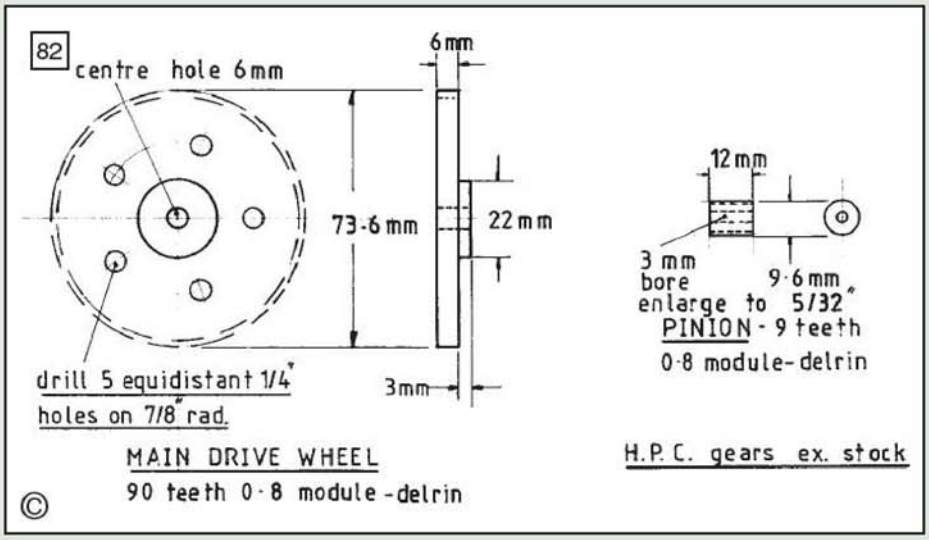
The wheel and pinion being meshed on the Wild tool.

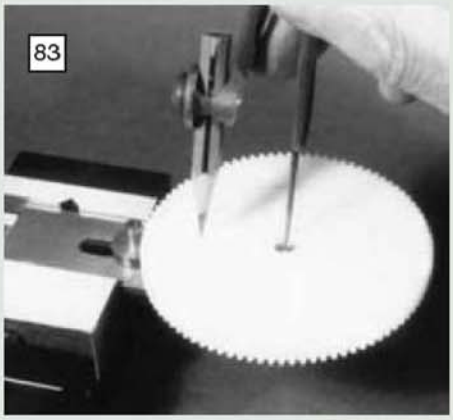


Using a home-made split collet to hold the pinion accurately without damaging the teeth.

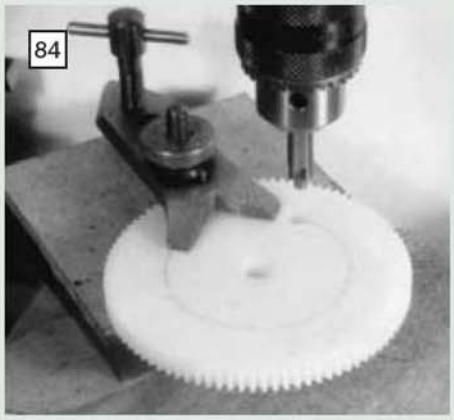


The pinion mounted on its arbor.





Marking out the 7/8in. radius circle.



Starting the drilling with a pin drill.

When drilling largish holes in soft material, better results will be obtained if a pin drill is used initially (**photo 84**). A small hole to suit the size of the pilot pin is drilled first, followed by the pin drill until the large diameter, in this case 1/4in., has been formed. The pin drill is then exchanged for the normal 1/4in. twist drill to complete the hole.

The final operation on this wheel is to reduce the thickness of the boss. I did this with the wheel mounted on its arbor in the lathe (**photo 85**). I include two more illustrations of the pulley wheel arbor; **photo 86** shows the front dimensions being machined in the lathe and after that the work was laid across the plates for marking out the location of the back pivot shoulder (**photo 87**).

Crank pin

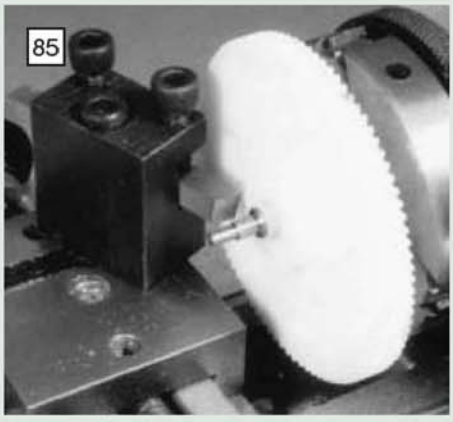
This item is dimensioned on the drawing **fig 88**. The 3/8in. stock is faced in the lathe then removed and the pin hole marked out at 1/8in. radius. This hole is drilled No. 53 size as demonstrated in **photo 89**. The stock is returned to the lathe for drilling the centre hole No. 36 size and parting off as shown in **photo 90**. Note the narrowness of the parting tool, it measures less than 1/16in. and cut straight through this stock without a murmur.

On the drawing, this component is shown fitted with a 10BA screw for clamping it to the extension of the arbor. But on the prototype I provided the extension on the arbor with a slight taper produced by using a fine needle file and lightly broached the centre hole of the crank and simply pushed it on. It was a tight push fit and worked beautifully. To remove it I had to use lifting levers (**ref 2**). Because it worked so well, I have used the same method again on the second timer.

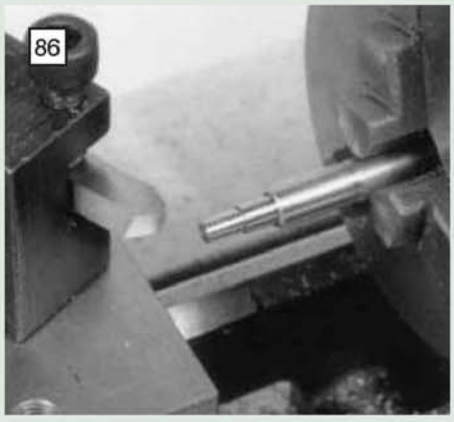
Two-pin suspended lantern pinion

This is also dimensioned on the drawing, fig 88. It is machined from 1/2in. brass rod. Turn the 3/8in. diameter first and drill the 1/8in. hole for some 1/4in. distance, part off and reverse in the chuck for facing the front to length. Bring up the tailstock with a centre in place and gently bump the work to form a centre dot.

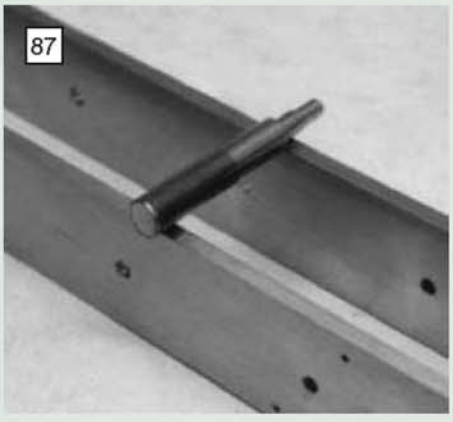
Remove the work from the lathe and, with the dividers set to 3/32in., mark out the locations of the pin holes 3/16in. apart (**photo 91**). The method of supporting the work for drilling the No. 55 hole is shown in **photo 92**. The actual theoretical distance apart of the two pins is 0.196in. which is just over 3/16 inch. When laying out this distance make sure ▶



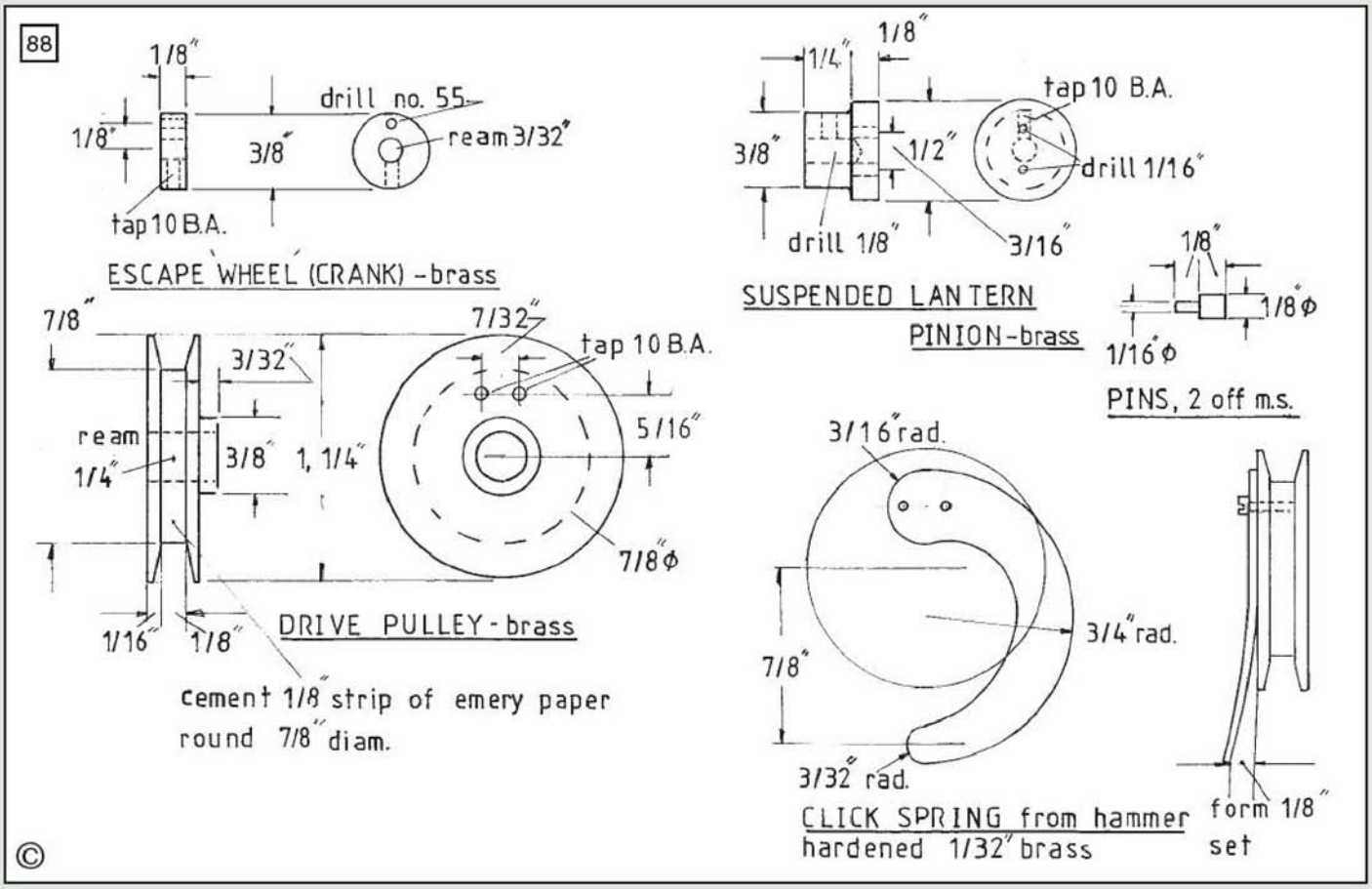
Reducing the boss with the wheel mounted on its arbor.



Reducing the main wheel and pulley arbor to fit the centre hole of the wheel.



Marking the position of the shoulder of the back pivot on the main arbor.



you are just over rather than under 3/16 inch.

The pins are also depicted on the same drawing and are straightforward turning from 1/8in. diameter mild steel. They can be pressed in using the jack screw of the holding clamp **photo 93**. The crank and the suspended lantern pinion fitted to their arbors are shown in **photo 94**.

Drive pulley

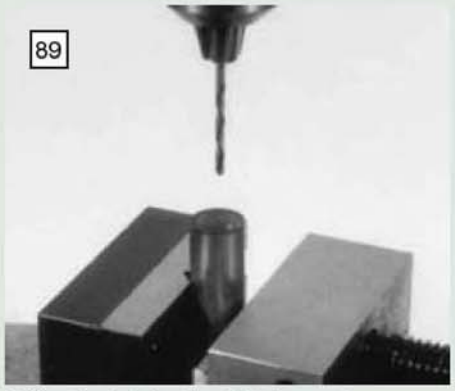
This item is also shown on the drawing fig 88. It can be seen that it carries a spring, the tip of which locates in the mouths of the holes drilled in the main wheel. This of course enables the weight to be wound without moving the main wheel.

Those with a larger lathe than the Unimat 4 could machine this component from the solid as in fact I did on the prototype timer. The 1/8in. wide groove was formed using the parting tool, but in order to offer another option I show how to fabricate it, and give a separate drawing of this method (**fig 95**).

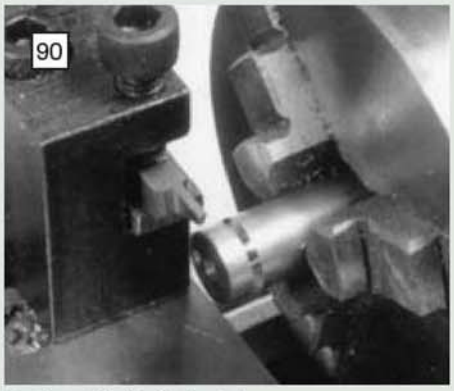
The two flanges are marked out on 1/16in. brass and cut out with the piercing saw. A 3/16 in. centre hole is drilled in each piece size . The two flanges are then mounted on a 3/16in. threaded mandrel for machining the circumference to size, (**photo 96**). This mandrel has a body diameter of 1/2in. and is one of the items which you have to make for yourself. I have chosen 3/16in. because this is a common size for the centre holes of wheels and so this mandrel can be used for mounting wheel blanks when cutting the teeth. The thread is 2BA. The centre of the drive pulley is cut out from the waste of your 1 x 1/8in. plates and is mounted on the same threaded mandrel for turning to size.

All three parts are held together with three equi-spaced 8BA countersink head steel screws on an 11/32 in. radius. A circle of this radius is marked out on one of the flanges. A simple way of indexing a lathe for three positions is to make use of the chuck jaws by placing a suitable spacer on the lathe bed and arranging for one of the chuck jaws to rest on this as demonstrated in **photo 97**. On the Unimat 4 lathe this can be 1 19/32in. in length in order for the lower side of the chuck jaw to rest flat on the top of the spacer. The spacer is used under each jaw in turn and a lathe tool can be brought up to cross the circle already marked out.

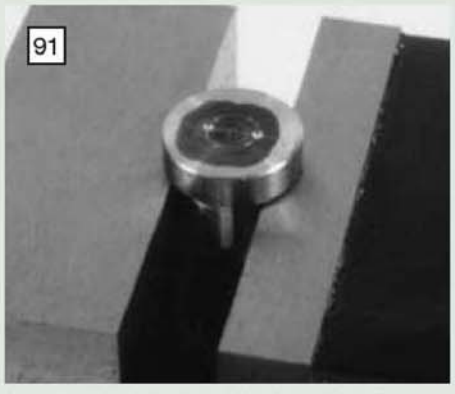
With the positions of the 8BA holes located, the three parts of the pulley can be mounted on the threaded mandrel and set up as demonstrated in **photo 98** for drilling No. 50 size right through the



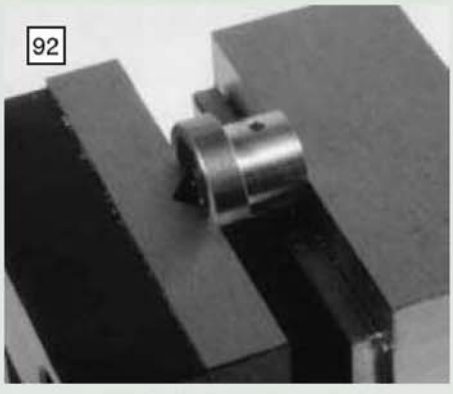
Drilling the hole for the pin in the crank.



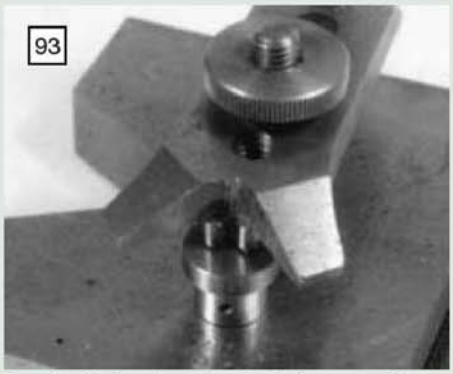
Parting off in the Unimat 4.



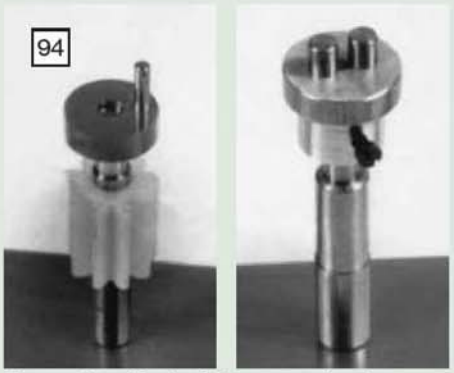
Marking out the positions for the pins on the 2-pin lantern pinion.



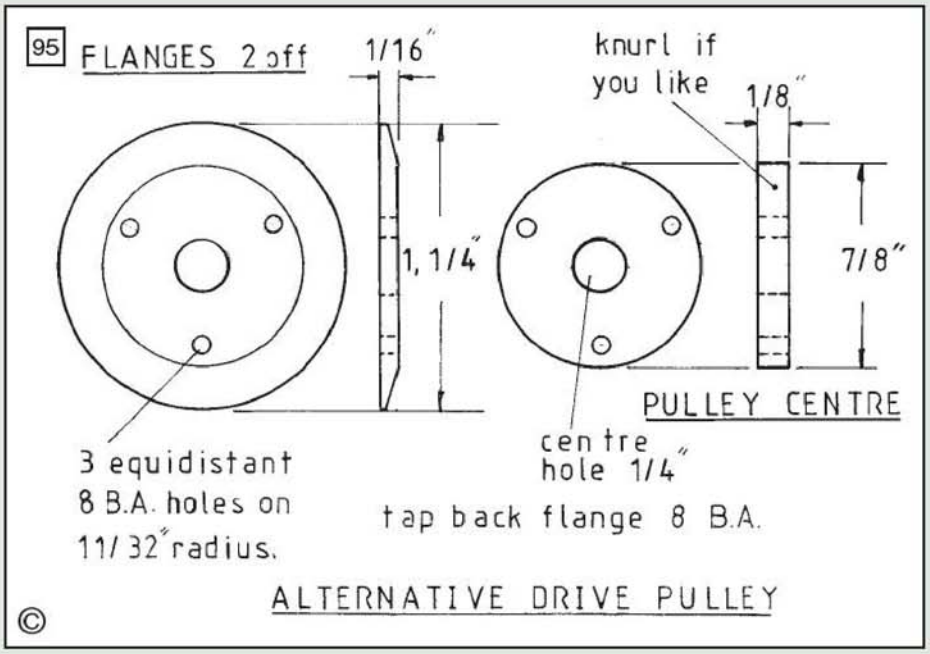
Method of supporting the work for drilling the 10BA tapping hole.



Pressing in the pins using the jack screw of the holding clamp.



The crank and 2-pin pinion mounted on the extensions of their respective arbors.



assembly. The holes in the front flange and the pulley centre are then enlarged to No. 43 size and those in the flange are countersunk. After tapping the back flange holes 8BA, the assembly can be secured together with three screws and remounted on the mandrel for machining the taper on the inner edges of the flanges (**photo 99**).

To do this, the top slide is set over 70deg.; the markings on the cross-slide will not register in this situation and you will need to use a protractor in order to make the setting. You will see that a parting tool is being used to carry out the machining. The extreme edges of the flanges can be rounded with a fine needle file. The work is now removed from the threaded mandrel and held in the 3-jaw chuck with its jaws reversed in order to reduce the excess length of the 8BA screws as shown in **photo 100** and at the same time drill out the centre hole letter 'D' size prior to finishing with the 1/4in. diameter reamer. A view of the dismantled pulley is given in **photo 101**.

The only remaining part of the pulley assembly is the click spring which I will cover in the next part.

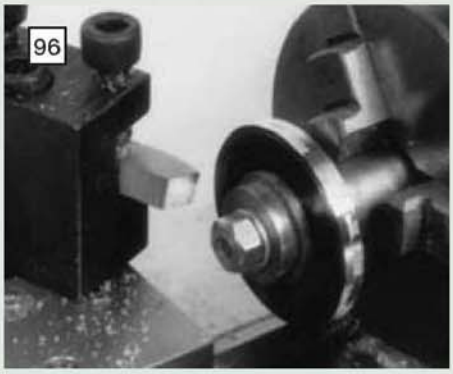
In order to prevent the driving cord from slipping on the pulley centre, I cut a 1/8in. strip of emery paper, I actually used 'production paper' and glued it on to the centre with Araldite. If you have knurled the centre, this of course will not be necessary.

References

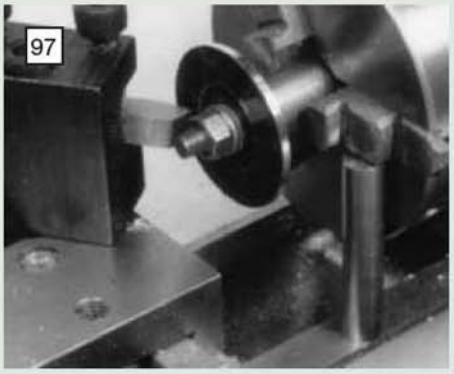
1: Hinchliffe Precision Components Ltd., Storforth Lane Trading Estate, Chesterfield S41 0QZ.

2: The construction of these is covered in my book *Tools for the Clockmaker*.

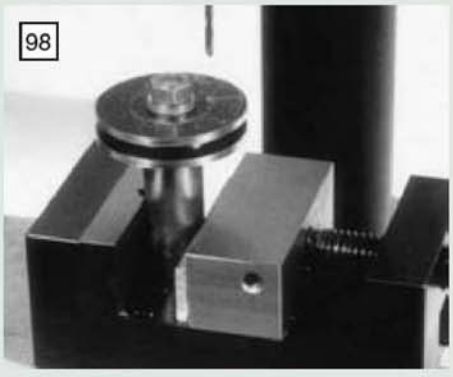
●*To be continued.*



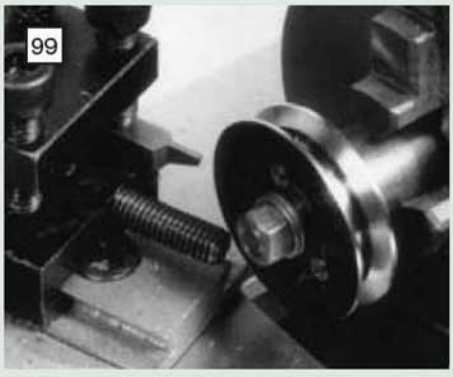
The two pulley flanges mounted on a threaded mandrel for machining the periphery.



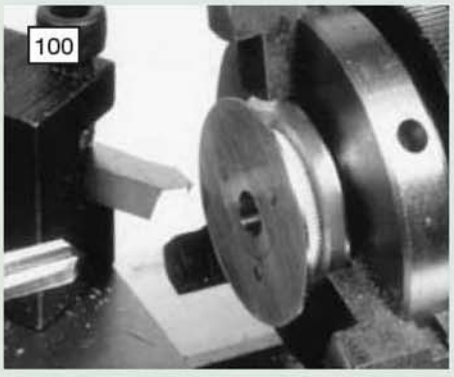
Using the chuck jaws to index three positions.



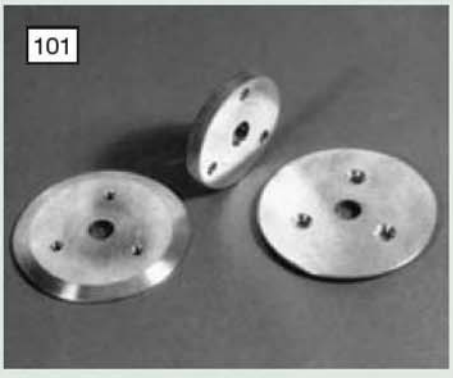
Set-up for drilling the pulley assembly.



Machining the bevel edges on the pulley flanges.



Reducing the excess length of the 8BA screws and reaming the centre hole 1/4in diameter.



The finished pulley components.

THE EFFECT OF SUPERHEAT ON CYLINDER CONDENSATION

W. B. Hall F.R.Eng., F.I.Mech.E

describes and analyses the results from tests on a small steam engine.

Perhaps I should start by stating how much effect cylinder condensation has on the performance of small steam engines. I have found in my experiments that an unsuperheated engine consumes two or three times as much steam as would be expected from the dimensions of the cylinders and the engine speed. Condensation can be reduced by superheating the steam, and the steam consumption will then be halved with little or no effect on power output. That is fine, but we don't know just how this works, how much superheat to apply, and how this depends upon things like steam pressure, engine speed and cut-off.

It is not generally known just how the condensation process operates. For example, a 5in. gauge engine can consume something like 25-30lb. of steam per hour, which is equivalent to a heat supply of about 10kW. If half of the steam is condensed, we have to explain where around 5kW of heat disappears! Certainly it cannot be lost by convection and radiation from the outside of the cylinders, even if they are unlagged. As an illustration of why this is impossible, a 2in. dia. x 6in. long cylinder would need to be at about 800deg. C to get rid of this amount of heat.

In fact, a plausible answer to this conundrum has been around for more than a century. The idea is that during admission (TDC to cut-off) steam is condensed and forms a film on the cooler walls of the cylinder, and the latent heat of condensation heats up the cylinder wall: as expansion proceeds after cut-off the steam saturation temperature falls to a point when it is cooler than the cylinder wall, whereupon condensation will cease. For the rest of the expansion and for the exhaust stroke, the heat deposited in the cylinder is extracted and used to evaporate the water film left on the surface. Some of this evaporation can contribute a little work by raising the steam pressure during expansion, but by far the greater part is a hindrance and may increase backpressure during the exhaust stroke.

Further study shows that this process of heat conduction into and out of the cylinder only affects a thin layer beneath the surface — something like a millimetre or two (0.040-080in.), so that its effect is not felt in the bulk of the cylinder material. The nature of this transient conduction process will be illustrated below, when the experimental results are outlined. Much depends upon the temperature of the bulk of the cylinder, for if this is above the inlet steam temperature condensation will be eliminated. However, when using unsuperheated steam, the bulk cylinder temperature lies somewhere between the inlet steam temperature and the exhaust steam temperature, and condensation occurs. So the answer to the above conundrum is that the latent heat of the condensing steam is temporarily side tracked into the cylinder wall, and returned to the steam too late to be of any use! So we are left with much the same work output and a considerable increase in steam consumption; hence a drastically reduced efficiency.

The single cylinder 50mm bore x 32mm stroke vertical engine used to obtain the results shown in the accompanying text.

When these ideas were first introduced they caused great controversy. Unambiguous experimental support was difficult to obtain with the techniques then available, and indeed the controversy was never fully resolved before the introduction of superheat partially removed the problem. It is also fair to state that many supporters of superheat believed its merit lay in improved thermodynamic cycle efficiency rather than reduced condensation; in fact the improvement in performance is much too big to be accounted for by increased cycle efficiency.

An experimental approach

It was realised in the late 1800s that measurements of the temperature fluctuation at the surface of the cylinder wall would greatly help in understanding the process. Callendar and Nicolson in a paper dated 1897 (**ref 1**) reported measurements of temperature in the cylinder cover at an engine speed of 100rpm. They used thermocouples in holes drilled from the outside to within 0.01in. of the inner surface, and the output of these was measured on a galvanometer that was connected via a contact-maker at various positions of the piston in its stroke. It was a remarkable achievement, but the number of readings that could be taken in one revolution was limited. Since the aim is to determine the temperature of the surface exposed to steam, some method had to be devised to extrapolate from temperatures measured at points below the surface. This involved using a standard theoretical solution for transient conduction; this is not strictly correct, but is probably a reasonably good approximation.

Using a computer and modern instruments it is possible to overcome the limitations faced by Callendar and Nicolson. Firstly it is possible to measure the surface temperature directly using a very fine thermocouple welded to the inner surface of the cylinder cover. Secondly the signal from the thermocouple can be read very quickly using a computer; in fact, I have been able to take measurements every 2deg. of rotation on an engine running at 1000rpm — this means reading and storing 3000 measurements per second.

For small engines running at high speed the temperature gradient near the surface of the cylinder is steep, and it is essential to measure the temperature *at the surface*. The technique of using a small thermocouple bead and attaching this to the surface is not satisfactory because of the difficulty of ensuring that the whole of the bead is at cylinder surface temperature: there is also the possibility that the presence of the bead may affect heat transfer at just the point where temperature is to be measured. However, a technique I have used to measure the surface temperature of nuclear reactor fuel elements seemed appropriate. This is to spot weld the thermocouple wires to the surface a small distance (a few millimetres) apart, using fine thermocouple wires (~0.15mm dia.). The intervening material does not affect the thermocouple output, and the fine wires lying close to the surface cause minimal interference to the surface temperature.

Given the surface temperature variation around one cycle it is then possible to deduce the heat flow into and out of the cylinder surface. This is possible because the temperature wave travels only a short distance into the cylinder wall. Such information is crucial to an understanding of the condensation process, and may enable us to discover just how much superheat is required to prevent condensation.

Apparatus

The engine used was a single cylinder vertical with a 50mm bore and 32mm stroke (**fig 1**). It has separate Corliss type inlet and exhaust valves, the inlet valves being trip operated so that cut-off can be regulated without affecting exhaust and compression events. The supporting equipment is very much as described in an earlier paper (**ref 2**): thus the bulk of the measurements, for example steam flow rate, temperatures, speed, brake load and indicator diagram are handled by a computer. In these experiments measurements were also made of the surface temperature of a stainless steel plug (**fig 2**) inserted in the top cover

The temperatures were recorded every 2deg. of rotation for one revolution. The voltage generated by the thermocouple was amplified and fed into an analogue-to-digital converter, and thence into the computer memory.

The computer programme controlling the experiment recorded the following data:

- Engine speed
- Indicator diagram (i.e cylinder pressure every 2deg. of rotation, for 1 rev.)
- Cover surface temperature (every 2deg. of rotation, for 1 rev.)
- Steam flow rate
- Steam inlet temperature

At the conclusion of a test the programme then automatically computed the following:

- Mean Effective Pressure
- Indicated Efficiency
- Steam Ratio (Ratio of steam actually used to that calculated from cylinder dimensions and engine speed)
- Superheat
- Saturation temperature of steam for each point on indicator diagram

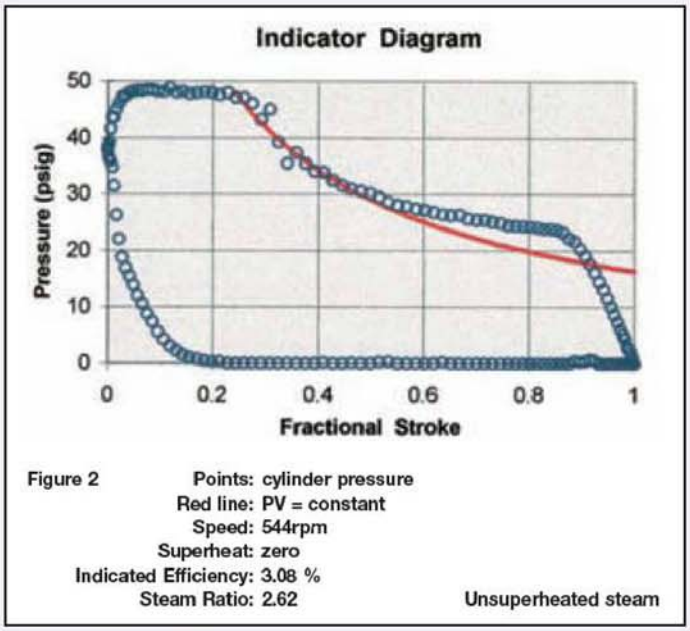


Figure 2 Points: cylinder pressure
Red line: PV = constant
Speed: 544rpm
Superheat: zero
Indicated Efficiency: 3.08 %
Steam Ratio: 2.62
Unsuperheated steam

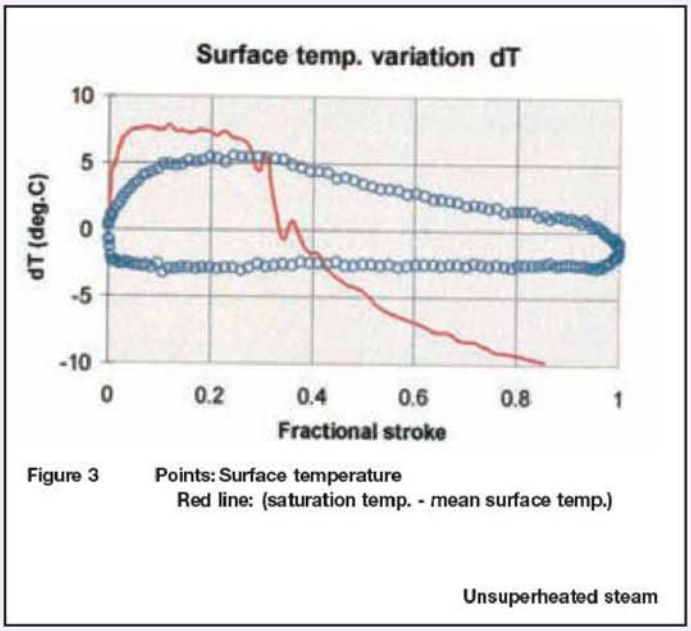


Figure 3 Points: Surface temperature
Red line: (saturation temp. - mean surface temp.)
Unsuperheated steam

Experimental Data

The tests were at nominally constant speed and constant steam chest pressure. The superheat was gradually increased over a period of about 2 hours, during which time 40 sets of data were obtained. The brake (a motor car disc brake with home made pads!) together with the boiler gas supply were used to control speed and steam pressure. In all the tests cylinder oil was fed into the steam pipe leading to the steam chest. (There appears to be a slight reduction in condensation when oil is supplied in the case of unsuperheated steam; the oil supply was of course always maintained when using superheated steam). A test using air rather than steam (Test No. 40) is also included, since it has a bearing on cylinder and valve leakage

Let us look firstly at the records of temperature and pressure for one revolution of the engine. These contain all the information needed to show how much condensation is occurring. Two sets of data, one using unsuperheated steam (**figs 2** and **3**) and the other superheated steam (**figs 4** and **5**) are presented.

Unsuperheated steam tests

The surface temperature loop in fig 3 is the measured surface temperature minus the mean of all the set of surface temperatures. The temperature variation (7 or 8deg. C) may not seem very large but, as will be demonstrated later, it represents a considerable heat input to and extraction from the cylinder cover as a result of condensation and evaporation. Such condensation occurs when the saturation temperature of the steam exceeds the surface temperature of the cover. The difference between the saturation temperature and the *mean* surface temperature is shown as a continuous red line. (The *saturation temperature* of the steam is merely the boiling point of water corresponding to steam at a given pressure. The computer is programmed to calculate the saturation temperature at each of the pressures recorded on the indicator diagram, fig 2) Not surprisingly this loop bears a resemblance to the indicator diagram. Notice that the surface temperature rises during the period when the saturation temperature exceeds the surface temperature, and then declines. This indicates that the heat of condensation is passing into the cover during admission, and that shortly after cut-off this heat is removed and used in evaporating the condensate left on the surface. This evaporation process continues throughout the exhaust stroke.

The continuous line superimposed on the indicator diagram, fig 2, represents a hyperbolic expansion (Pressure x volume = constant), which is a good approximation for the expansion of saturated steam. Notice that the measured pressures rise above this line as expansion proceeds. This is due to the evaporation of the water layer described above. The effect is to increase the area of the indicator diagram slightly, and therefore the work output. Thus we reach the surprising conclusion that condensation may slightly increase power, but at the expense of a much reduced efficiency. Consequently it would be difficult to detect condensation except by measuring the steam consumption, since the power output is little affected.

The evil effects of condensation are reflected in the low Indicated Efficiency of around 3%, and the Steam Ratio indicates that 2.62 times as much steam was admitted than could be accounted for from the known dimensions of the cylinder, cut-off, speed, and the density of the inlet steam.

Superheated steam tests

In this test the surface temperature is always above the saturation temperature of the steam; consequently no condensation can occur, and the virtually constant surface temperature confirms this. Notice also the change in shape of the indicator diagram; the pressure now falls slightly below the 'PV = constant' line. Most striking, ▶

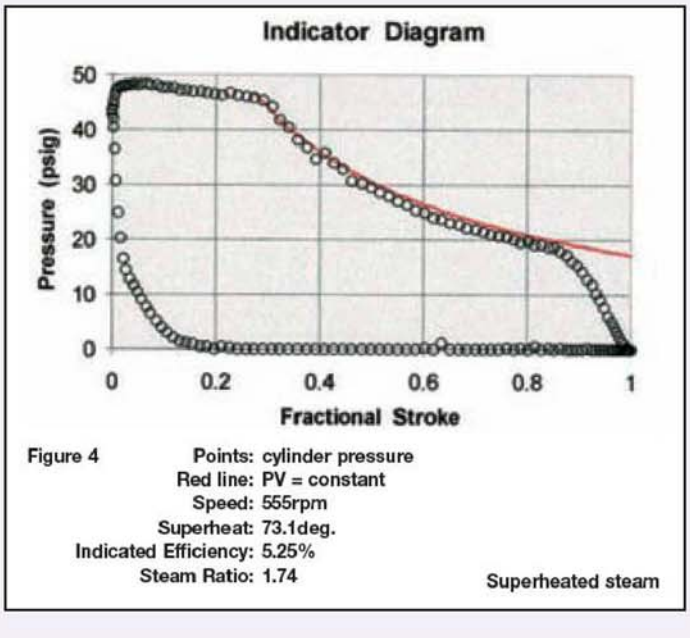


Figure 4 Points: cylinder pressure
Red line: PV = constant
Speed: 555rpm
Superheat: 73.1deg.
Indicated Efficiency: 5.25%
Steam Ratio: 1.74
Superheated steam

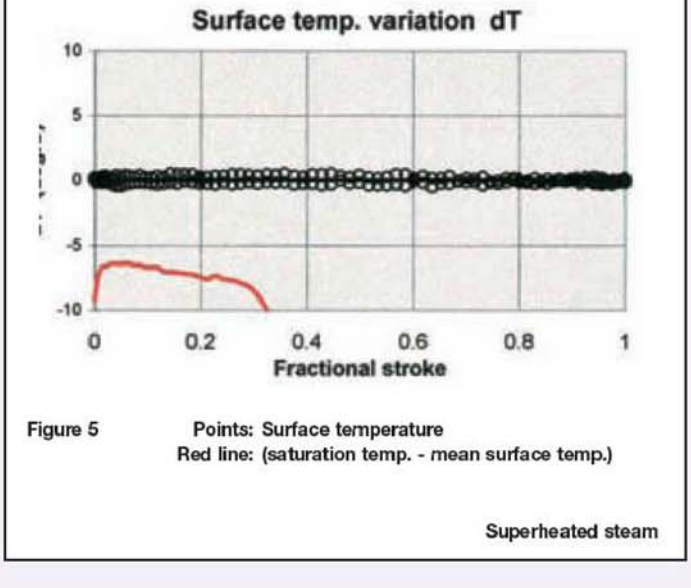


Figure 5 Points: Surface temperature
Red line: (saturation temp. - mean surface temp.)
Superheated steam

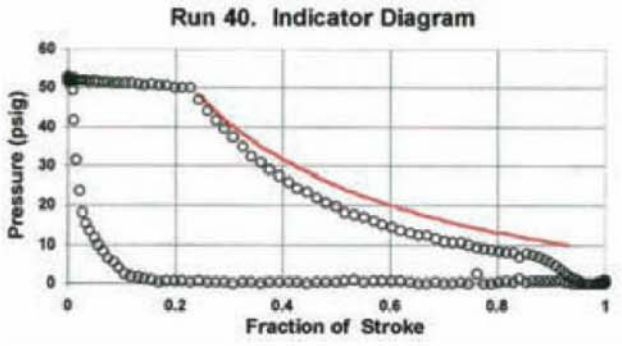


Figure 6 (Air: 237 rpm)

however, are the values of the Indicated Efficiency and the Steam Ratio.

It must be emphasised that the above temperature measurements refer only to the cylinder cover, whereas the condensation process will also occur on the cylindrical surface of the cylinder. The cover is probably more important, area for area, and its temperature fluctuation seems to be a reliable indicator of condensation. In the case of the test engine the Corliss type exhaust valve sealed at the outlet; it would be well cooled by exhaust steam, and then exposed to inlet steam. This may well make a significant additional contribution to condensation. In the case of the tests reported in reference 2 the engine was fitted with piston valves (at inlet and exhaust), and the cold exhaust valve was not exposed to inlet steam. In this case the Steam Ratio approached 1.0 with superheats of 100deg. C or greater.

It is instructive to test the engine using air as the working fluid at conditions fairly similar to the steam tests. The indicator diagram from such a test is shown in **fig 6.** In this case the expansion falls well below the 'PV = constant' line; the greater part of it is close to a ' $pv^{1.4}$ = constant' line, as would be expected for adiabatic expansion of air. This result is quite useful in that it confirms that leakage past the piston is not significant. Another quite interesting aspect of fig 6 is the contrast in shape of the diagram when compared with the steam indicator diagrams. The start of the diagram following admission is much 'sharper', as is that following cut-off. I think that in the case of steam when both liquid and vapour may be present together with a heat source/sink in the form of the cylinder surface, the mixture is much more 'compressible' and does not adjust as quickly to changing conditions. There is certainly a noticeable difference in the running of the engine — steam gives smoother running!

Analysis of results

Whilst the width of the temperature loop and the Steam Ratio are both good indicators of cylinder condensation, it is possible to extract more direct evidence concerning the heat flow into and out of the cylinder by analysing the surface temperature fluctuations. As mentioned above, these fluctuations do not penetrate more than a millimetre or two into the cylinder wall, and in these circumstances it is possible to calculate the changing temperature profiles in the cylinder wall. I will not go into the details here; sufficient to say that they have been calculated using the Crank-Nicholson finite difference method. My computer programme accepts a disc containing the experimental measurements and applies the surface temperature fluctuations to a semi-infinite solid; the resulting temperature profiles corresponding to the data of figs 3 and 5 are shown in **figs 7** and **8**. Whilst the profiles are calculated for each 2deg. of rotation, I have shown profiles only for every 20deg. in figs 7 and 8 to improve the clarity of the figures. The drastic reduction in both amplitude and penetration as a consequence of superheat are clearly evident.

The programme that calculates the shape of the above temperature profiles (figs 7 and 8) also determines the rate of flow of heat into or out of the cylinder corresponding to each profile. If all the profiles that give a heat input are added together, we get the amount of latent heat that is deposited in the cylinder cover during the period when condensation is taking place. This is in reasonable agreement with the amount of condensation indicated by the measured Steam Ratio. (Exact agreement would not be expected because condensation takes place also on the cylinder bore as well as the cover)

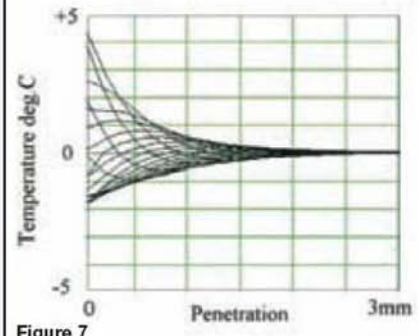


Figure 7

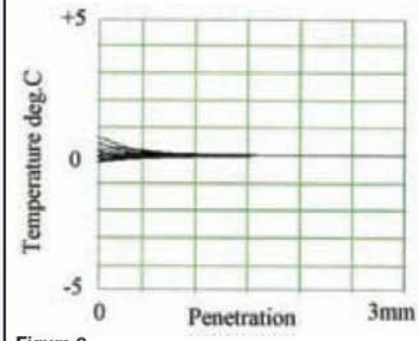


Figure 8

Discussion

The experiments have shown very clearly the cyclical nature of condensation and evaporation that occurs in an unsuperheated steam engine, and the effectiveness of superheat as a remedy. However, there remains an important factor that is still to be elucidated — the relationship between the temperature of the cylinder and the superheat.

Consider firstly unsuperheated steam. Condensation to and evaporation from a water layer are available as a heat transfer mechanism and the mean surface temperature of the cylinder must lie between the saturation temperature of the inlet steam and that of the exhaust steam. The heat transfer rates under these conditions are potentially very high, and the cylinder temperature is tightly bound between these two temperatures. Because the heat flow into the cylinder must be nearly balanced by the heat flow out it is tempting to imagine that at some point when condensation is balanced by evaporation the cylinder will be dry; however, there is no reason why this should be so, and a water layer, albeit of varying thickness, may be present for the whole cycle. If superheat is applied, condensation is still possible during admission provided the surface temperature of the water layer is below the ***saturation*** temperature of the steam. Presumably less will be condensed because of the higher enthalpy of the condensing steam, and consequently the layer may be thinner. The crucial question is then to determine how much superheat will cause the water layer to disappear. In the above experiments it appears that around 100deg. C or more is required, but at the present the problem is too complex to analyse theoretically.

It is interesting to speculate what happens after the cylinder has completely dried out, when the cylinder temperature will then be less tightly coupled to the steam temperature by relatively low convective heat transfer coefficients. The cylinder surface temperature will at all points around the cycle be above the saturation temperature of the steam, and it seems possible that a reduction in superheat may not cause the system to revert to one in which condensation occurs; in other words, there may be some hysteresis in the process. In fact, such hysteresis was observed in the above experiments, and it appeared that reversion did not occur until the superheat was reduced to around half the value at which it initially prevented condensation. More data are necessary before the matter can be taken further.

Other factors affecting condensation, in addition to superheat, were engine speed and pressure. Data obtained so far are insufficient to define these accurately, but it became clear that even with unsuperheated steam condensation had less effect as speed and pressure increased. Some of these factors were investigated in the tests reported in reference 2.

It was found that even when superheat has removed the surface temperature fluctuation, a sudden increase in steam pressure could cause reversion to condensation; possibly a decrease in speed could also have the same effect. This has interesting implications for driving technique with small locomotives. Driving on the regulator at fixed cut-off clearly involves pressure variation, and might be expected to increase condensation and reduce efficiency. It may well be that the alternative, i.e. using cut-off rather than regulator, improves efficiency more by reducing condensation than by improving thermodynamic efficiency. It would therefore be interesting to fit a locomotive with a surface thermocouple to see what happens with various driving techniques. My friend Tom Jones has in fact devised an portable instrument that continuously displays the magnitude of the surface temperature loop when attached to a surface thermocouple. This works well on the test engine, and we hope to test it on the track before long.

References

1: *On the Law of Condensation of Steam deduced from Measurements of Temperature-Cycles of the Walls and Steam in the Cylinder of a Steam-Engine.* H. L. Callendar and J. T. Nicolson, 1897. Min.Proc.Inst.C.E. vol. CXXXL, 1897.

2: *Measuring Steam Engine Performance.* W. B. Hall, Journal of SMEE, vol. 9 No. 3, 1998.

LETTERS TO A GRANDSON

M. J. H. Ellis

describes his adjustable boring bar, discovers a technique for the production of small diameter brass balls, and offers some personal opinions on financial matters.

●*Part XXXV continued from page 489 (M.E. 4159, 2001)*

Dear Adrian, am I right in imagining that my last letter left you in a state of expectancy, eager to hear how resourceful Grandpa solved the problem of lining up the two bearing housings? Well, I won't keep you in suspense for a moment longer.

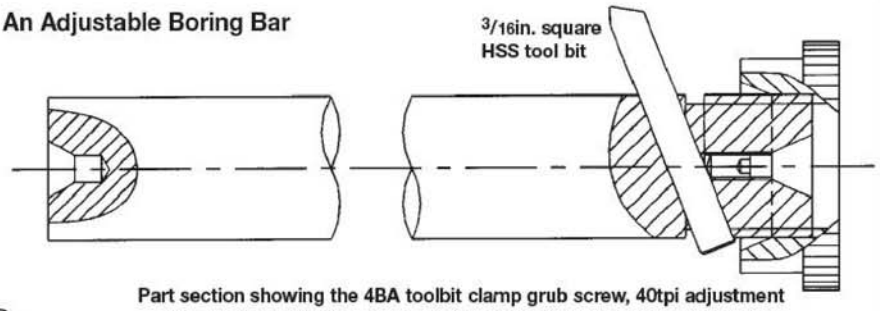
I should first explain that the work on the second end of the casting included roughing out the housing for the cup of the roller bearing about 0.015in. undersize. We can be sure that the first housing and the long bore were co-axial, for they were machined at the same setting. It follows that if the other housing is machined co-axially with the long bore, all three bores will be co-axial.

My first idea was to turn a mandrel between centres to a drive fit in the long bore, and use that to bore out the other bearing housing. I believe that this would have been perfectly practicable, but attended by certain difficulties. I would have had to make a special L-shaped boring tool to get into the bore at all, and I could foresee difficulty in measuring the bore with calipers, at least, with the mandrel in position. On reflection, this difficulty now appears more imaginary than real, and in any case, I could have overcome it by making a special pair of calipers. At any rate, that is all water under the bridge now, as I dropped this scheme in favour of Plan B.

It would have been a lumpy and out-of-balance casting to have going round in the lathe, and that was another consideration which inclined me to decide in favour of making a special boring-bar for the purpose. I enclose a sketch of it, and I don't suppose that you have ever seen the like of it before. Certainly, I hadn't, and I hope that you will tell your father that it demonstrates conclusively what a smart fellow Grandpa really is.

You will see that the cutter is made from a piece of 3/16in. square H.S.S. bit, fitting into a square hole in the boring-bar and inclined sideways. It is secured by an Allen grub-screw in an axial hole at the bottom of the centre in the end of the bar, and on which, if it were required the bar could rotate. Beyond the cutter, the bar is threaded 40tpi and onto this thread there screws a ring, graduated around the outside, and bored conical at its inner end. This means that by turning the ring, the conical bore is able to press on the rounded heel of the cutter to advance it very precisely; if I remember correctly, by a tenth of a thou at a time. Of course, it can only do this over a limited range, which is why the bore was roughed out earlier.

Because I thought that the long bore might be a little conical, I made no attempt to make the bar run directly in it. Instead, I turned two short brass bushes to be a press fit in it, and bored out to a good fit on the bar which was made of new bright mild steel stock, and measured the same diameter all along its length.



Part section showing the 4BA toolbit clamp grub screw, 40tpi adjustment thread and internal coned face of the cap graduated with 50 divisions.

When pressed into position, the bushes were now too small in the bore to admit the boring-bar, and I eased them slightly (as planned) with an expanding reamer until they would take it without shake. At last, I was in business.

All this took place ten years or more ago, and I cannot be sure in detail how I went on from here. However, from the centre-line of the spindle to the base of the mounting pad measures 3 1/2in. while from the table of the 5in. lathe to the centres is 1/16in. more. This confirms my recollection that it was possible to hold the boring bar, in place in the casting, with its mounting pad attached, between centres and the pad just cleared the top of the table. So all I had to do to set the work up was, to insert a piece 16swg aluminium alloy sheet under the pad, loosen the tailstock centre and bolt the casting down on the saddle with a strap across it.

The boring bar could now be driven by means of a carrier (another name for 'lathe-dog') loosely located between the lathe centres but really running in its own proper bearings in the long bore of the casting. Thereafter, it was just a matter of taking things very steadily. On more than one occasion, as a job approached its conclusion, have I fallen prey to a treacherous euphoria, which caused me to relax my concentration, with unhappy consequences. If you make a boob, the worst time is on the final operation, for which reason, if it is possible to do so, it is wise to tackle the most difficult operation first.

Before leaving this subject, I should mention that (1) I gave the cutter a fairly sharp radius seen from its front), less than that to which the cup of the roller bearing was finished, and (2) I ground the inside edge (i.e., the one which would finish off the inside rim of the cavity) as near as I could make it at right angles to the axis of the boring-bar. These were precautions to ensure that the cup would seat itself correctly.

Turning small brass balls

On an entirely different subject, not long ago I was browsing through some back issues of this magazine when, in the issue for 11 March 1937, I came across the following brief but interesting contribution from a Mr. R. Lloyd in which he explains how he overcame a problem. He said:

"Recently, I wished to make some balls in brass for the valves of a water pump and, not knowing how to turn a perfect sphere, I asked an engineer friend how this was done. He has had considerable experience in turning balls for boiler valves, and he told me that they were held in a lead chuck, and worked upon with a cupped tool. I tried this method, but did not meet with much success, so I had to conceive a method of my own. This method may not be anything new; nevertheless, it may be of interest to some readers.

"The balls I wished to make were to be 3/8in. in diameter and, having roughed them out from brass rod with a graver, I proceeded to make the finishing tools as follows. Chucking a short piece of 5/8in. silver-steel, the end was faced and a 1/4in. hole drilled up the centre for about 1/2 inch. The outer diameter was then tapered down and finished off with a file to a knife edge like a leather punch. The shank was then centre popped at the first chuck jaw, taken out, hardened, and re-chucked.

"The hand tool was made by fixing a leather punch of approximately the same diameter in a tool pad. Then, placing one of the rough balls against the revolving cutter in the chuck, and keeping it in position with the hand tool, the latter was worked with a rotary motion in the opposite direction to the lathe mandrel while being held at about 45deg. to the lathe centres. In this manner, the ball revolves in all directions, and cutting is done by both the revolving cutter and hand cutter. The result is a perfect sphere, but with a scraped appearance.

"The balls were polished by rolling them together between the palms of the hands with a flannel and metal polish. Later, I found that I could turn a number of balls, all exactly the same size, by making a revolving cutter with a hole of the exact size required, and cutting till the ball went inside the cutter."

Value for money

Your latest letter arrived today; I am glad that you have asked my advice about buying workshop equipment on credit. Resist the temptation; save up for what you want and you will appreciate it the more. Credit can diminish the value of you money by the interest charges incurred and the lost opportunity to obtain a discount when closing a cash deal. Moreover, ready money in your pocket can be very useful when an unexpected bargain turns up, perhaps at a boot sale or in the scrap-yard.

If I may close by quoting the words of Bell Burnell, the lady astronomer who discovered pulsars. She said: *"The art of deception is at its most effective when it fulfils pre-determined desires and pre-conceived ideas."* In other words, beware of believing to be true that which you would like to be true.

Your affectionate Grandpa.

●*To be continued.*

OLIVER EVANS' HALF-BEAM ENGINE

Colin Pape,

in France, details the construction of the beam and valve chest and offers a useful technique for making neat elliptical rod glands.

●*Part III continued from page 448 (M.E. 4159, 14 December 2001)*

As in the full-size engine, the beam in the model is fabricated and assembled by riveting. The beam components are shown in **drawing 4**. Care is required to ensure that the spacers are all made to the same length. When closing the rivets, put short lengths of 4mm and 6mm dia. rod through the main holes in the side plates to ensure good alignment. In the Munich engine, the shafts for the piston rod head and the connecting rod are also riveted, and they could be fitted this way in the model. However, I chose to have removable shafts in my model so that I could use one-piece bearings. This makes the pivot shafts a bit more complex. With removable shafts it is necessary to ensure that they cannot turn. For this reason the spacers with the 6BA internal thread must be slightly shorter than the width over the beam side plates, but the shaft plus spacer must be the same total length as the riveted spacers. When the 6BA screws are tightened they will then squeeze the shaft pieces between the side plates and lock them firmly.

Drilling the critical holes in the radius links and the beam requires careful work. At this stage, the two beam side plates should be equal lengths of straight-sided pieces of flat stock. Begin by marking one plate with the positions of the holes for the radius link pivot at the centre, and one end pivot.

Position the vice to drill the 4.0mm dia. central hole. Don't drill the hole yet, but clamp the vice in this position. The vice and the drilling table will not now be moved until the critical holes in the side plates and radius links have been drilled.

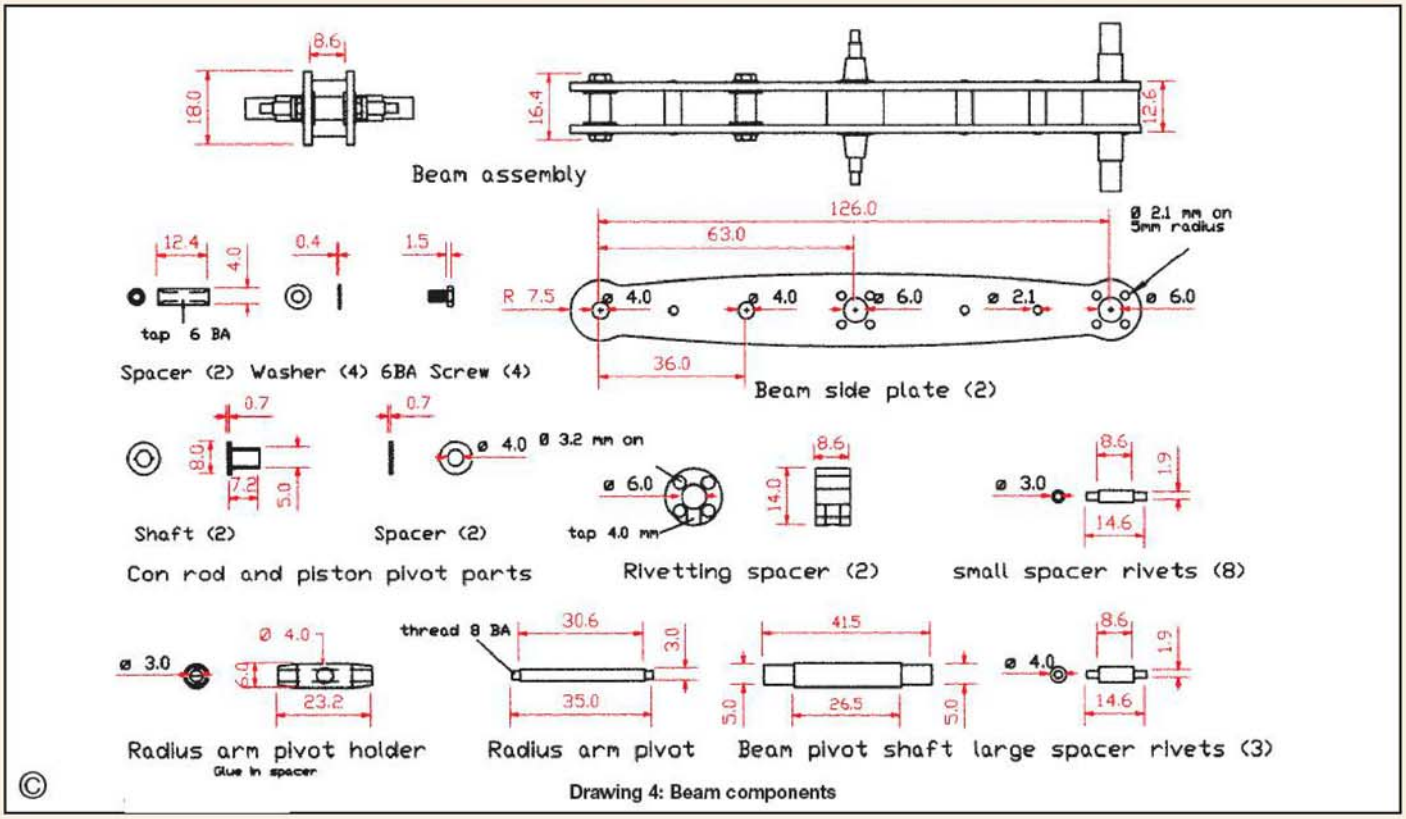
It is now necessary to make two jigs for drilling the other holes. The first jig will help to accurately drill the holes in the radius links. These holes must be centred in the rod stock, parallel and the correct distance apart. The drilling jig may be made from a piece of 15mm square mild steel. The length should be about equal to the width of the stock used for the beam side plates which was 20mm in my case. Square off the ends to about this length.

You need to drill a hole crosswise through this future jig. Mark one end face and place the piece flat in the vice on a piece of flat scrap with the marked end face against the fixed jaw. Position it so that when you drill the 6.0mm dia. hole it will be about 7mm from one side and only 2mm from the other. Drill the 6.0mm dia. hole right through the jig piece. Now rotate the piece so that it is flat in the vice with the marked face still against the fixed jaw and the 6mm dia. hole nearer to the bottom of the jig than the top. Drill the 4.0mm dia. hole down through the jig piece such that it is positioned more or less centrally in the top face. Barring accidents, this hole will be exactly across the 6.0mm dia. hole. Remove the jig from the vice, remove any burrs, clean out the swarf and replace it in the vice, the same way up that it was before and with the marked face against the back jaw. Feed the 4.0mm drill down through the jig to position it and clamp the jig in this position.

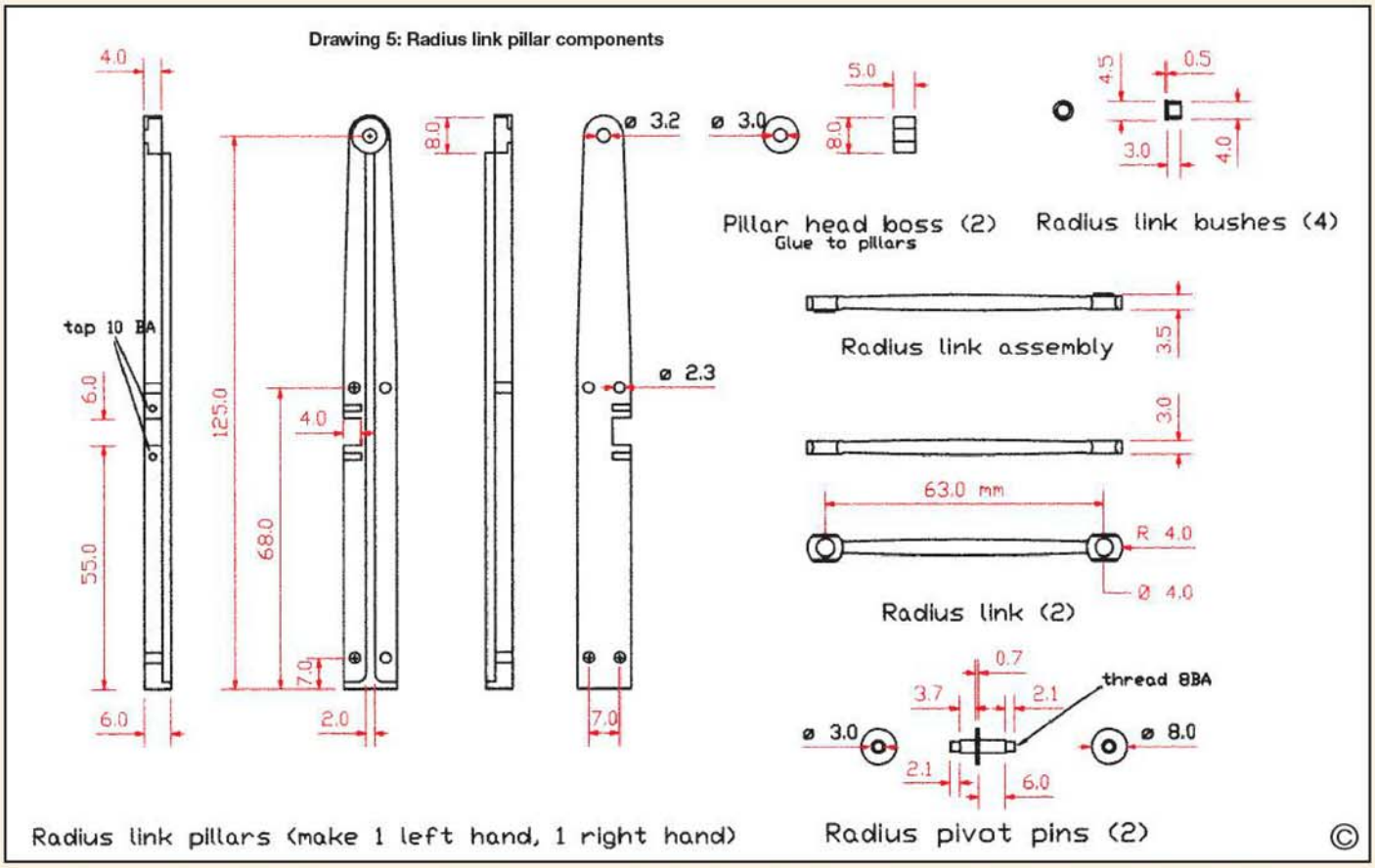
The radius links are shown in **drawing 5**. The stock used for these should be about 30mm longer than the final length to provide material at each end for holding the pieces. You can now feed one end of each radial link piece into the jig and drill one end hole in each. Put the links aside for the moment and take the jig out of the vice.

Now for the second jig which controls the hole spacing. Take a small piece of flat stock that can be clamped to the drilling table. When flat on the table, the top of this piece should be at about the same height as the bottom of the vice jaws. Do not change the position of the vice or the drilling table. Drill a 4.0mm hole vertically down near one edge of this piece of stock. Press a short piece of 4.0mm dia. rod into this hole. It should be a tight fit. Put this jig aside for the moment.

We will now start on the side plates. Take the two side plates, one on top of the other, and position them laterally in the vice for drilling the 4mm dia. central hole. Drill the hole. Remove the plates but keep them together. Place the second jig close to the vice and without separating the two plates, place the centre hole of the side plates over the jig pin and position the side plates in the drilling vice ready for drilling the marked end pivot hole. Secure the side plates and then clamp the second jig to the drilling table. Drill the pivot hole. Release the pieces from the vice and lift them off the jig pin. Turn the pair upside down together and rotate them 180deg. around the central hole, replace them



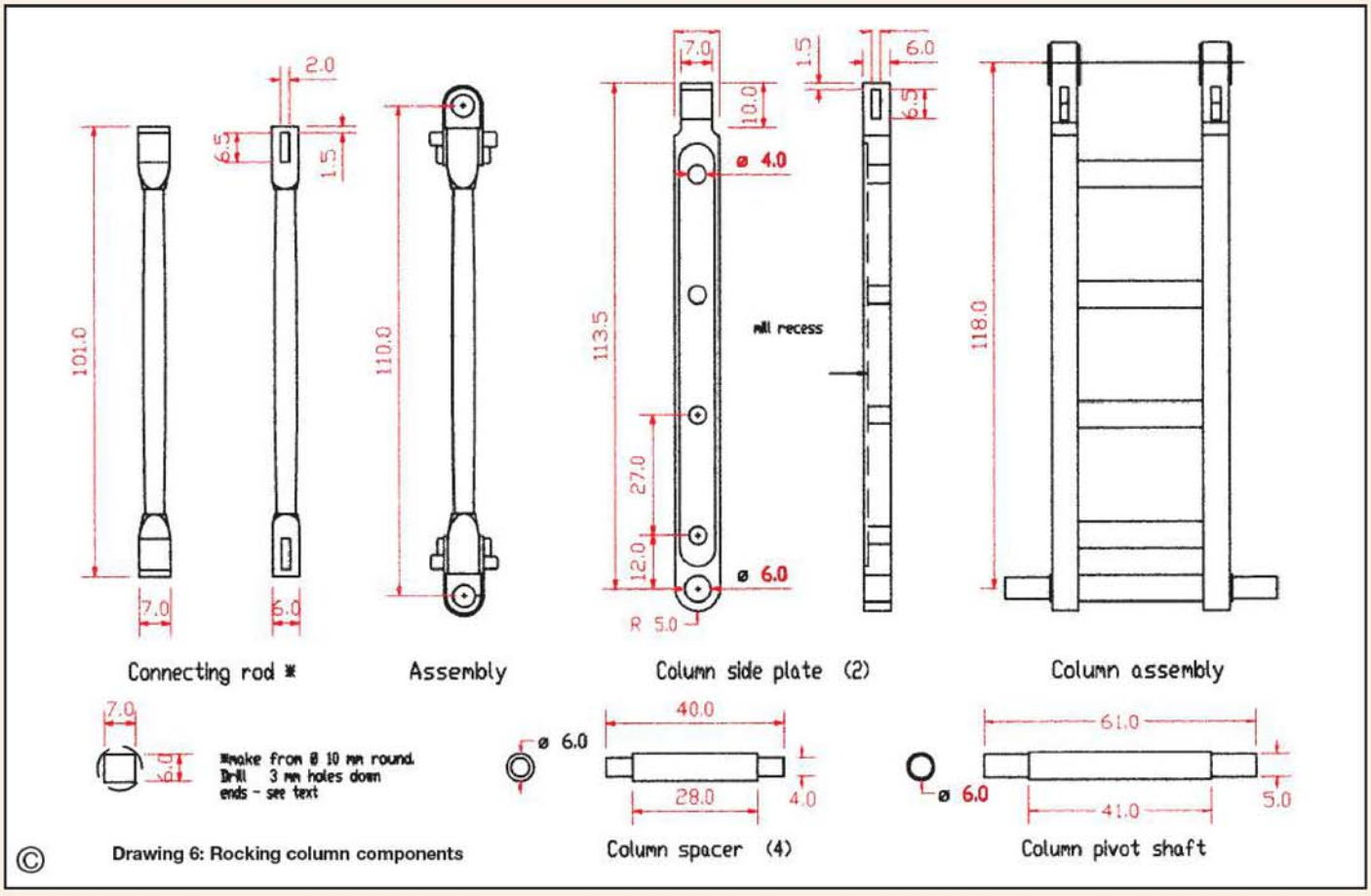
Drawing 4: Beam components

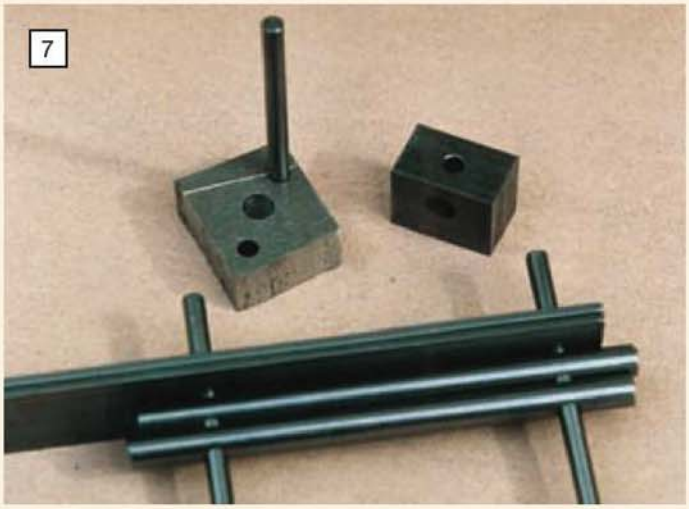


with the central holes on the jig pin, clamp them in the vice again and drill a 4mm dia. hole at the other end of the beam. By turning the pair of side plates in this manner you will ensure that the three main holes are in line even if the plates were not centrally located in the cross-wise sense.

Both side plates are now of the same effective length and each has a correctly positioned central hole. The central hole and one end hole will have to be opened up to 6mm dia. but not yet.

Next, take a radius link. Slide the rod-drilling jig over the un-drilled end. Locate the other end on the pin of the second jig. Make sure that the rod-drilling jig is the right way up with its marked face towards the rear vice jaw, bring down the drill to locate it in the drilling hole and secure the jig in the vice. Drill through the radius link and then repeat the operation on the other ▶





The critical holes in the beam have been drilled correctly thanks to the careful use of the drilling jigs described in the accompanying text..

A simple machining techniqe followed by a minimum of hand work with a file produces glands of a neat elliptical form.

link. The radius links will now have correctly located holes at each end, and these holes will be parallel to each other.

You should check the drilling at this stage before you have invested a lot of time in finishing the side plates and the radius links. It should be possible to push two pieces of 4mm dia. rod through the holes in the side plates and the radius links as shown in **photo 7**. This photograph shows the embryo beam plates and radius links with the two jigs.

If you cannot succeed you will need to identify the bad part and make another. If the radius links fit better at one end of the beam than at the other then mark this end of the beam for the piston end. The other end, which is less critical, can be used as the support end.

Radius link pillars

These are shown in drawing 5; they are made from 6mm thick mild steel. When the milling is done to remove the material at the sides and leave the central rib, the steel piece will probably assume the familiar banana shape because only one face has been removed. It will then have to be straightened. This happened to me and then I remembered a tip from *M.E.* some time ago about annealing the steel in the glowing ashes of a fire. I did this for a second pair and it worked beautifully.

Assemble the bosses to the pillars with adhesive. Make a quick check of the alignment by placing the pillars back to back and passing a 3mm rod through the bosses. The small parts of the stirrup shaft bearings are also fixed in the pillars with adhesive.

Rocking column

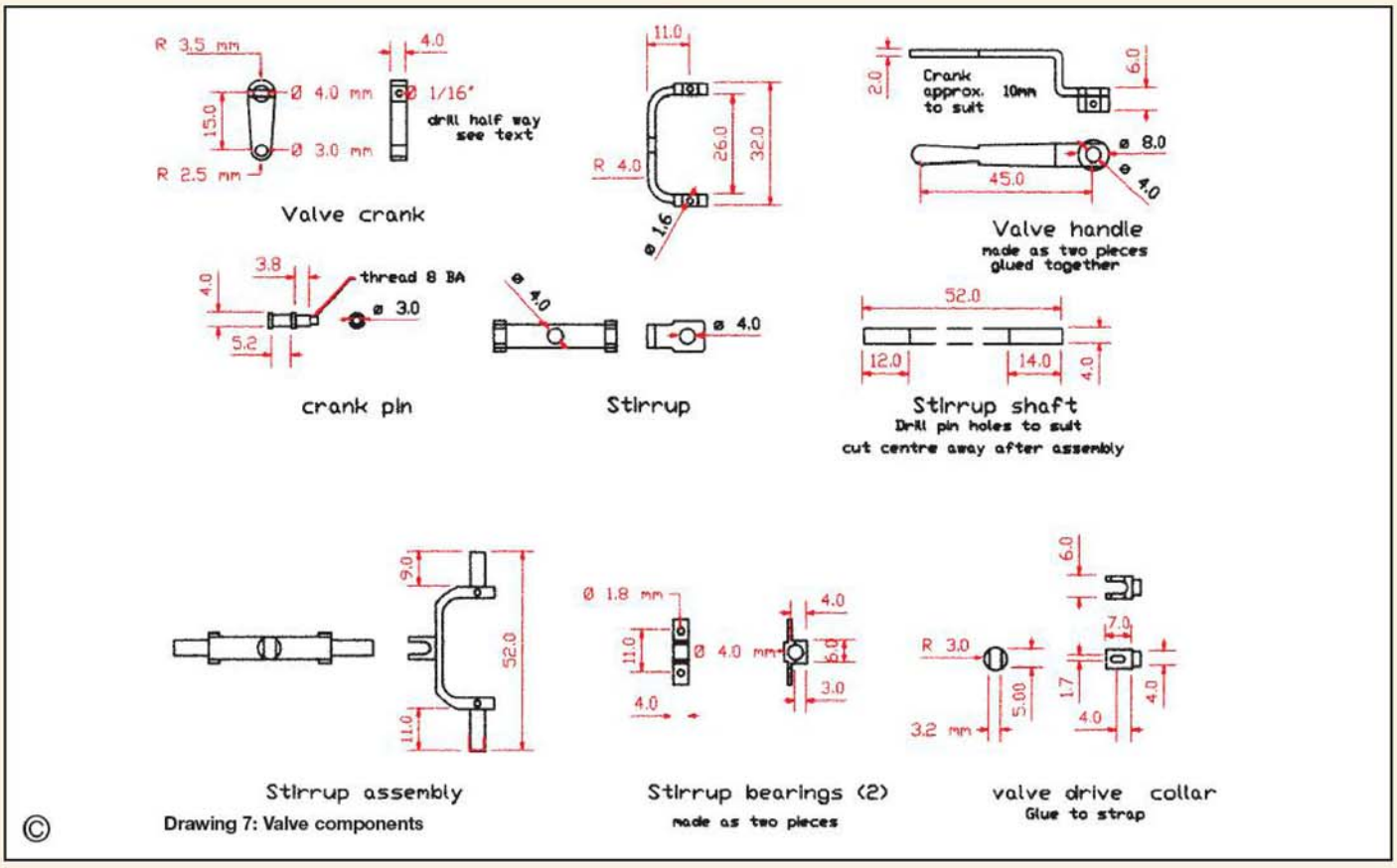
In the Munich engine, this column is a casting. I decided to make a simple ladder design which I could fabricate. The column components are shown in **drawing 6**. There are no special difficulties and the assembly can be done by silver-soldering, by riveting or using adhesive. I chose to use adhesive. The assembly was held against a flat plate while the adhesive was setting.

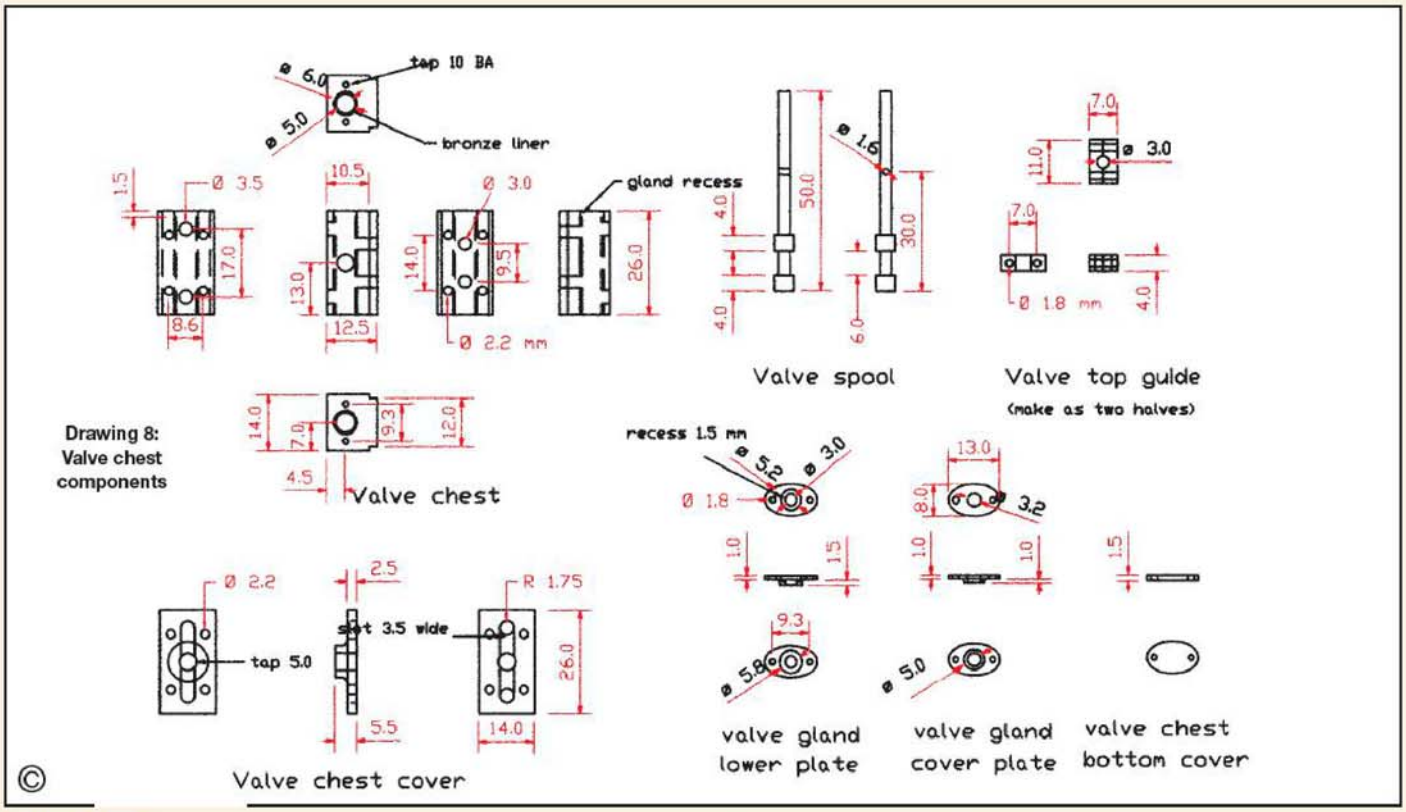
Valve stirrup

The stirrup and other valve drive components are shown in **drawing 7**. This piece can be made in a variety of ways. I decided to fabricate this item. The component pieces are straightforward to make and assembly is by means of adhesive and pins.

The strap started out as a piece of 3 x 10mm flat strip. The central part was thinned down to 2 x 6 millimetres.

The two stub axles are made from a single piece of 4mm dia. rod, which is as long as the overall finished width of the stirrup assembly. It remains as one piece until the stirrup strap has been pinned to it. This ensures that the axles are aligned, and then the unwanted central part is cut away.





Drawing 8: Valve chest components

Valve chest

I do not know what sort of valve is used in the Munich engine. It could be a spool valve. I decided to use a spool valve in the model because I find them easy to make to good tolerances. They do not have the wear problems of D valves and they work very well.

Drawing 8 shows the pieces used for the valve chest which I made from aluminium alloy, fitting a bronze liner for the valve spool. The liner is slightly shorter than the chest to leave room for the gland at the top. The valve chest cover was also made using the same alloy. There are a lot of holes in these pieces but it is just a straightforward, careful drilling exercise. For my model, I made a very simple provision for the air (steam) inlet. It is a tapped hole. It would be more correct to provide a fitting for a union. Two suitable unions are shown in the foreground in **photo 8.**

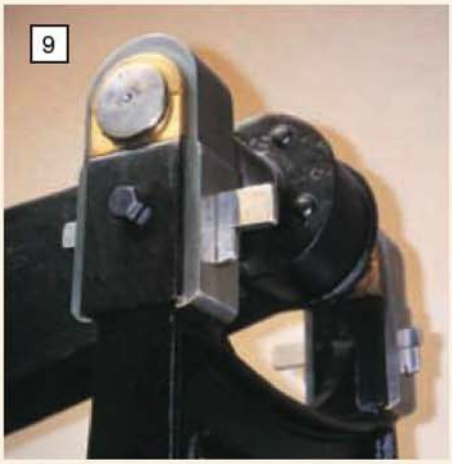
Glands

The glands that I used are small O-rings. I used 1mm thick rings and the dimensions were 5mm O/D with a 3mm I/D for the valve rod and 6mm O/D with a 4mm I/D for the piston rod. These make a very good seal and the gland covers can be tightened against them to improve the fit if necessary. The dimensions given for the gland pieces shown in **fig 8** may be varied to suit available material. The rods should be polished to give a grain along their length.

Elliptical pieces for the valve rod

I like my ellipses to be symmetrical so I devised a way of doing most of the operations under controlled conditions using the lathe. The ellipses I made are in fact approximations composed of two pairs of arcs. One pair of arcs is from a circle of one diameter and the other pair is from a circle of a larger diameter. At the end of the lathe operations the arcs are merged together with a few careful strokes of a hand file.

The different elliptical pieces are made from a single piece of round brass. The first operation is to turn the material to a diameter equal to the maximum diameter of the finished ellipse. In the case of these pieces, this will be 13mm diameter. Then the fixing holes are drilled, then the different bosses and/or circular recesses are cut wherever possible before each piece is parted off.



Big end bearing assembly with split brasses, straps and cotters on the full-size engine.

When all the pieces have reached this stage, the pieces are taken one by one and attached to a small jig. This jig consists of a short length of 16mm dia. rod with two 10BA studs set off-centre in one end. The pieces are held in place on this jig with nuts screwed onto the studs. One side of the piece overlaps the jig and this protruding segment of the gland can be trimmed away on the lathe. The piece is then reversed on the jig and the other side can be trimmed away. These operations form the larger radius arcs. After this, the piece is removed and the arcs are blended by hand filing. Very little metal needs to be removed so there is not much scope for error and the finished pieces have a good chance of being symmetrical.

Photograph 8 shows the stages in the manufacture of the ellipses and the simple jig. In the foreground, the left hand piece has come directly from the lathe, the centre piece has the off-centre machining completed and the right hand piece has been finished off with a small file. The jig is simple to make. In fact I made two extra ones just to take the photograph.

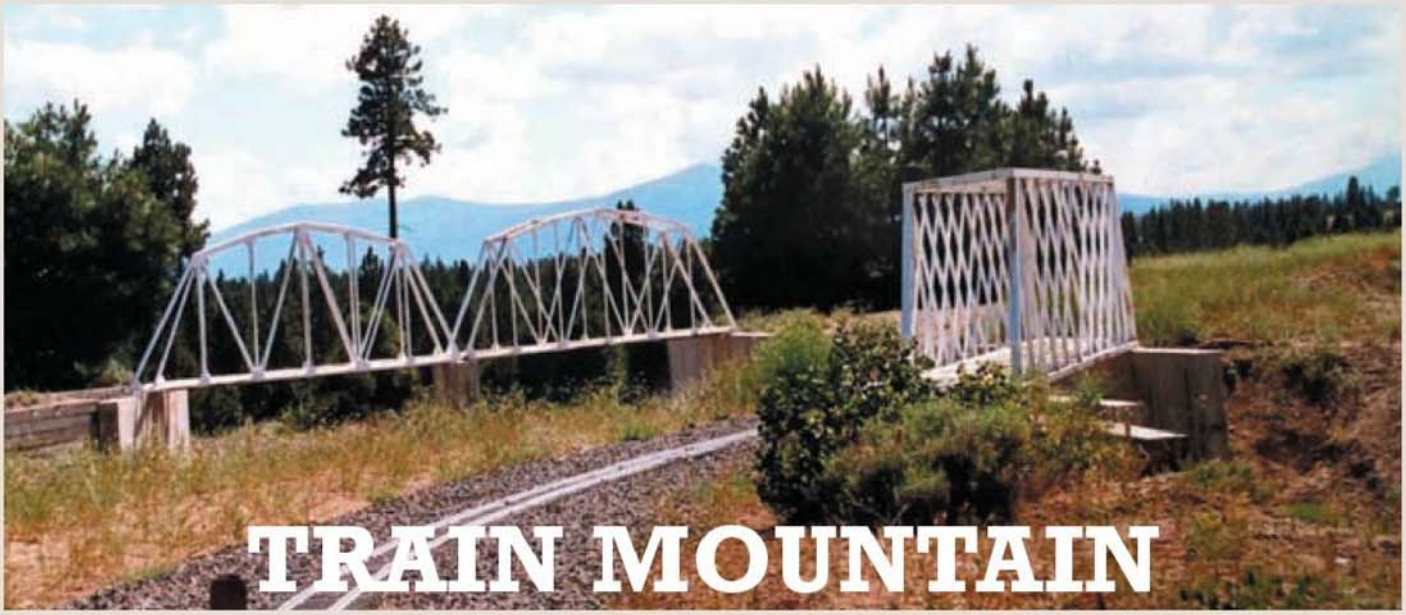
Slots for the wedges

The model employs the same system of securing the bearings to some of the pieces as is used in the original engine. This system, combining straps, clips and wedges, was used for many years by the early machine builders and must have been extremely reliable. Having said that I should say that the German maker of the example machine (or its owner) decided to ensure that the wedges never worked loose by fitting a setscrew to each wedge set. **Photograph 9** shows the beam support bearings of the Munich engine.

The setscrew jams the wedge in each set. At some stage, the wedges holding the bearing to the bottom end of the connecting rod must have come out for there are deep gouges in the cylinder wall.

The straps and wedges for the model are shown in **drawing 9**. The wedge pieces pass through slots cut in the straps, the pillars and connecting links. The smallest metric slot drill that I have is 2.0mm dia.; it is of the FC3 type and very short. Cutting the slots in the straps is not a problem but the metal in the pillars and links is quite thick and exceeded the depth that this type cutter can reach. Accordingly, we need to cheat a little! In this case it is useful to drill an axial hole down into the link from the seat end. In some cases a centre hole is required here anyway for machining purposes, and in all cases this hole is invisible once the bearing is in place. I drilled a 3mm hole about 8mm deep in the end of each component where a bearing had to be seated after which I was able to cut the 2mm slots by working from both sides. In this way it was never necessary to cut more than 2mm deep and this is within the capabilities of a 2.0mm dia. FC3 type slot drill.

●*To be continued.*



TRAIN MOUNTAIN

The backdrop to these two overbridges gives an idea of the impressive scenery in which Train Mountain Railroad is set.

Keith Wilson
waxes lyrical about what he found on his recent trip across the 'pond'.

With (at present) well over 2000 acres to play with, regrettably, we are unlikely to see such a railway on this side of the 'Pond', sufficient space being something that we have not got a lot of. It would be splendid to visit Train Mountain with a locomotive; we have quite a few in this country that could survive a drive of two solid hours. Alas, due to a typing error many years ago we are forever cut off by the difference in gauges: 7¼in. for us, 7½in. for them. However, we can at least visit and can be sure of a warm welcome.

Train Mountain is located just beside Chiloquin, in southern Oregon. Just over 4000ft. above sea level, it is desert conditions in summer: i.e. very hot by day and very cold by night. The fact that it is also in an earthquake and volcano zone appears to be no great problem. The main buildings, museum, headquarters, etc., are on the top of the mountain although, in comparison with the surrounding land, this mountain is hardly even a respectable hill. There is a complete continuous track on top around the buildings and 'Central Station'. Boasting 32 bays (28 for raising steam fitted with water, electricity, and compressed air) around a 40ft. turntable, it is the hub of the system, the tracks spreading out from it somewhat resembling a spider's web. However, not far out is Grand Junction, which is the place where you choose where you will go.

The short loop round the top takes about 10 minutes. Next comes a run (Klamath & Western) that as I recall is open to public visitors on Sundays, this runs down one side of the hill on easy gradients and then up again, passing through a short tunnel in the process. This took us about half an hour, partly due to some bright spark on the train ahead of us leaving a set of points thrown the wrong way, so we went round it twice before finding the way out. The third main run looks at two hours. We were taken round this on our first afternoon, by courtesy of a driver. With two twin-track tunnels under a public road it will be realised that this railway is quite something!

Incidentally, most steam locomotives here feed on propane, and there is a small sidings-yard devoted to realistic scale replicas of a suitable vehicle. There 25 of these vehicles, containing 25 gallons of propane in each. They are most smart and attractive as can be seen from my photographs. Coupled immediately behind the tender, with a flexible hosepipe connection to the engine, they do not detract from the appearance of the train. It will be understood that, although desert conditions generally prevail in summer and fall, there are many thousands of trees and plenty of 'scrub'. Hence in summer, fire risk is high. There are, however, obvious advantages in gas firing as it makes for better steaming and better endurance, but it is rather noisy and the sound of good old-fashion puffs is greatly reduced.

I know of no tracks in this country where there are vital water-towers necessarily provided 'out the line' but there are also one or two toilet huts to be found, with an accompanying siding, vital when running several trains. It is the habit of some to load up train with family and picnic basket, puffing off merrily into the 'wild blue yonder' for much of the day, 'parking up' in a convenient siding.

That evening we set off, double-headed, just before 9pm. We returned just after 11pm, not having lingered *en route*, somewhat cold, but with a sense of enjoyment/fulfilment. This two-hour trip winds down the south side of the hill on a piece of track known as the Serpentine, It is fascinating to ride on this line (twin-tracked) and note how space permits reasonable curves (75ft.) and gradients, although there is a short patch of 3% (approx. 1 in 33) which poses a problem for trains on the way up, the rails being 'aloominum'

Signs of future improvements are everywhere,

Just one of the 25 propane vehicles used to power the majority of steam engines on site. Each wagon contains 25 gallons of propane.

The hub of the Train Mountain system is this 40ft. turntable seen here complete with train.

Ladder Sidings beside workshop.

Twin Tunnel entrance.

for example signal gantries are coming along on the short sections of single track, always a risk problem. As a matter of interest, in England there has only been *one* fatal accident (Abermule, circa 1926) on our railways as long as the old-fashioned staff or token was in use but since 'safer, more modern systems' have been in use, the story is not quite so good — far from it in fact.

It would be useless for me to try to describe the complete layout, for even with a map it would take some hours. Sufficient to state that at the last count there were some 105,000ft. of track (just under 20 miles) with something like 8 miles of sidings. One big 'ladder' yard has a mere 22 sidings, and as we discovered later, a 300 yard tunnel underneath it.

For visiting personnel with locomotives, accommodation is available in the form of 33-odd cabooses (one might think that the proper plural of caboose was cabeese) which are gradually being 'done-up' as accommodation flats. In case my British fan(s) are not familiar with the term 'caboose' we would know it as Toad or guard's van.

There are lineside buildings here and there, built to a scale of 1:6. Some are assembled into miniature townships with appropriate buildings (shops, warehouses, factories, etc.) and add pleasure to passengers and train crews alike. One such is 'Youngstown' in one of the 'Serpentine' loops and can thus be viewed from all sides. At the water towers are neat 'model' wind pumps.

Keeping in touch

The size of the Railroad is such that CB or equivalent radio is compulsory on all trains, two wavebands being constantly monitored during railroad operation. Since a train can be several miles away from 'home' at times, the use of this for safety reasons (both engineering and medical) make the need for this obvious.

Such a large 'layout' requires divisions of which there are three at time of writing: Caboose Ridge, Romulus, and Douglas. There are also many sub-divisions, Romulus for example having seven. Although full block signalling would be welcome, the problem is virtually insurmountable. Such a system must either be automatic or manual. In the case of automatic (electrical) a team of engineers would have to be on standby whenever the track was operating, for automatic systems are very prone to failure if large (small being hard enough) and the weather of virtually any country can do naughty things to track fittings and the like. Contrari-wise, manual control would need a small army of towermen (signalmen) to operate.

How many small railroads find it necessary to have a specially made train for tracklaying purposes? Train Mountain has been coerced by sheer necessity to go into production of some items for itself. For example, at one time they had 100 cars (wagons or carriages to us) out of service due to lack of supply of suitable 'buckeye' couplers! Some other items available are 'crossbuck' signs for level crossings, and rail — both steel and aluminium alloy. One needs something like them if one aims to lay 5,000ft. of track per week!

Bridges are avoided if possible, for they need maintenance, an obvious bugbear for so many miles of track. It was found generally better to use embankments or earthworks or re-routing; however there are some places where one track has to cross another at a different height and so a bridge is unavoidable. ▶

The mighty impressive bulk of a 2-8-2 locomotive, main line type.

These lineside buildings at Youngstown 'village' are built to 1:6 scale and are full of character.

Piles of track on tracklaying train.

A 2-8-2 locomotive, logger type in close-up.

Some statistics

One mile of trains were present at the big meet of 2000. There is a total of 105,000ft. of track and two twin-track tunnels under a main road. About 300 trains can run at once. With such a big 'train set', when arranging meetings some juggling with dates is unavoidable so that maximum numbers can attend. The next big International Meet is the Train Mountain Triennial, 21-29 June, 2003.

e-mail addresses

Stores & General Information: **tmrr@cvc.net**
General Manager: **tmrrgm@aol.com**
Quentin Breen, President: **qlb@cdsnet.net**

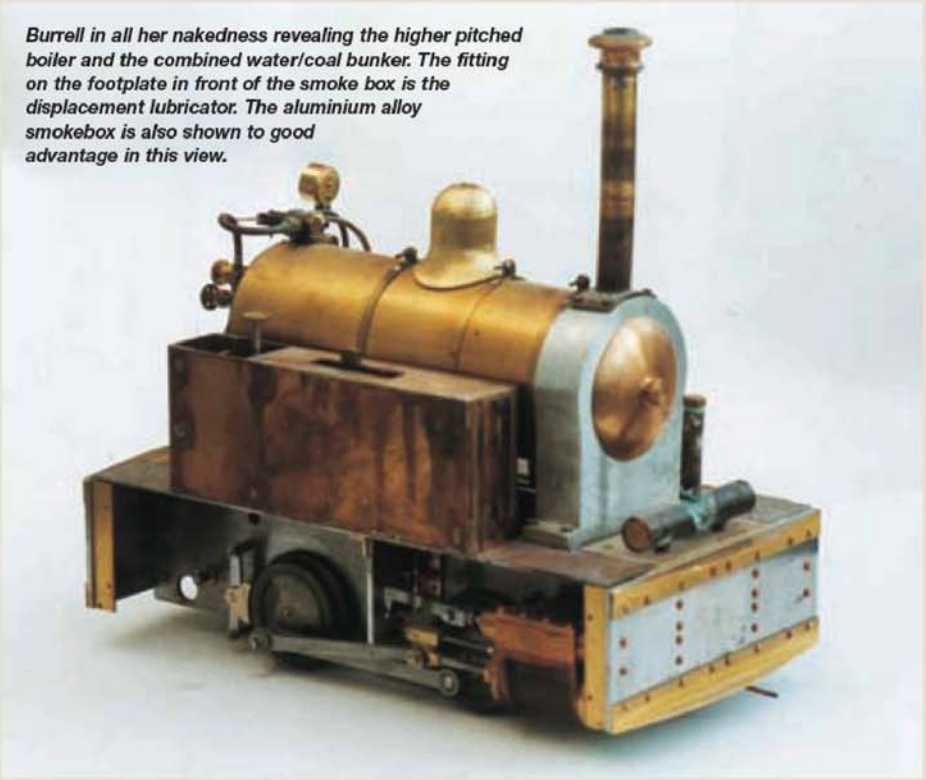
US miniature railroads websites

www.trainmountain.org Useful information under Archive/Encyclopaedia section.
www.ironacresrailroad.homestead.com
www.rmirailworks.com

BURRELL A STEAM TRAM

Marcus Rooks
describes the remaining details of his model steam tram based on a Charles Burrell and Sons Ltd. prototype.

●*Part II continued from page (M.E. 14 December 2001)*



Burrell in all her nakedness revealing the higher pitched boiler and the combined water/coal bunker. The fitting on the footplate in front of the smoke box is the displacement lubricator. The aluminium alloy smokebox is also shown to good advantage in this view.

The boiler is based on the large version of *Tich* but is pitched much higher. New boiler mounting brackets are fitted, which simply comprised angle sections silver-soldered to the base of the wrapper. An external throttle valve on the back head is specified, which is easier to make and fit. If the pipe is lagged, condensation should not be a problem but superheating is not possible. The full-size *Burrell* had external steam lines, so I was in keeping with the original.

Another variation is the fitting of twin check valves on one side only, allowing the fitting of a full-length water tank/bunker on the opposite side. The other side is clear, allowing the miniature driver to move from one end of the tram to the other.

For the simple minded (including myself) and for ease of construction, the smokebox was made from an aluminium alloy casting. This was supplied by Manor Brass from my wax pattern; a company more used to dealing with vintage cars than steam engines. This may be somewhat radical in its approach, however, by making the base solid it is an easy matter to drill and tap for the blast pipe without having to compromise airtightness in the smokebox. I also used a simple central locking screw to attach the door, rather than the more usual hinges, again making it easy!

Platework and fittings

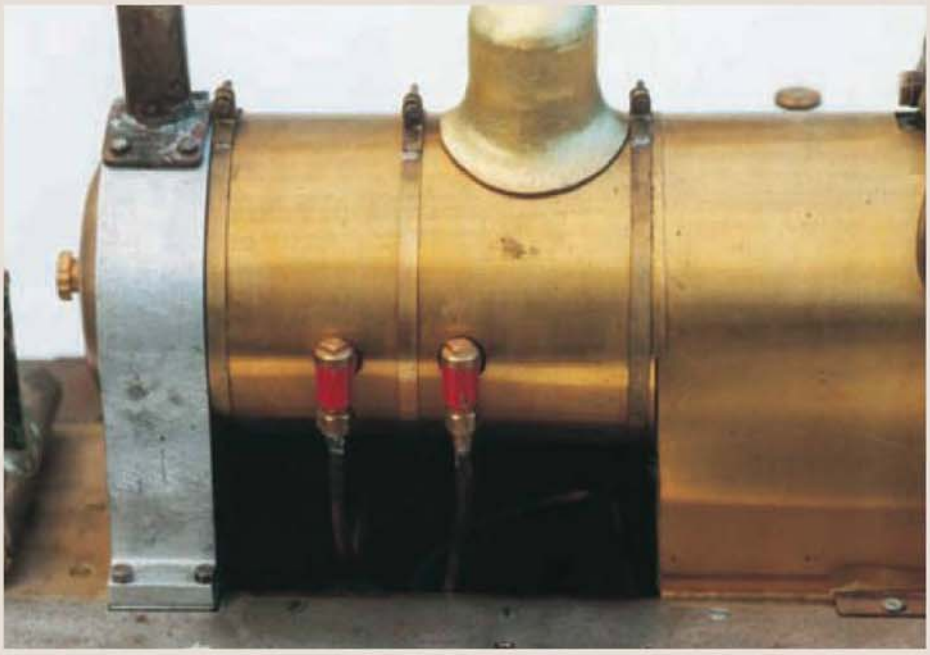
The platework for *Burrell* is laser profiled from 1mm mild steel sheet, the process being ideally suited to such a job. To cut out such large items without distortion would be difficult using conventional methods. I would recommend laser cutting to anyone who desires accuracy and intricacy. There is only one drawback; it is not cheap for one-off items. The design is such that the body is an integral unit which can be removed if desired. During normal running, the rear end sheet is removed, and for maintenance and oiling the front piece can similarly be removed.

The condenser is made from 15mm dia. domestic water tube, being readily available at a very reasonable cost. Four metres of this material will cost in the region of a few pounds, depending where it is bought. Two such lengths will be needed. This type of piping is not suitable for high-pressure steam — it will fail, so be warned. It would not be practical to make it functional in this scale, but I suppose that remark will be like a red rag to a bull and someone will probably come out with a working condenser!

I used a commercial copper pipe cutter to cut the pipes to length. It leaves a very smooth cut surface and I use it routinely now when I cut copper pipe. The tube end is slightly reduced in diameter but careful use of a small round file will bring it back to the full bore. I did not fit any connecting pipes but it would be easy enough to attach 'live' and exhaust steam pipes.

Due to the enclosed nature of the tram, arranging a lubricator was quite tricky. In the end I set-

This close-up of the windows illustrates well the fine finish achieved by the laser cutting process.



Two check valves are mounted on one side of the boiler to give access for the driver to move from one end of the tram to the other The expansion brackets are just visible in the bottom right hand corner.

tled for a displacement type which sits on the front running board, the drain running down below the front skirt and is easily accessible when the tram is in operation.

Only the rear wheels of *Burrell* are braked — they are more of a parking brake than anything else. Remember the old adage, it is the locomotive that pulls the train, but the train that stops the locomotive. In this day and age of Health and Safety awareness, if the locomotive is not braked then you may not be allowed to take it on the track, so it would probably be well worth the extra effort of fitting brakes. The main train braking power will be from the trolley braking system.

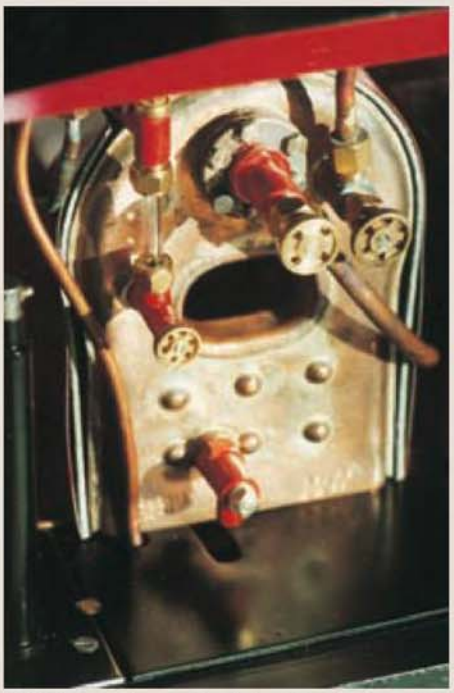
Burrell utilises a combined water and coal-bunker. The top and bottom are made from 1/8in. brass, the sides are from 1/16in. brass. The end pieces are made from 1 1/4in. square tube, cut in half and the various pieces are held together with 6BA brass countersunk screws. The items are made watertight by running soft-solder over the various joints and screw holes. The hand pump and pipe work is assembled before the end piece is soldered in place.

Burrell's chimney is made in three sections. The central part comprises two pieces of 5/8in. brass tube tightly sleeved together, allowing the top half to be removed along with the bodywork. The cap is turned and parted from the basic *Tich* casting and silver-soldered to the brass tube. The base of the chimney is a piece of 1/16in. brass sheet bent and silver soldered in place and is secured to the smokebox with four 6BA bolts. A length of the tube projects into the smokebox to act as the petticoat pipe. The exhaust from the safety valve is directed through a 3/8in. tube passing through the roof.

The headlights are standard Mamod items which are available for about £2 each and certainly add to the appearance. *Burrell* can be finished in any suitable livery, those with access to archives will be able to find the authentic colours of the two companies where *Burrell* worked. For those who do not, then a two-tone colour scheme looks nice, with satin black for the lower skirts. The motion work, although hidden, can be painted red.

The original idea was to make *Burrell* as simple as possible, allowing the builder to embellish it as he or she felt fit. Glazing, destination boards, handles, and the like can all be added if desired. If anyone is interested in making *Burrell* then I would be more than happy to give as much assistance as possible and I hope that it gives great pleasure to anyone who does manage to build one.

A close-up of the leading cab showing the Lerwick destination board and the Mamod headlamp.



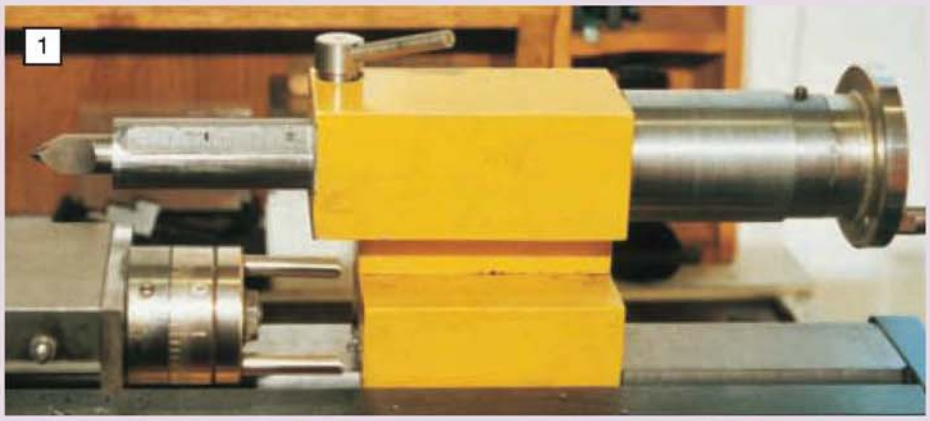
With the usual controls, the backhead of Burrell *is extremely simple. The pump by-pass is mounted on the water tank and the brake is on the left.*

A driver's eye view of Burrell *that also shows the layout of the condenser to advantage.*

A TAILSTOCK EXTENSION FOR THE MD65 LATHE

Joe Preston

designed and made a new tailstock barrel, spindle and extension to permit conventional handwheel rotation and the fitting of a rule to indicate axial tailstock movement.



The Author's tailstock modification allows for conventional rotation of the handwheel to operate the barrel together with a facility to house a steel rule to indicate barrel extension.

Apart from the limited extension of the tailstock, another idiosyncratic feature of the MD65 is that the handwheel to advance the tailstock centre must be turned in an anti-clockwise direction. Many years of turning things in the other direction to advance forward inevitably leads to mistakes, not serious perhaps, but a nuisance. I decided therefore to make the new pieces left-hand thread, not essential perhaps, but it certainly makes life much easier. Anyway, I like cutting left hand threads, as one is working away from the chuck, one has plenty of time to switch off the self-act at the end of the thread. I am told that the MD65 for the American market had a left hand thread!

There are only three new parts to make; these are shown in **photo 4** with the original parts top right, plus four longer bolts which surprisingly can be obtained four in a packet from the local ironmonger. The fact that these are pan head screws avoids deepening and therefore weakening the spindle guiding plate. Note that the terms or descriptions used herein are those given in the MD65 operating instruction diagrams.

At the time I ordered the left-hand tap to thread the tailstock sleeve, I hadn't then dismantled the tailstock — the description and diagram appearing to show the spindle to have M8 threads at both ends. As can be seen from photo 4, it hasn't — at least not on my lathe. It doesn't really matter, but you may have wondered why the original part (photo 4) shows a larger thread which in fact is M10.

The new parts to be made are shown in the accompanying drawings as items A, B and C.

Components

It occurred to me that a good way of graduating the sleeve would be to mill a shallow groove and insert a section of rule (**photos 1** & **5**). Over the years several fairly thin stainless steel rules 6in. long have come my way as free gifts with *Model Engineer* and *Model Engineers' Workshop* magazines. If one of these is carefully cut, you will have a suitable length of rule, imperial on one side and metric on the other which will fit in the groove milled in the sleeve. Done carefully, the rule will stay in place and can be inverted to show metric or imperial dimensions as required and as visible in the photos.

The spindle can next be made out of a piece of 16mm dia. bright mild steel. Turn the shorter handwheel end first and cut the M8 thread. It is better to screwcut this in the lathe first and then finish with an M8 die to get a good profile.

Then reverse the piece end for end in the chuck, leaving the section 6mm long at full 16mm dia. reducing the 100mm section to size as shown in Item B. The last 25mm should be reduced to M8 clear. The 75mm section should be screwcut M8 left hand thread and finished with a left hand M8 die (**photo 2**). The end of the spindle should be drilled and tapped M2 12mm deep to accommodate an adjustment screw.

The tailstock sleeve can be made next from a 160mm length of 22mm dia. bright mild steel, but it would be a wise worker who checks the dia. of the existing sleeve! Having centred this, drill out one end 7.1mm, or suitable equivalent for M8, drilling as far as possible and then tapping a left hand thread for at least 25mm.

Reverse the piece and drill 10mm from the other end 125mm deep, somewhat further than the length of a standard drill. Then bore out to roughly 1 Morse taper by offsetting the top-slide, (**photo 3**). The final cut should be taken with a 1 MT taper reamer fitted in the existing tailstock sleeve. It is essential, of course, to use a fixed steady, as shown in photo 3, when boring out the tailstock sleeve which has a 3 x 3 mm keyway cut along its length as also shown in photo 4.

The purpose of this keyway is to prevent the sleeve rotating in the tailstock housing. I machined it in a mill/drill but the work could be done in the lathe using a suitable end mill, but because the MD65 cross-slide traverse is only 80mm, the cut would have to be taken in two bites.

The third and final component to be made is the rear extension to the tailstock housing. It is made from a 50mm length of bright mild steel turned to a diameter of 42mm. It could just as well be machined up from aluminium alloy, it is only a spacing piece, after all is said and done. The 22mm hole through the centre could be first drilled out with the largest drill you can find, (provided it is less than 22mm dia.) and bored to final size.

The spindle guiding plate may now be used as

Screwcutting a left hand thread is always less trying than cutting a right hand thread because the tool travels away from the spindle during the cut.

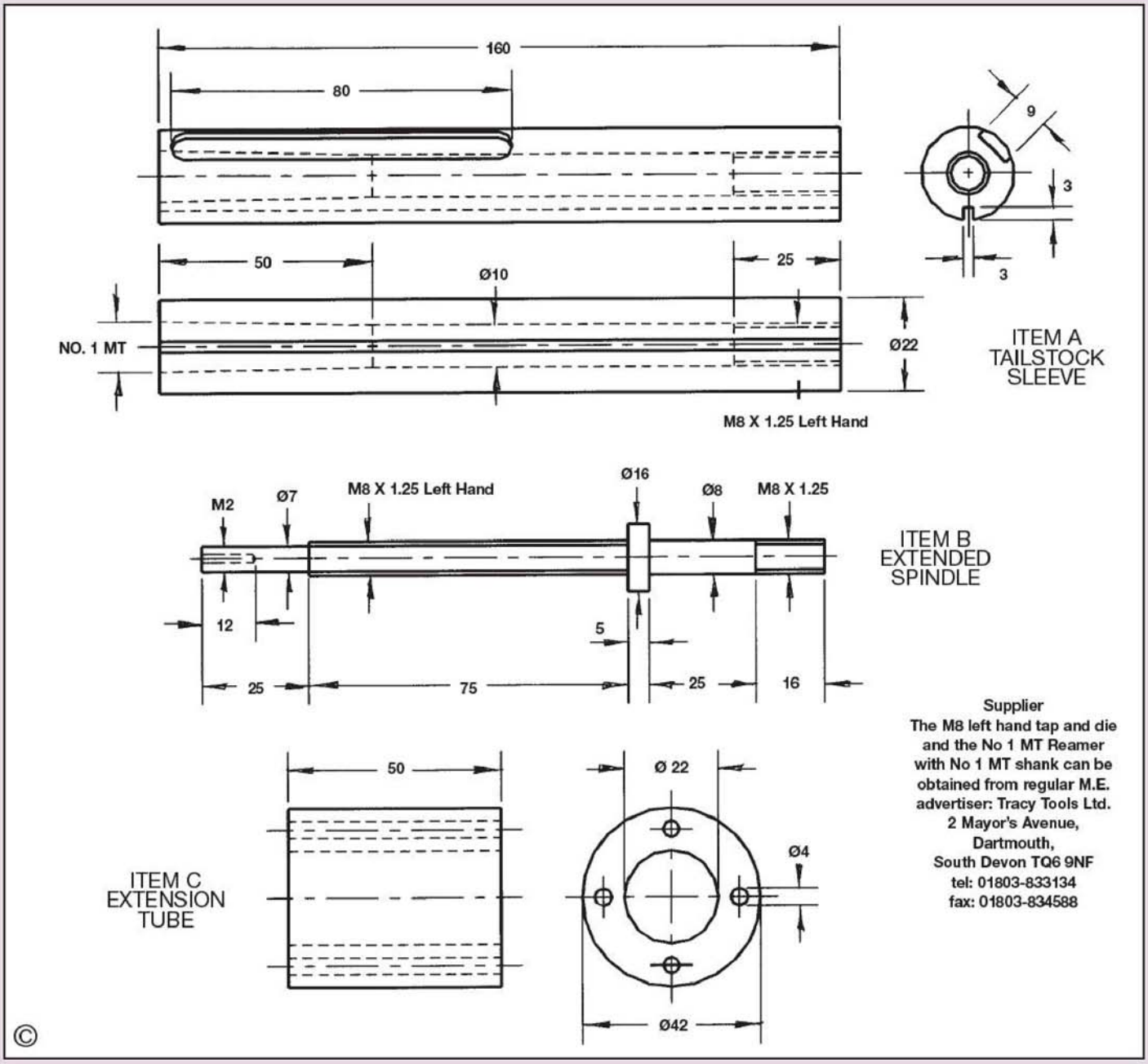
A fixed steady is used to support the workpiece while boring the No. 1 MT barrel nose taper which is finished with a suitable taper reamer.

The new components (from lower left) and those which they replace (top centre). The original tailstock spindle featured a right hand thread.

The new components with a steel rule in position in the groove machined for it and the pan head screws obtained from a local DIY store.

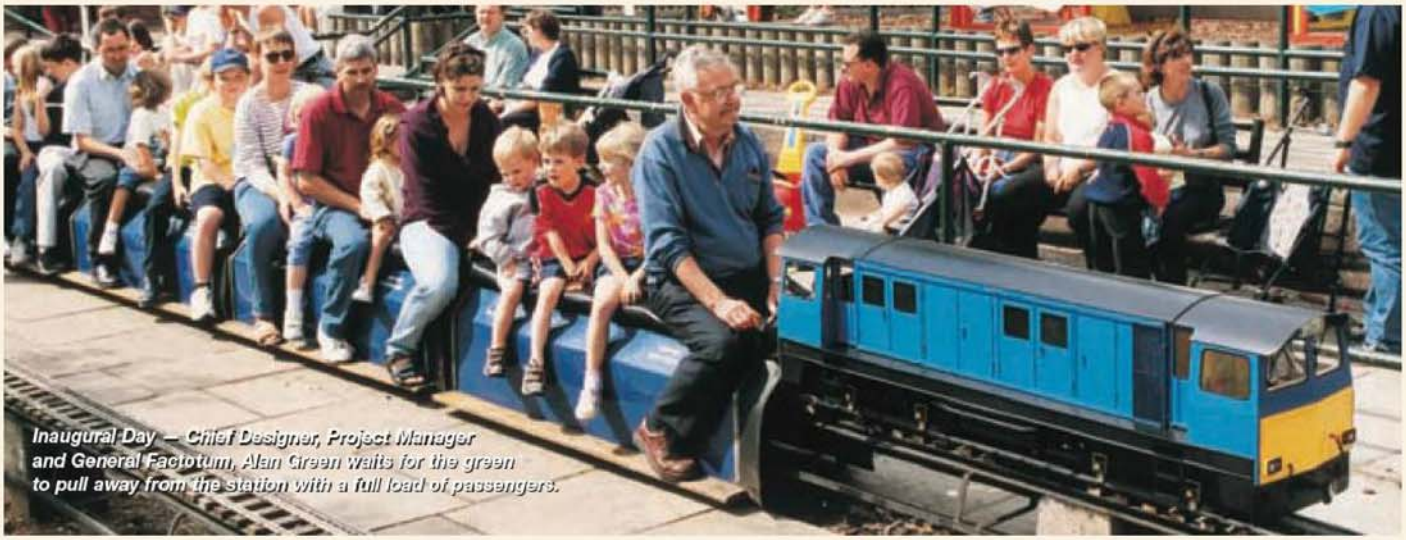
a template, placed over the end of the spacing piece to drill four M4 clearance holes to fix the spindle guiding plate to the tailstock housing with the new 70mm long pan head screws. A PTFE washer should be fitted between the spindle guiding plate to reduce friction when using the tailstock; this washer can be seen at the centre of photo 5.

In the end of the spindle the M2 tapped hole (photo 5, lower left) should be fitted with a suitable pan head screw. The purpose of this screw is to adjust the length of the spindle so that when the sleeve is fully retracted, the tailstock centre is ejected. The final assembly should now appear as shown in **photo 1**.



Supplier

The M8 left hand tap and die and the No 1 MT Reamer with No 1 MT shank can be obtained from regular M.E. advertiser: Tracy Tools Ltd. 2 Mayor's Avenue, Dartmouth, South Devon TQ6 9NF tel: 01803-833134 fax: 01803-834588



Inaugural Day — Chief Designer, Project Manager and General Factotum, Alan Green waits for the green to pull away from the station with a full load of passengers.

THE 'SPIRIT OF URMSTON'

Don Broadley
describes a successful club project which involved a good number of members and has resulted in the building of a powerful workhorse.

In common with many model railway clubs, the Urmston and District Model Engineering Society (UDMES) derives revenue, and not a small amount of pleasure, providing rides for children and adults alike. Of course there is a downside from the mindless few who regrettably pervade many aspects of daily life these days, but it is more than offset in keeping this great hobby of ours alive and, who knows, some or all of our passengers may one day come to take it up at some stage.

Leyland MES are particular friends of ours, in common with many clubs operating here in the North of England. One Spring day, friends from the Leyland Club in the shape of Father and Son Bill and Steve Stockdale, turned up with a new and most impressive electric diesel-outline locomotive obviously capable of doing a serious amount of track work. It is a model of a diesel locomotive 'Vale of Festiniog' now preserved on the Ffestiniog narrow gauge railway in North Wales. What makes this remarkable model even more outstanding is that it was built with reference only to a single photograph and without access to any drawings. It ran faultlessly on our track pulling huge loads all afternoon.

As with other clubs committed to public running, there is always the rush to get a machine on the road at the start of the day and to keep running so long as passengers are available. However, it takes time to load locomotives onto the track and take them off at the end of the day be they steam or diesel/electric. The appeal of this fine privately owned workhorse as a club locomotive was immediately apparent and in no time a decision was made to embark on the design and manufacture of a similar machine, but in our case it was to be for the club and made by members of the club. A visit to the Ffestiniog Railway provided the opportunity for detail measurements of the prototype. We must therefore thank our friends at both Leyland and Ffestiniog for the assistance so readily and willingly afforded to us.

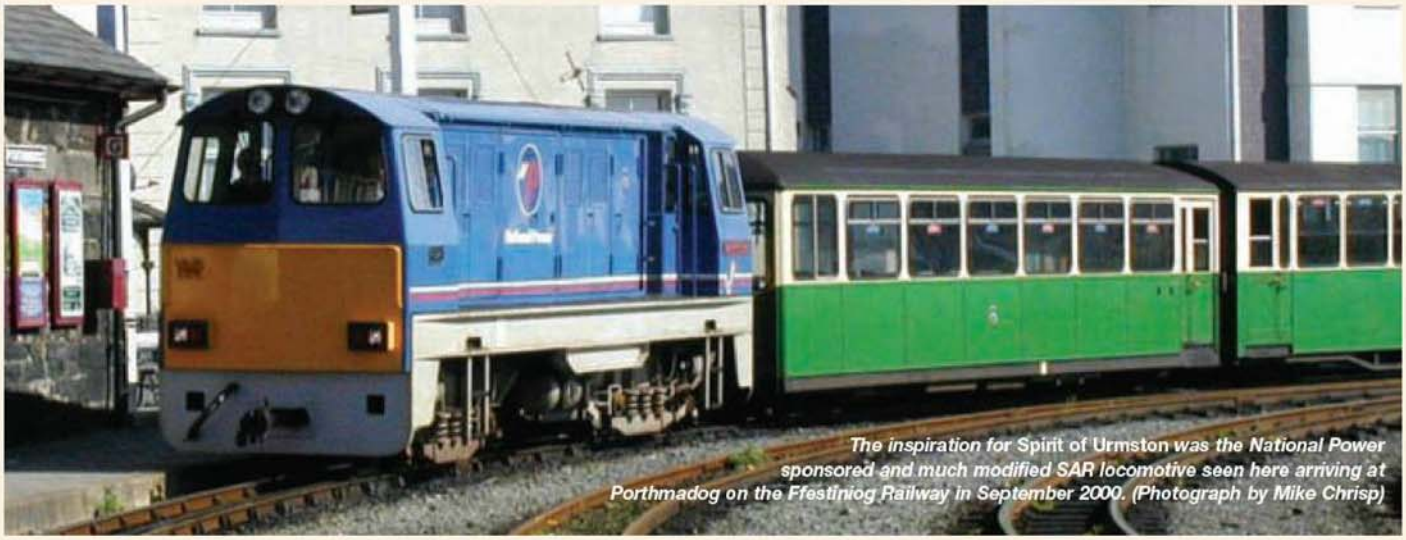
Because as many members as possible would be involved, drawings were clearly necessary. The design was prepared by long standing member Alan Green and were professionally drawn up using CAD, detailing virtually every component. Material was purchased and drawings were set out in the Club House from which members chose the components they were prepared to make. The only problem with this process was that the drawings went too quickly and many members were disappointed that they had failed to get a piece of the action!

Many hands make light work as the saying goes but it must be said that while these machines are quicker to build than a steam locomotive, there are nevertheless a number of tricky bits and pieces. To itemise but a few, one member made his very first patterns for the cast gunmetal bogie frames, the axle-boxes required careful machining, and the ventilation grilles were tricky. Worthy of mention is the MDF bodywork which contained a lot of fine detail. It must also be said that in addition to the design, Alan Green not only acted as project manager but also did a great deal of the work himself.

The prototype is in preservation at the Ffestiniog Railway in North Wales. As we understand it the chassis came from South Africa and, under sponsorship of National Power, a new cab and body superstructure has been added; it is this outline which has been used, albeit significantly shorter than scale. A scale body would have been 9ft. long! We are told that the original machines

Left: The 'Stockdale Prototype' was built by Father and Son team, Bill and Steve Stockdale of Leyland SME and is based on the 'Funky Diesel' prototype which runs on the Ffestiniog Railway.

Right: Spirit of Urmston *on shed and ready for the off. The driver figure in the cab is actually Barbie's boyfriend Ken!*



The inspiration for Spirit of Urmston was the National Power sponsored and much modified SAR locomotive seen here arriving at Porthmadog on the Ffestiniog Railway in September 2000. (Photograph by Mike Chrisp)

went under the name 'Funky Diesel' for reasons unknown to us ... at the moment.

Electrics

There are a total of four 12 volt semi-traction batteries, two paired in series to give 24 volt supply to the two motors, each independently driving a four-wheel bogie by way of a countershaft, the drive being by chain. The 0.5hp motors run at 3,900rpm., each being controlled independently but ganged together to the speed controller. The electronics were sourced from Parkside Electronics, with whom we have no other connection than as satisfied users of their products. The supply also included meters to indicate speed, mileage and current. Braking is by vacuum to the passenger trucks, a small 12 volt compressor of the type used in car tyre inflators which work off a cigar lighter cutting in automatically, sensing vacuum in plastic reservoirs slung from the underside of the chassis.

The vacuum pump and very powerful twin lamps in the forward cab are each run from one of the two 12 volt batteries. Battery supplies have contact breakers, the back contacts of which connect to charging sockets under the chassis, charging being by means of a bespoke charger which automatically regulates the charge and can be left on indefinitely. This charger is also part of the Parkside Electronics equipment. Control of the train, speed and braking, is from a control panel in the rear cab.

Chassis

The chassis, to scale except for length, is a very substantial and heavy welded structure, the frames being of channel section. Plate cross pieces provide support for the bogies, and the batteries rest on a wooden floor.

Bogies

The substantial bogie frames are of cast gunmetal, the horns being an integral part. Stretchers are both rod and plate, the latter supporting the pivots. The axleboxes are borne on an equalising beam which in turn rests on three springs to the frames; they really do look the part. Axlebox travel is quite short. The axles run in double ball races as does the countershaft, the whole being extremely free running. The motors are an integral part of the bogies, supported on four 1/2in. diameter columns.

Cab structure

The cab and main body structure is made from 1/4in. MDF. The dummy door details and windows were cut on a vertical milling machine equipped with digital readout. The many ventilation grilles are in brass, a simple jig being used to ensure an equal spacing of the slats. It is important to get this right otherwise they look awful. The curved roof is in three pieces of steel, the centre section of the bodywork being easily removable to gain access to the batteries and electronics. The driving cab is fully enclosed complete with dummy controls and model driver but a removable hatch gives access to the ergonomically laid out control panel.

Operation

A trawl of club member suggestions resulted in the name *Spirit of Urmston* reflecting the considerable *camaraderie* generated in the club, if indeed it needed it, by the project. The entire project took four months from start to finish, the actual construction phase absorbing about three months. A significant feat, we think you will agree.

In operation, the locomotive lives up to all that was hoped of it. It is extremely powerful, the number of trucks carried does not seem to affect its performance, and it runs all day if necessary. Electrical current drain rarely exceeds 40 amps up the two banks, even when accelerating, the controllers being rated at 100 amps.

So there you have it, we now have a workhorse which can very quickly be set to work and put away at the end of the day. Comprehensive drawings of the chassis and bogies are available at modest cost to cover their production, to other model engineering societies with similar needs.

Acknowledgements

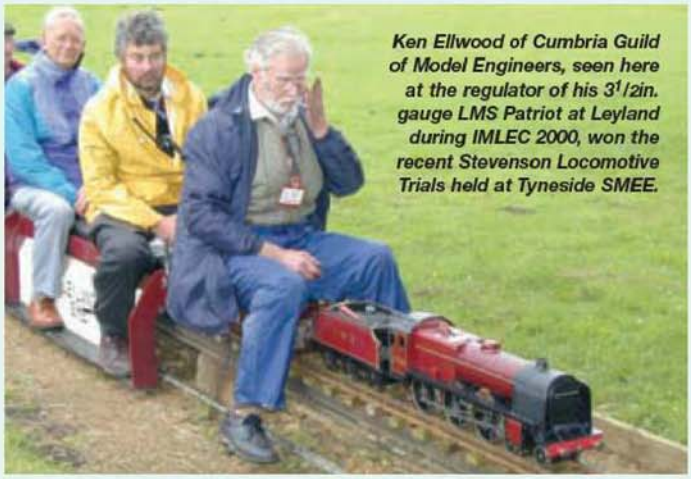
It has been a privilege for me, a relatively new club member, to be involved in this project and the opportunity to write it up hopefully for the benefit of the hobby at large.

Mention must again be made of the huge contribution of Alan Green and his band of willing helpers. Also past and present Chairmen Jim Moyle and Ken Wilcock, not forgetting our hard working Secretary Bryan Cantwell.

Left: Driver's control panel with a vacuum gauge (right) and meters to indicate battery condition, speed and current drawn. The lever at the left is for speed control while that on the right is the vacuum brake lever.

Right: Unmodified sister locomotive to the FR Vale of Ffestiniog at Dinas on the Welsh Highland Railway, September 2000. (Photograph by Mike Chrisp)

CLUB CHAT
With Stan Bray



Ken Ellwood of Cumbria Guild of Model Engineers, seen here at the regulator of his 3½in. gauge LMS Patriot at Leyland during IMLEC 2000, won the recent Stevenson Locomotive Trials held at Tyneside SMEE.

UK News

A group of disabled people visited **Ascot LS** in August and despite their difficulties they all managed to ride on the trains and enjoy the following feast of tea and cakes. The visit was much enjoyed, not only by the visitors but also by the members who entertained them and received pleasure in return for that given. We have no firm news yet regarding the relocation of the track, although negotiations are still in progress and plans for the new and very extensive layout have been prepared. The racecourse authority which owns the land is fully supportive of the move, but little more can be done until the local authority grants planning permission. In August, the club hosted a 7¼in. gauge rally strictly for standard gauge locomotive models which was attended by many visiting locomotives. Worthy of particular note is that a number of elderly models, some from pre-war days were running and still going strong after all these years.

Norwich DSME has purchased a public address system for use at meetings and at any future exhibitions which may be held; it is also expected to be used at regular meetings for the benefit of the hard of hearing, to enable them to follow the speaker's address. The trophy winners at the last club exhibition were as follows: *Albert Peacock Cup, Bailey Bowl and Gold Certificate* to J. W. M. Peterson for a North London Railway tank Locomotive; *Best in Show, Sidney Hines Trophy and Gold Certificate* to A. J. Stevens for a 3½in. centre height lathe to his own design; *Unfinished Trophy and Gold Certificate to* A. R. Durier for *Virginia*. In addition one Gold, ten Silver and a Bronze Certificate were awarded and three entrants were Highly Commended for their work.

Having served for a number of years as Editor of the **Southern Fed. MES** quarterly newsletter, Stan Bishop has declared his intention to stand down at the next SoFed AGM. Traditionally, the holder of the post has been charged with not only producing the newsletter but also maintaining a database of societies, however this latter task has recently passed to committee member John Walker who is now known as Membership Secretary, so at least whoever takes on the job of Editor will have one less chore than Stan has had for most of his time in the Edtorial hot seat. The SoFed Spring Rally will be hosted on 8 May by Birmingham SME but as yet we have no details about the SoFed Autumn Rally.

Members of **Romney Marsh MES** have been asked to submit suitable designs for a track cleaning vehicle which will remove the grease from the track, and have facilities to cope with 5, 3½ and 2½in, gauge rails. The designer of the winning vehicle will receive a prize of a year's free membership. Work on extending the clubhouse and building a new toilet block is making good progress and when we last heard work was expected to commence at any time on the main drainage system. An appeal for donations towards a track extension has brought a good response and the fund is mounting nicely. A considerable sum has been donated as a result of a Novelty Toilet, courtesy of Sheila Percival, which must be quite something. *Please do not write in to enquire about the Novelty Toilet — we have no idea what it is and dare not ask!*

Cambridge MES will host the very popular *Sweet Pea* Rally during the weekend of 15/16 June 2002. An ideal family venue, not only is the extensive track situated at one of the loveliest sites in the country but also there is plenty for the family to enjoy within walking distance of it. The City is noted for its variety of very fine shops and, of course, the University, the colleges of which are scattered throughout the town. Several excellent museums cater for just about every possible interest, there is no shortage of evening entertainment and there are numerous restaurants of all types. Not perhaps within walking distance, but only a very short drive away is the Museum of Technology with its fascinating collection of preserved stationary engines and other artefacts, including the unique rotary beam engine, which alone is worth a visit. The railway itself is well laid out with a large area for picnics, and an excellent supply of refreshments is invariably available in the clubhouse. Easy access from major roads makes the club easy to get to from any part of the country.

Tyneside SMEE reports a very successful Autumn Rally with large numbers of visitors bringing and running models; there was also a display tent with an exhibition of finished and unfinished models. A number of visitors who arrived on Saturday stayed overnight and took part in the Stevenson Locomotive Trials, the winner of the 5in. gauge section being Bill Oliver from Carlisle with an 'Emmett' type locomotive and the 3½in. gauge prize going to Ken Ellwood of West Cumbria who also won the overall title. Work on the new track is making good progress and, when we last heard, the society was about halfway through the major construction work, despite at one stage during a particularly rainy period, water draining into holes prepared for the pillars, bringing work to a halt until the water had drained away.

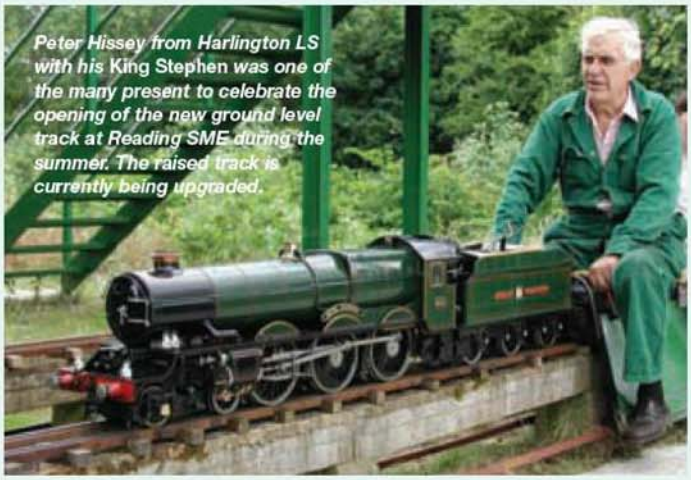
All members of the **Gauge One Model Railway Ass'n** have been issued with a new membership list and a list of suppliers of suitable equipment. The development of interest in the gauge and the Association over the last 20 or so years has been at once both gratifying and surprising. The membership, which at one time stood at about 150, is now counted in thousands and extends into many countries around the world. There are strong contingents in many European countries as well as in North America and the Antipodes, but perhaps more surprising is the fact that there are members living in places such as Brazil, Taiwan, Trinidad and other countries which we do not normally think of as having an interest in model railways or model engineering. The number of suppliers has shown a similar increase rising tenfold from around half dozen to over sixty.

Efforts to obtain a full history of the **Reading SME** are making steady progress with members being urged to dig out old photographs, press cutting, and the like so that a proper historical record can be assembled for the benefit of future members. The raised track has been receiving much attention of late with the replacement of several of the main supporting beams. The final stage of the work will be to upgrade the 2½in. gauge rail ready for the coming running season.

Work on the **Frimley and Ascot LC** club locomotive, an 08 shunter, has lost some of its urgency and members are therefore being asked to volunteer to make parts and do some assembly work. Members are also being urged to join and attend meetings of the Friends of Frimley Lodge Park in order that the society can gain more recognition among the various organisations which use the park in which the track is situated.

The **Model Steam Road Vehicle Society** AGM was well attended, and most of the standing committee were re-elected. That said, the very important post of Rally Co-Ordinator did change hands; Vernon Painter, who has done a magnificent job, decided it was time to stand down and his position has been taken by Ann Freeman and Chris Stubbins who will share the work load. Chairman Tony Putterill had also announced his intention to stand down, but somehow without realising it, he found himself re-elected. He remains unsure as to quite how it happened, but members are very relieved to know that he will remain at the helm for at least another year. Although the society was obliged to vacate its regular meeting place at short notice, the new venue at the Gloucestershire Club has proved more satisfactory, although it is considerably more expensive to hire. The 2002 MSRVS Rally will be held on 29/30 June at the Rugby Club, and the society will be at the Cheddar Models Open Weekend on 13/14 April.

A Sub-Committee of **Bristol SMEE** members has been set up to organise an exhibition at the Thornbury Leisure Centre on 16-18 August. Previous exhibitions organised by this club have been first class and since this has been scheduled during the main holiday period, readers travelling to the West Country may wish to plan ahead and arrange to stop off to visit the exhibition. The possibility of charitable status for the club is still being pursued, and a special meeting has been arranged to give members an opportunity to learn exactly what such action will involve, and to air their views on the subject.



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Guildford MES has a new club locomotive in the form of a 7¼in. gauge *Wren* which had its first trials as a club engine in late September and should prove to be a good investment on public running days. Generous cash donations from members made it possible for the locomotive to be purchased without the club having to dip into its reserve fund. Last year, no fewer than 32 new members joined the society, which may be taken as an indication of how interest in the hobby is generally on the increase, although there can be no doubt that specific interests and activities have changed considerably during recent years. An event which enables newcomers and established members of the club alike to get to know each other is the club's annual Christmas American Style Supper. Everybody brings along a supply of food and drink which is shared among all present and gives everyone an opportunity to get talking with one another.

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World News

Canada

The most recent newsletter from **Bluewater MES** contains drawings and instructions for a design by David Abbott for a device to adapt a drilling machine for use as a tapping tool. Like so many of the best ideas, it is very simple and easy to make while at the same time it is obviously very efficient. Members are being urged to prepare models and other suitable items for display in the Brigden Steam Show in August. This may seem somewhat previous but experience has shown that it is never too early to start making such preparations.

Partly because the weather was ideal with no frost to make participants shiver and the rails too slippery for the trains, the Halloween Night organised by **British Columbia SME** in 2001, always a popular event, was reckoned to be the best ever. In all, 65 pumpkins were suitably prepared, a row of them being arranged just before the tunnel entrance. Inside the tunnel, a couple of fog machines loaned by a movie production company provided the appropriate atmosphere to accompany tape recorded sounds of ghostly noises. On emerging from the tunnel, passengers faces were brushed by strings suspended at a suitable height to heighten the eerie feeling, while suitably dressed and shrouded figures jumped out from the shadows. Further along the track, a specially prepared old time train with ghostly figures was floodlit, more ghosts jumped out from concealed places and more dangling strings brushed against passengers' faces as they entered the next tunnel. Drivers kept their locomotive drain cocks open most of the way round the track, creating an even more ghostly steamy atmosphere. At the end of the ride the ladies, all dressed as witches, gave passengers free Halloween Orange Cookies and hot chocolate.

New Zealand

Some changes to the **Auckland SME** committee were approved at the recent AGM, Allan Gasteen taking over the post of President once more, this time from Alan Emerson who will doubtless be relieved to be able to get on with some model engineering. Gary Farquhar is now the Secretary and can be contacted by telephone on 576-7025. There was plenty to discuss at the first meeting of the new committee and, as far as the railway is concerned, work is to begin on installing new handrails on the 3-way bridge, and a height gauge is to be re-sited at its correct place on the track. A drawing of the proposed new station, which will form the basis of a planning application to the local authority, was tabled for general discussion.

South Africa

In the spring of 1995 12 people, calling themselves the **Highway Group**, some being members of **Pietermaritzburg MES** and some of **Durban SME**, commenced work on a 7¼in. gauge 2-6-2 freelance tank locomotive. On 28 October last, the model was officially handed to **Pietermaritzburg MES** for use on their ground level track at Ruddling Road. The official handing-over ceremony was attended by 10 of the original group, one being unable to attend due to business commitments and sadly the other having passed away. It cannot have been easy for a group to work together on such a project over a protracted period, and completion of the locomotive says much for their enthusiasm and dedication. Finance was assisted by a few anonymous donations, but the cost of the locomotive was mainly borne by the members of the group. Such a project not only requires a great deal of work, but effective discussion and efficient communication between those taking part is also essential; they devised a novel way of ensuring this by arranging inexpensive lunches in a restaurant with the men sitting at one table and their wives at another. After the meal the ladies returned home for tea and cakes while the men continued their meeting. It all sounds to us like a very civilised way to go about things, by involving partners, hopefully internal friction was avoided and the idea is one which others may wish to consider when having to discuss or deal with major projects.

In Memoriam

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

Reg Cross	*SMEE*
Ted Hankinson	*Wigan DSME*
Arthur Jopp	*Model Steam Road Vehicle Society*
Bill Kirk	*Tyneside SMEE*
Maurice Simmonds	*Norwich DSME*
Cyril Sweet	*SMEE*

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.

JANUARY

25 **Colchester SMEE.** *A. Grose: Hertford East Engineman.* Contact L. G. Hammond: 01376-511686.

25 **Hereford SME.** *AGM.* Contact John Arrowsmith: 01432-265151.

25 **Historical MRS (Essex Area).** *Dave Carson: SP/'Frisco Transfer.* Contact Jem Harrison, 27 Colne Place, Basildon, Essex SS16 5UZ.

25-27 **Meridienne Exhibitions. *The London Model Engineering Exhibition*** at the Wembley Exhibition Centre. 10.30am-6pm (Fri/Sat) 10.30am-5pm (Sun). Adults £6, Senior Citizens £5, Children £3, Family (2+3) £15. Enquiries: 01926-614101.

26 **Historical MRS (Bristol Area).** *Jem Harrison: Highbridge Works.* Contact Gerry Nichols: 0117-973-1862.

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

26 **Mashonaland SME.** *Bits & Pieces.* Contact Ian Andrews: 263-4-882893.

26/27 **Southland SME.** *Edendale Crank-Up Days.* Contact Peter Stark: 03-21-89702.

28 **Bedford MES.** *Surgery Night.* Contact Ted Jolliffe: 01234-327791.

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

29 **Chelmsford SME.** *Video Night.* Contact D. Blake: 01376-324205.

29 **Stafford DMES.** *Alan Fozard: The "Turbomotive 2" Project.* Contact Chris Dobbs: 01889-270533.

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

30 **Historical MRS (Bedford Area).** *David Barker: Railway Filmshow.* Contact John Chamney: 01442-851214.

31 **Sutton MEC.** *Mike Stevens: How the Waterways Work.* Contact Mike Dean: 0208-657-5401.

FEBRUARY

1 **Vale of Aylesbury MES.** *Chairman's Cup Night.* Contact Clive Ellam: 01296-623433.

1 **North Norfolk MEC.** *Jim Missen: Engineering Technology 1750-1850.* Contact Gordon Ford: 01263-512350.

1 **Portsmouth MES.** *AGM.* Contact Bob Aldred: 023-92-523366.

1 **Rochdale SMEE.** *Sid Mortimer: Wire Drawing.* Contact Mike Foster: 01706-360849.

2 **SM&EE.** *Gordon & Ann Hatherill: A Look at Slate Quarries.* Contact David Boote: 01202-745862.

3 **Ottawa Valley Live Steamers.** *Meeting.* Contact John Bryant: 761-1109.

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

4 **Leicester SME.** *John Mawby: Insurance — Would You Take The Risk?* Contact Raymond Wallis: 0116-285-8824.

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

5 **Oxford (City of) SME.** *Tim Bryan: Great Western Swindon.* Contact Chris Kelland: 01235-770836.

5 **Romney Marsh MES.** *Bobby Jones: Miniature Railways, etc.* Contact John Wimble: 01797-362295.

5 **Stamford MES.** *Mark Mumby: Concrete.* Contact David Ash: 01780-751211.

5 **Taunton ME.** *Stationary Steam Night.* Contact Don Martin: 01460-63162.

5 **Tyneside SMEE.** *Meeting.* Contact Malcolm Halliday: 0191-262-4141.

6 **Birmingham SME.** *Club Auction.* Contact John Walker: 01789-266065.

6 **Bradford MES.** *Stanley King: Bradford's Trams & Trolleybuses.* Contact Gordon Eddison: 01943-864217.

6 **Bristol SMEE.** *AGM.* Contact Trevor Chambers: 01454-415085.

6 **Chingford DMEC.** *Bits and Pieces.* Contact Martin Masterson: 0208-989-5552.

6 **Guildford MES.** *K. Catchpole: Longmoor Military Railway.* Contact Dave Longhurst: 01428-605424.

6 **Hull DSME.** *Derek Brown: Sharpening Drills.* Contact Chris Parsons: 01964-630563.

7 **Historical MRS (North West Area).** *John Field: Fifty Years at Chester.* Contact David Goodwin: 01224-880018.

7 **Sutton MEC.** *Bits & Pieces.* Contact Mike Dean: 0208-657-5401.

7 **Warrington DMES.** *K. Cruickshank: MetroVick Engineering in World War II.* Contact Bill Underwood: 01606-891225.

8 **Colchester SMEE.** *Auction.* Contact L. G. Hammond: 01376-511686.

8 **Hereford SME.** *Joe Nemeth: Signalling and its Components.* Contact John Arrowsmith: 01432-265151.

9/10 ***Festival of British Railway Modelling*** at Doncaster Exhibition Centre, Doncaster Racecourse. Advance booking (to 25 January 2001): Adults: £4.50, Children: £3, OAP: £4, Family (2+3): £15. Information and Ticket Hotline: 01778-391134/80.

10 **Southland SME.** *Teddy Bear's Picnic.* Contact Peter Stark: 03-21-89702.

10 **Sutton MEC.** *Track Day.* Contact Mike Dean: 0208-657-5401.

11 **Bedford MES.** *Dick Billington: Boilers for the Layman.* Contact Ted Jolliffe: 01234-327791.

11 **Erewash Valley MES.** *Dave Turner: Dart Engine Failures.* Contact Jim Matthews: 01332-705259.

11 **Frimley & Ascot LC.** *Meeting.* Contact Bob Dowman: 01252-835042.

11 **Melton Mowbray DMES.** *Video Night.* Contact Phil Tansley: 0116-2673646.

12 **Birmingham SME.** *Colin Garratt: Special Illustrated Presentation.* Contact John Walker: 01789-266065.

12 **Crawley ME.** *Robin Davies: Chat Night.* Contact Allan Sinclair: 01293-888203.

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

13 **Chingford DMEC.** *Working Models Night.* Contact Martin Masterson: 0208-989-5552.

13 **Historical MRS (East Midlands Area).** *Videos, Slides and Modelling — a Members' Evening.* Contact Mark Shipman: 0194-983-6311.

13 **Norwich DSME.** *Alf Stevens: Tool Sharpening.* Contact Barry Steel: 01603-743372.

13 **St. Albans DMES.** *Frank Banfield: Films.* Contact Roy Verden: 01923-220590.

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

14 **Sutton MEC.** *Ron Churchill: 13th Century Coinage & The Brussels Hoard.* Contact Mike Dean: 0208-657-5401.

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

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

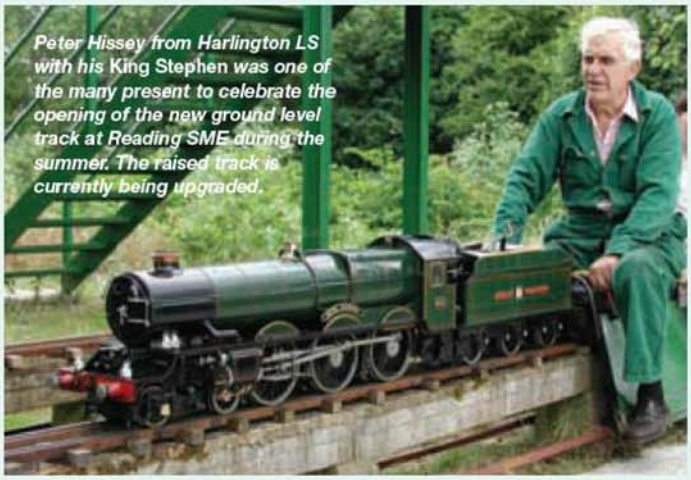
15-17 ***Brighton ModelWorld*** at the Brighton Centre. 10am-5.30pm; Adult: £5, Child/Senior Citizen: £3, Family: £15. Contact Tim Steven: 01444-254057.

16/17 **Erewash Valley MES.** *Steaming Weekend.* Contact Jim Matthews: 01332-705259.

16/17 ***Scale Rail - North West 2001*** at Bolton School Arts & Conference Centre, Bolton. 10 am-6pm (5pm Sunday 17th). Adults £4, Senior Citizens £3.50, Children £2. Contact Iain Gammack: 01204-852681.

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

No. 3* Pender *was built in 1874 for the Isle of Man Railway and now resides in the Power Hall of the Museum of Science & Industry in Manchester, sectioned so that the workings of a steam locomotive can be studied. Locomotive* Lion *(of* Titfield Thunderbolt *notoriety) can be found further down the hall.



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World News

Canada

The most recent newsletter from **Bluewater MES** contains drawings and instructions for a design by David Abbott for a device to adapt a drilling machine for use as a tapping tool. Like so many of the best ideas, it is very simple and easy to make while at the same time it is obviously very efficient. Members are being urged to prepare models and other suitable items for display in the Brigden Steam Show in August. This may seem somewhat previous but experience has shown that it is never too early to start making such preparations.

Partly because the weather was ideal with no frost to make participants shiver and the rails too slippery for the trains, the Halloween Night organised by **British Columbia SME** in 2001, always a popular event, was reckoned to be the best ever. In all, 65 pumpkins were suitably prepared, a row of them being arranged just before the tunnel entrance. Inside the tunnel, a couple of fog machines loaned by a movie production company provided the appropriate atmosphere to accompany tape recorded sounds of ghostly noises. On emerging from the tunnel, passengers faces were brushed by strings suspended at a suitable height to heighten the eerie feeling, while suitably dressed and shrouded figures jumped out from the shadows. Further along the track, a specially prepared old time train with ghostly figures was floodlit, more ghosts jumped out from concealed places and more dangling strings brushed against passengers' faces as they entered the next tunnel. Drivers kept their locomotive drain cocks open most of the way round the track, creating an even more ghostly steamy atmosphere. At the end of the ride the ladies, all dressed as witches, gave passengers free Halloween Orange Cookies and hot chocolate.

New Zealand

Some changes to the **Auckland SME** committee were approved at the recent AGM, Allan Gasteen taking over the post of President once more, this time from Alan Emerson who will doubtless be relieved to be able to get on with some model engineering. Gary Farquhar is now the Secretary and can be contacted by telephone on 576-7025. There was plenty to discuss at the first meeting of the new committee and, as far as the railway is concerned, work is to begin on installing new handrails on the 3-way bridge, and a height gauge is to be re-sited at its correct place on the track. A drawing of the proposed new station, which will form the basis of a planning application to the local authority, was tabled for general discussion.

South Africa

In the spring of 1995 12 people, calling themselves the **Highway Group**, some being members of **Pietermaritzburg MES** and some of **Durban SME**, commenced work on a 7¼in. gauge 2-6-2 freelance tank locomotive. On 28 October last, the model was officially handed to **Pietermaritzburg MES** for use on their ground level track at Ruddling Road. The official handing-over ceremony was attended by 10 of the original group, one being unable to attend due to business commitments and sadly the other having passed away. It cannot have been easy for a group to work together on such a project over a protracted period, and completion of the locomotive says much for their enthusiasm and dedication. Finance was assisted by a few anonymous donations, but the cost of the locomotive was mainly borne by the members of the group. Such a project not only requires a great deal of work, but effective discussion and efficient communication between those taking part is also essential; they devised a novel way of ensuring this by arranging inexpensive lunches in a restaurant with the men sitting at one table and their wives at another. After the meal the ladies returned home for tea and cakes while the men continued their meeting. It all sounds to us like a very civilised way to go about things, by involving partners, hopefully internal friction was avoided and the idea is one which others may wish to consider when having to discuss or deal with major projects.

In Memoriam

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

Reg Cross	*SMEE*
Ted Hankinson	*Wigan DSME*
Arthur Jopp	*Model Steam Road Vehicle Society*
Bill Kirk	*Tyneside SMEE*
Maurice Simmonds	*Norwich DSME*
Cyril Sweet	*SMEE*

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.

JANUARY

25 **Colchester SMEE.** *A. Grose: Hertford East Engineman.* Contact L. G. Hammond: 01376-511686.

25 **Hereford SME.** *AGM.* Contact John Arrowsmith: 01432-265151.

25 **Historical MRS (Essex Area).** *Dave Carson: SP/'Frisco Transfer.* Contact Jem Harrison, 27 Colne Place, Basildon, Essex SS16 5UZ.

25-27 **Meridienne Exhibitions. *The London Model Engineering Exhibition*** at the Wembley Exhibition Centre. 10.30am-6pm (Fri/Sat) 10.30am-5pm (Sun). Adults £6, Senior Citizens £5, Children £3, Family (2+3) £15. Enquiries: 01926-614101.

26 **Historical MRS (Bristol Area).** *Jem Harrison: Highbridge Works.* Contact Gerry Nichols: 0117-973-1862.

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

26 **Mashonaland SME.** *Bits & Pieces.* Contact Ian Andrews: 263-4-882893.

26/27 **Southland SME.** *Edendale Crank-Up Days.* Contact Peter Stark: 03-21-89702.

28 **Bedford MES.** *Surgery Night.* Contact Ted Jolliffe: 01234-327791.

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

29 **Chelmsford SME.** *Video Night.* Contact D. Blake: 01376-324205.

29 **Stafford DMES.** *Alan Fozard: The "Turbomotive 2" Project.* Contact Chris Dobbs: 01889-270533.

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

30 **Historical MRS (Bedford Area).** *David Barker: Railway Filmshow.* Contact John Chamney: 01442-851214.

31 **Sutton MEC.** *Mike Stevens: How the Waterways Work.* Contact Mike Dean: 0208-657-5401.

FEBRUARY

1 **Vale of Aylesbury MES.** *Chairman's Cup Night.* Contact Clive Ellam: 01296-623433.

1 **North Norfolk MEC.** *Jim Missen: Engineering Technology 1750-1850.* Contact Gordon Ford: 01263-512350.

1 **Portsmouth MES.** *AGM.* Contact Bob Aldred: 023-92-523366.

1 **Rochdale SMEE.** *Sid Mortimer: Wire Drawing.* Contact Mike Foster: 01706-360849.

2 **SM&EE.** *Gordon & Ann Hatherill: A Look at Slate Quarries.* Contact David Boote: 01202-745862.

3 **Ottawa Valley Live Steamers.** *Meeting.* Contact John Bryant: 761-1109.

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

4 **Leicester SME.** *John Mawby: Insurance — Would You Take The Risk?* Contact Raymond Wallis: 0116-285-8824.

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

5 **Oxford (City of) SME.** *Tim Bryan: Great Western Swindon.* Contact Chris Kelland: 01235-770836.

5 **Romney Marsh MES.** *Bobby Jones: Miniature Railways, etc.* Contact John Wimble: 01797-362295.

5 **Stamford MES.** *Mark Mumby: Concrete.* Contact David Ash: 01780-751211.

5 **Taunton ME.** *Stationary Steam Night.* Contact Don Martin: 01460-63162.

5 **Tyneside SMEE.** *Meeting.* Contact Malcolm Halliday: 0191-262-4141.

6 **Birmingham SME.** *Club Auction.* Contact John Walker: 01789-266065.

6 **Bradford MES.** *Stanley King: Bradford's Trams & Trolleybuses.* Contact Gordon Eddison: 01943-864217.

6 **Bristol SMEE.** *AGM.* Contact Trevor Chambers: 01454-415085.

6 **Chingford DMEC.** *Bits and Pieces.* Contact Martin Masterson: 0208-989-5552.

6 **Guildford MES.** *K. Catchpole: Longmoor Military Railway.* Contact Dave Longhurst: 01428-605424.

6 **Hull DSME.** *Derek Brown: Sharpening Drills.* Contact Chris Parsons: 01964-630563.

7 **Historical MRS (North West Area).** *John Field: Fifty Years at Chester.* Contact David Goodwin: 01224-880018.

7 **Sutton MEC.** *Bits & Pieces.* Contact Mike Dean: 0208-657-5401.

7 **Warrington DMES.** *K. Cruickshank: MetroVick Engineering in World War II.* Contact Bill Underwood: 01606-891225.

8 **Colchester SMEE.** *Auction.* Contact L. G. Hammond: 01376-511686.

8 **Hereford SME.** *Joe Nemeth: Signalling and its Components.* Contact John Arrowsmith: 01432-265151.

9/10 ***Festival of British Railway Modelling*** at Doncaster Exhibition Centre, Doncaster Racecourse. Advance booking (to 25 January 2001): Adults: £4.50, Children: £3, OAP: £4, Family (2+3): £15. Information and Ticket Hotline: 01778-391134/80.

10 **Southland SME.** *Teddy Bear's Picnic.* Contact Peter Stark: 03-21-89702.

10 **Sutton MEC.** *Track Day.* Contact Mike Dean: 0208-657-5401.

11 **Bedford MES.** *Dick Billington: Boilers for the Layman.* Contact Ted Jolliffe: 01234-327791.

11 **Erewash Valley MES.** *Dave Turner: Dart Engine Failures.* Contact Jim Matthews: 01332-705259.

11 **Frimley & Ascot LC.** *Meeting.* Contact Bob Dowman: 01252-835042.

11 **Melton Mowbray DMES.** *Video Night.* Contact Phil Tansley: 0116-2673646.

12 **Birmingham SME.** *Colin Garratt: Special Illustrated Presentation.* Contact John Walker: 01789-266065.

12 **Crawley ME.** *Robin Davies: Chat Night.* Contact Allan Sinclair: 01293-888203.

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

13 **Chingford DMEC.** *Working Models Night.* Contact Martin Masterson: 0208-989-5552.

13 **Historical MRS (East Midlands Area).** *Videos, Slides and Modelling — a Members' Evening.* Contact Mark Shipman: 0194-983-6311.

13 **Norwich DSME.** *Alf Stevens: Tool Sharpening.* Contact Barry Steel: 01603-743372.

13 **St. Albans DMES.** *Frank Banfield: Films.* Contact Roy Verden: 01923-220590.

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

14 **Sutton MEC.** *Ron Churchill: 13th Century Coinage & The Brussels Hoard.* Contact Mike Dean: 0208-657-5401.

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

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

15-17 ***Brighton ModelWorld*** at the Brighton Centre. 10am-5.30pm; Adult: £5, Child/Senior Citizen: £3, Family: £15. Contact Tim Steven: 01444-254057.

16/17 **Erewash Valley MES.** *Steaming Weekend.* Contact Jim Matthews: 01332-705259.

16/17 ***Scale Rail - North West 2001*** at Bolton School Arts & Conference Centre, Bolton. 10 am-6pm (5pm Sunday 17th). Adults £4, Senior Citizens £3.50, Children £2. Contact Iain Gammack: 01204-852681.

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

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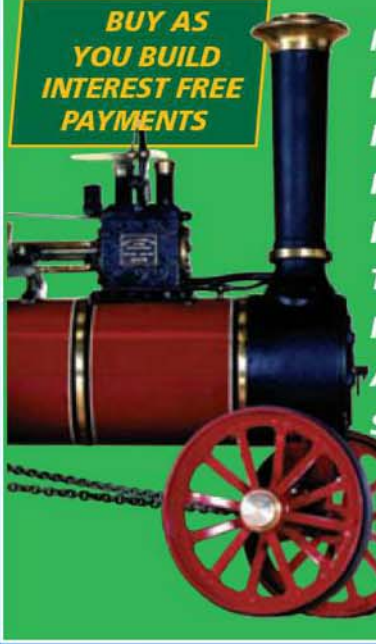

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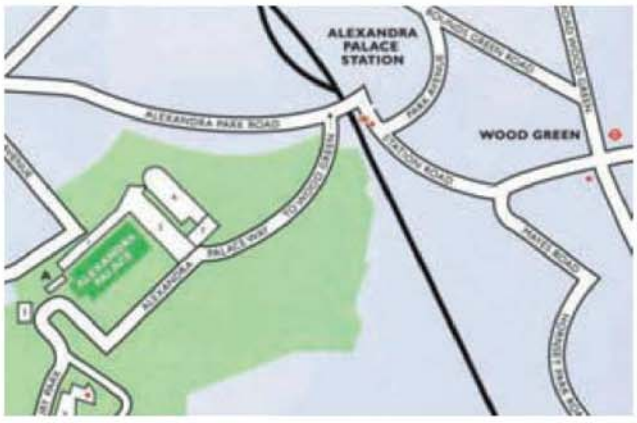

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The Art of Welding **WPS 7**
W.A.Vause
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The author is an instructor in metal work and allied crafts and describes clearly all the processes likely to be encountered by the hobbyist in a model or light engineering workshop.
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Soldering & Brazing **WPS 9**
Tubal Cain
Joining metal by one form or another of soft and hard soldering, or brazing with various alloys, are run-of-the-mill jobs in model and light engineering workshops.
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Saws & Sawing **WPS 10**
Ian Bradley
This book examines all types of saw, hand and machine, their use, maintenance and useful tables relating to various applications.
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Electroplating **WPS 11**
J.Poyner
This title will be of value to model engineers and small workshops wishing to plate with any of the customary metals using simple equipment.
1987 *0-85242-862-4* *210x148mm*
64 pages *Illustrated paperback* *£4.25*

Drills, Taps & Dies **WPS 12**
Tubal Cain
In this book, Tubal Cain discusses drills and drilled holes and threading with taps and dies, primarily by hand. Imperial and metric sizes plus conversions are included together with all standard thread gauges.
1987 *0-85242-866-9* *210x148mm*
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Making Small Workshop Tools **WPS 14**
Sean Bray
Making 14 simple but useful adjuncts to the tool kit for bench and lathe use, taking no more than 1 to 4 hours or involving special materials, yet each able to save considerable time in use as well as aiding accuracy.
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Tubal Cain
Tubal Cain discusses all the practical aspects of the subject, with many photographs to illustrate specific points.
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Electric Motors **WPS 16**
Jim Cox
Principles, characteristics, operations, installation, speed control, braking etc. plus generators, safety, testing and a useful section on identifying and applying scrap motors.
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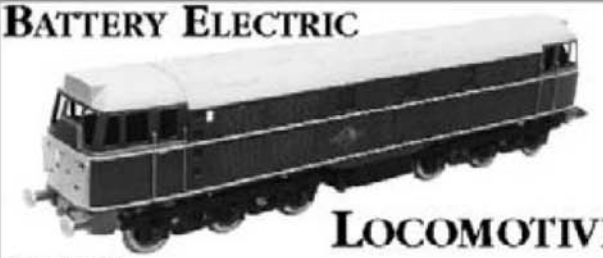

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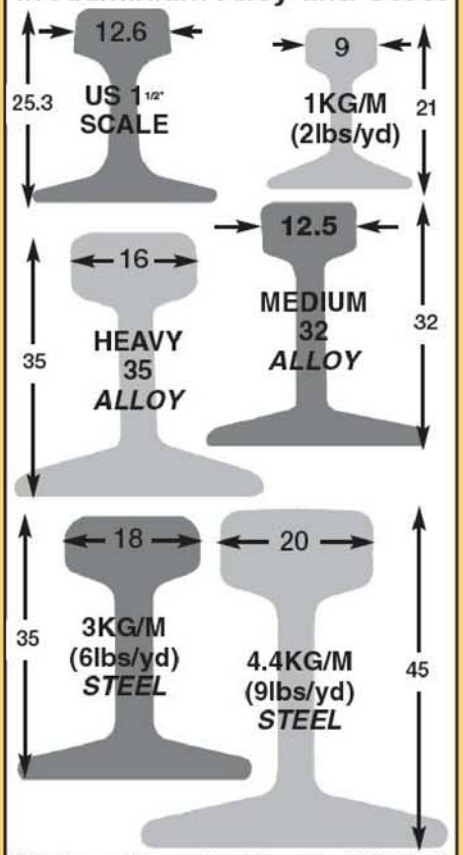

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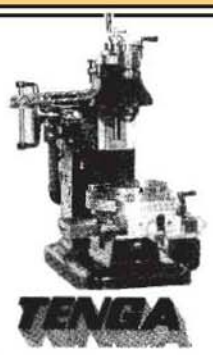

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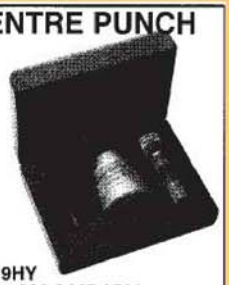

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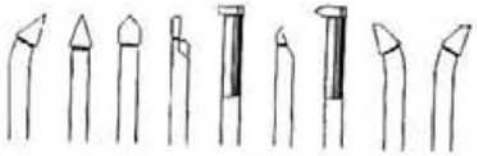

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