MODEL ENGINEER

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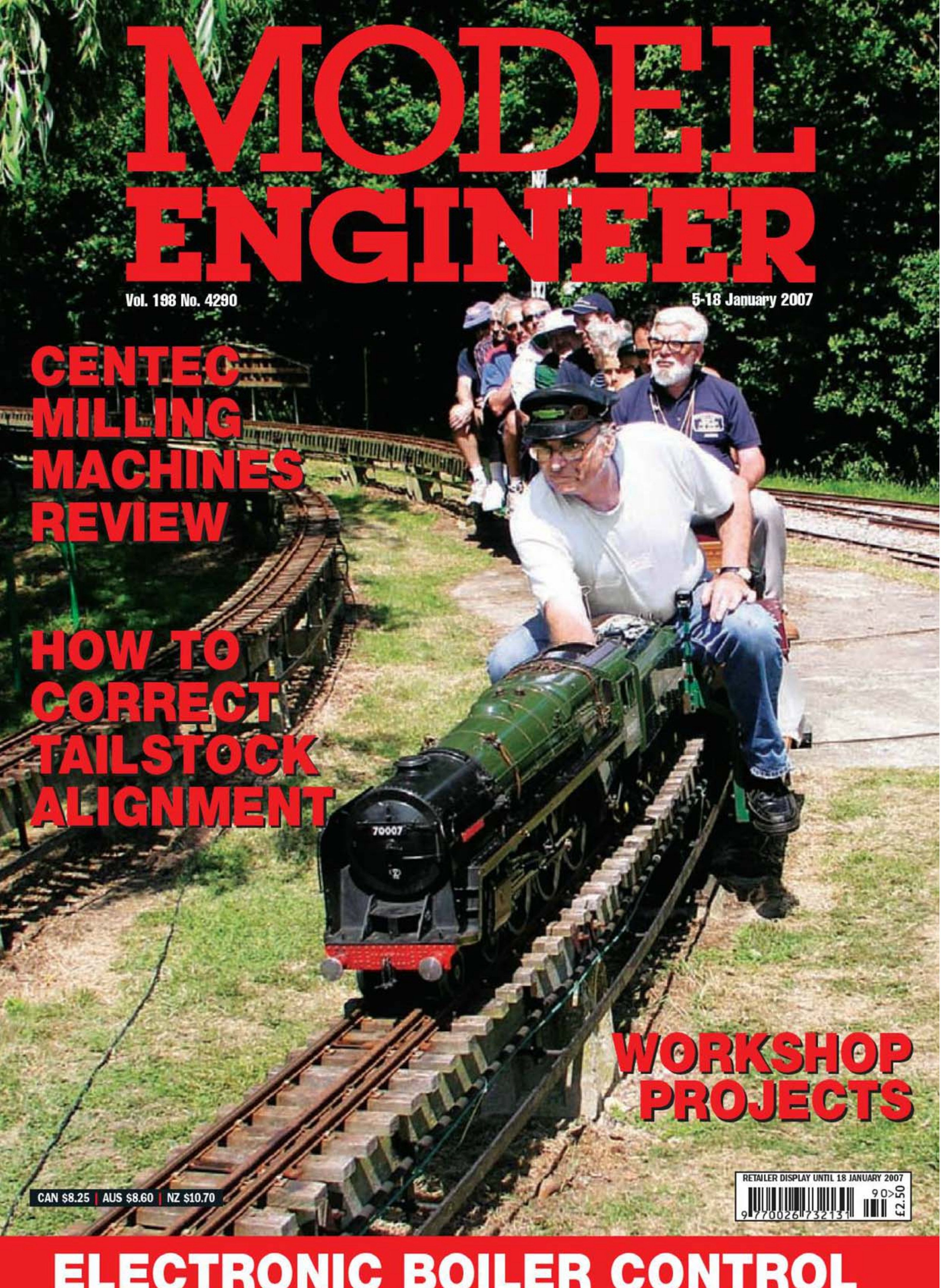

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On the cover ...

Memories of a super summer. Len Steel, driving Britannia, *hauls a good load around the tricky Fareham track at IMLEC 2006. We shall have details of IMLEC 2007 in the next issue of* Model Engineer, *including details of the Llanelli track, and how to enter. Once again there will be classes for 5in. and $3^1/_2$in. gauges, and a special one for previous winners of the event, like Len.*

(Photograph by David Carpenter)

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‡ REDUCED CBB209 was £140.94 Inc.VAT

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TRACTION ENGINE

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Look out for our adverts and some exciting announcements in the coming year.

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Wishing you all a very Happy New Year!
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SMOKE RINGS
With the Editors

Secret steam

The stationary engine photo is from Strathclyde University. They have a Thomas Russell steam engine of 1887 that was used for generating electricity in the old royal college, a Paxman which is said to be a brilliant engine to run but very manual to start, and a Ruston diesel.

These engines in Glasgow do run, but are a well-kept secret. Sadly their days are now numbered due to engineering moving on from the college.

One of the stationary engines at Strathclyde, under threat.

Clock this

What promises to be the largest meeting for clockmakers in the UK for some time takes place on Sunday March 4, 2007. The Midlands Branch of the British Horological Institue is hosting a national meeting with an open invitation to everyone with an interest in the making of clocks.

It is anticipated that some 100 delegates will attend, to hear presentations by David Poole FBHI, Richard Stephen and experts from the South London Branch of Clockmakers. There will be plenty of time to ask questions, including a forum along the lines of '*Clockmakers Question Time*'.

There will also be an exhibition of clocks made by Midlands' members, John Wilding, the South London Branch and the speakers. John Wilding's clocks will appear by courtesy of Roger Drake of Ritetime Publishing who will have available John Wilding's books, videos, etc. The meeting will be opened by the President of the BHI, Jill Hadfield HonFBHI.

The ticket price includes morning coffee, buffet lunch and afternoon tea. During these breaks in proceedings, delegates will be able to examine the clocks on display and talk to speakers and exhibitors.

David Poole is a renowned clockmaker, an accomplished speaker and has recently been elected as Master-elect for 2007 of the Worshipful Company of Clockmakers. He will use specific examples of problems he has encountered in his current project, a month going regulator with calendar and moonphase dials, to illustrate general principles in clockmaking.

Dick Stephen has published extensively in the *Horological Journal* and he will be talking on particular subjects that have been suggested by BHI members, including the use of modern materials and CNC machining, a technique whose equipment is now commercially available and within the means of many clockmakers. The subject of finishing to is expected to feature. Incidentally we hope to have a series on Dick Stephen's latest, highly original and very elegant clock in the near future.

Members of the South London Branch will be explaining their team approach and some of the challenges that make clock making so absorbing.

This event takes place at the Stonebridge Golf & Conference Centre, close to the National Exhibition Centre, Birmingham International railway station, and the M42 in Warwickshire. There is ample parking.

The cost is £27.50 if booked before February 4, 2007. (After February 4 there will be an additional late-booking fee of £2.50.) For enquiries contact: **info@rtclockmaker.co.uk** or the address below. To book, please send cheques made out to 'BHI, Midlands Branch' to:

Mr. R. Thomas, Grad BHI
3 Stannells Close
Stratford-upon-Avon
Warwickshire
CV37 9SA

Stainless steel

We are obliged to those readers who wrote to us after the appearance of the editorial note in *Road Steam* (*M.E.* 4284, 13 October 2006) concerning the date when stainless steels were developed. Most correspondents give credit for the invention of stainless steels to Harry Brearley of the Brown-Firth research laboratory in Sheffield – something we ourselves would have done until we checked the piece on stainless steels published on the internet on the 'free encyclopedia' Wikipedia website.

In 1913 Brearley was involved with the development of materials for corrosion resistant gun barrels and discovered, allegedly accidentally, how to make martensitic stainless steel. His process was subsequently brought to production and a legend was born.

However, during the same period similar developments were taking place at the Krupp Iron Works in Germany and in the USA. Eduard Maurer and Benno Strauss developed an austenitic stainless alloy in Germany, whilst in the USA Christian Dantsizen and Frederick Becket were working on the industrialisation of ferritic stainless steel.

Even as far back as 1821, a French metallurgist called Pierre Berthier had discovered the corrosion resistance of iron-chromium alloys, though the production techniques of the day meant that the materials produced were too brittle for practical use.

In the 1890s Hans Goldschmidt of Germany developed a process for producing carbon-free chromium and this led to materials that could be called stainless steels being developed by people like Leon Guillet of France. In 1911, Philip Monnartz of Germany wrote a paper on the relationship between chromium content and the corrosion resistance of iron-chromium alloys.

So, it seems that the development of stainless steels was a rather complex affair involving the work of many individuals from several countries. We, therefore, stand by the carefully worded comment in the *Road Steam* article. It is just possible, though unlikely, that the designers of the Savage *Universal Carrier* could have specified stainless steel for parts of the vehicle. However, why wasn't the stuff used more during the 1920s when it was commercially available in quantity? Was it too difficult to machine by the processes of the day or were its mechanical properties suspect?

Correction

Readers might have noticed that the Plans Handbook has been re-published recently. Sold under the *Model Engineers' Workshop* banner, it contains details of sets of drawings of many of the designs published in *Model Engineer* over the years.

A couple of details of castings suppliers were not updated from the previous version. Unfortunately Norman Spink of Chesterfield died about two years ago, and his business was taken on by:

Blackgates Engineering
Unit 1 Victory Court
Flagship Square
Shawcross Business Park
Dewsbury
West Yorkshire
WF12 7TH
www.blackgates.co.uk
T: 01924 466000
F: 01924 488888
E: **sales@blackgates.co.uk**

Also Dave Goodwin of Rishton, Blackburn has retired. His 2½in. gauge locomotive castings are now available from the National 2½" Gauge Assocation.

Auction items

Special Auction Services have two interesting locomotives for sale in the next auction of model engineering items on January 20.

The first is a 2½in. gauge Martin Evans *Eagle* to the design first published in *Practical Mechanics* and based on the GNR(I) Class V. This has the chassis basically complete with cylinders and motion work and includes the drawings and copies of the articles from *Practical Mechanics.*

The second locomotive is also 2½in gauge and is a *Flying Scotsman* to the design by Bassett-Lowke from 1940 and again published in *Practical Mechanics*. The locomotive has the chassis almost complete as is the spirit fired water tube boiler and is complete with all drawings and castings. The well detailed eight wheel tender is complete apart from some minor details.

There are also several other engineering lots in the auction.

Special Auction Services are located just to the west of Reading on the A4 and can be contacted on 01189-712949 or at **www.specialauctionservices.com**

POST BAG

Russian restoration

SIRS, - Thanks to the assistance of Mr. Chrisp, I joined the exciting world of *Model Engineer* 10 years ago and have been taking it ever since. In 1998, on the 100th anniversary of *Model Engineer* I showed my 1:32 scale model of a Russian 2-6-2 steam locomotive at Olympia, and in 2000 at Sandown Park I received a Bronze Medal for a model of a 6-ton steam crane in 1:10 scale.

After this I began to upgrade my workshop in order to prepare another model for the next exhibition, but an event occurred which gradually changed my life; a full size 'P' series locomotive arrived at our depot. This class of locomotive has a 2-10-0 wheel arrangement and a Vanderbilt type tender. The class was built in 1906 in small numbers.

After some negotiations I was given permission to carry out a rebuild of the engine. I started by disconnecting the tender and moving the engine into the depot where I started removing the old paint and a thick layer of grease and dirt. In some places this was over 1in. thick. With the use of a mechanical scraper and a propane torch, the 28 metre engine was cleaned down to the bare metal.

After this effort, I received assistance from a railway engineer who revived his steam engine past and also a student mechanical engineer who put aside his diploma work to help. We connected the engine and tender and started repairing the mechanical parts but our only craftsman left us to work on another site and to my great disappointment I could not finish the work at 'one breath'.

I had postponed all my other work while being engaged in restoring the engine, so I was forced to return to more trivial affairs. With the locomotive 80% complete we decided to get together once more to try to complete the work.

If any enthusiasts from Britain would join us and take part in test running we would receive them with pleasure. We have very picturesque non-electrified tracks.

Mike Chernishev, Belgorod, Russia.

Youngsters in clubs

SIRS, - Thank you for publishing the club profile featuring the Worthing & District Society of Model Engineers (*M.E.* 4284, 13 October 2006). The *"& District"* part of the title casts a wide net. We have regular members from as far afield as Brighton, Horsham, Chichester and many places in between, so one might call it the 'Worthing and most of Sussex Society'.

We like to let people know that it is not just an 'Old Geezer's' club and we actively encourage young members, of whom we have a healthy number. We also organise courses for children which provide hands-on experience in simple scientific and engineering principles. In the summer we run, in conjunction with the local council, what we in the society call our 'Kids Courses'. Each course is conducted by a group of several society volunteers over three days and, in a reversal of current nanny trends in this country, we allow children as young as 10 years of age to use, under close supervision of course, such things as modelling knives, tin snips, gas soldering torches and even a miniature Unimat lathe. Each course has up to 12 children, girls sometimes, as well as boys. They build simple rubber-powered model aircraft, soldered tinplate candle-powered 'pop-pop' boats and very basic steam powered turbines. They would have to be, wouldn't they, if they are to be completed in three days, along with everything else? Admittedly there is, of necessity, a degree of pre-fabrication. None of the activities is any more dangerous than the things the older members would have done in their own pre-teen years when schools once had woodworking and metal working workshops.

I would be interested to know, in these litigious 'compensation-culture' times in which Scout Groups and Boy's Brigade companies are closing down through lack of willing adult help and, especially as schools no longer conduct hands-on manual work studies, how other societies feel about encouraging youngsters into our clubs and societies? Should we stick our necks out or should we let everything just fizzle out?

A letter published in the same issue of *M.E.* warns of a *"highly dangerous"* activity in pressurising 2-litre plastic drinks bottles, apparently ignoring the fact that they are designed to withstand the pressure of the dissolved gas in the drink and probably a whole lot more.

I have helped supervise the use of rocket propelled plastic fizzy drinks bottles at the University of Brighton Mechanical and Manufacturing Engineering Department for many years. It is a cheap and easy way of demonstrating various principles from a commercially produced kit of parts supplied for the purpose (minus the fizzy drink bottle which the student is usually well able to contribute). Has anybody ever measured the pressure build-up of a fizzy drink in a well-shaken bottle?

And what about Champagne bottles? I was once hit in the eye with a high-velocity Champagne cork. I didn't sue anybody. It cannot be the only occasion this has happened to anybody and yet, I notice, Champagne is still supplied in the traditional way.

David Lewins, Sussex.

Small I/C engine

SIRS, - Regular readers may remember my photograph and request for information about a tiny 1cc 2-stroke petrol engine which I made from drawings during the 1940s. I cannot recall from where I got the drawings but feel sure I had a single proper blue print about 18-20in. square. As I subscribed to the *English Mechanics* magazine at the time, this may have been the source of the construction article(s) and drawing.

Two readers kindly replied and both agree on the original design which was published in the pre-war issues (1936-1938) of Newnes *Practical Mechanics*. W. H. Deller described his 1cc engine in November 1936 as a prelude to a series of construction notes, sketches, photographs and drawings starting in January 1938 and ending in August 1938.

Both respondents to my original query had the actual magazines and one kindly sent me copies with further information that *English Mechanics* also carried a design for a 1cc engine known as the 'E.M.I.', and that Hallam of Poole, Dorset put out a tiny engine known as the 'Little Briton'.

Mike Chernishev's Russian 2-10-0 locomotive.

A fine job of restoration on the Vanderbilt type tender of the Russian 2-10-0.

Peter Spenlove-Spenlove's 1cc 2-stroke engine cylinder and spark plug.

I remember Hallam for rough light alloy parts. The initials E.M.I. also ring a bell with my memory.

In comparing my engine with the 1938 Deller drawings, I find several design differences, minor but important changes. I finished the engine by 1945 or 1946.

My new request is; has anybody got copies of *English Mechanics* which includes the E.M.I.? I wish to include the pre-war *Practical Mechanics* (as sent by a Southsea reader) and the *English Mechanics* versions in the paperwork submitted to the SMEE to accompany my actual, now worn out engine.

Peter Spenlove-Spenlove, Leics.

Cordless drill repair

SIRS, - About five years ago I bought a Parkside cordless drill. It came in a carry case with one battery and a charger, in time the battery went '*kaput*' due to a leak, result, one perfectly good machine but no power source.

As luck would have it our local Lidl store had a sale on. Silly prices were the order of the day, one new Parkside drill with two batteries and a charger for £25. Spare batteries were £10 each.

Having seen batteries in B&Q priced at £30 each I got greedy and bought two spares and rushed home to find that the new batteries wouldn't fit my older drill!

After a lot of thought I dismantled both types of battery and found that the guts were the same so I clicked the new innards into my old casing and hey presto it worked. I hope this may be of some use to other readers.

John Campbell, Antrim.

Out of print books

SIRS, - Some time ago I was looking for a book that, unfortunately, was printed some years ago and well out of its sell by date. I gave up looking as I thought that I would never see or be able to read this particular book again. I was browsing on the Internet when I was lucky enough to come across a website and I found the book that I was looking for.

The website is **www.martinbott.com** and the company is situated in Lostock, Bolton, telephone number (+44)01204-691489

I phoned the company up just to see if this particular book was still available and the young lady who answered my call was most helpful and very polite and the book was put aside until they received my cheque. I received the book within a few days and the service provided was excellent.

I believe that many model engineers may be interested in what they have to offer as their prices are very reasonable indeed. As usual I do not have anything to do with this company I am just a very satisfied customer which, unfortunately, is rather unusual in this day and age .

C. G. Williams, Birmingham.

Bench maker needed

SIRS, - Some time ago I approached the then Editor with a view to finding someone who could make a pair of special work benches for me.

I have now finished the concept drawings apart from the material sizes and am looking for someone to sort out the safe working load calculations and to build the two benches.

The benches are for a Cobra lathe and a Cobra small mill.

I. Cooke, Birmingham.

Charles Rolls and Nemett

SIRS, - There was a slight mistake in the article on cranes by John Ditchfield (*M.E.* 4285, 27 October 2006).

In fact Charles Rolls of Rolls-Royce was not a 'Sir', he was known as *"The Honourable Charles Stewart Rolls"*.

He might well have earned a knighthood had he lived, but unfortunately was killed at an early age in a flying accident near Bournemouth on 12 July 1910, becoming the first Briton to die in powered flight.

He was, incidentally, the first man to make a double crossing of the English Channel by air.

While writing, may I also answer Nemett's request for ideas on the next I/C engine project? I like vintage style 60deg V-twin four stroke engines with exposed overhead valve gear so that you can see the tappets operating.

Neil G. Heppenstall, Cheshire.

Preference noted – Nemett.

Trevethick engine information

SIRS, - In *M.E.* 4271, 13 April 2006 an advertisement for an auction at the British Engineerium was published with a photograph of a wonderful engine named *Richard Trevithick 1802.*

Can any reader help me with the following requests?

What is the function of the two handles on the side of the engine and how do they work?

Are any drawings or sketches for this engine in existence?

Michel Paturel, France.

Dezincification areas

SIRS, - Clive Young is indeed fortunate in that he lives in an area where the water company's water treatment does not give rise to dezincification, (*M.E.* 4283, 29 September 2006),

Neither Mr. Counsell nor I have fallen into a trap, for while dezincification is not quite a national problem, it is far more widespread than Clive appears to believe.

The attached map, courtesy Messrs Yorkshire Imperial Metals Ltd., was appended to a paper on dezincification published by them some 12 years ago. It shows the

Map of dezincification prone areas in the UK.

areas in Britain that at that time were prone to dezincification.

During a recent check with the company, they indicated that with the growing use of surface water supplies, the formation of larger water authorities, and the integration and reuse of water supplies, the problem is likely to have become more widespread since then.

Then there is the added problem that boilers produced in trouble-free areas can migrate into the trouble areas. I would, therefore, suggest that brazed boilers be checked periodically for the telltale pink deposit of dezincification.

Should this be found and the boiler leaks at the braze on hydraulic test, it might as well be scrapped for safety, as it is impossible to repair advanced dezincification.

Dennis Monk, Derby.

Nemett future designs

SIRS, - I am enjoying making the *Nemett NE15S* and have made the major alloy parts from castings, cored in some cases.

Along the way I have completed minor details of the Dore Westbury mill I have made from the kits of materials and parts.

I have also made a 4in. rotary table from cast iron castings in order that I shall be able to spot and drill the various holes in the *Nemett*.

As you can tell I have been busy!

With regard to future I/C designs that Nemett may be persuaded to produce, I would like to see a horizontally opposed 4-stroke of say 30cc total – after the style of Douglas 350cc motorcycle engines.

In the meantime keep it all coming!

Paul Abley, North Yorkshire.

Noted once more – Nemett.

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The six webs are all aligned and kept in this order until assembled

The three offset cranks have been assembled on a piece of 6mm rod.

OVERHEAD VALVE ENGINES

Colin Pape
of France continues the description of his Step 3b engine and starts on the Step 4.
●*Part VI continued from page 684 (M.E. 4288, 8 December 2006)*

Since the webs have been partially cut off already there is space to bevel the edges of both sides of the round ends of the webs. When they were finally separated they were kept until assembly, as shown in **photo 24**, in the same sense as they were so that any positioning errors in drilling would always be in the same direction.

The first step in the crankshaft assembly process was to make the three offsets. The six webs were lined up on a piece of 6mm rod and three offset cranks were assembled and fixed with adhesive. **Photograph 25** shows the crankshaft at this point.

The offset crank sets were then placed on the main shaft that had been partly cut through at the places where pieces would be removed after assembly. This pre-cut shaft can be seen in photo 25. These cuts provided convenient references for the web longitudinal positioning and also ensured a good alignment of the finished shaft. One offset crank set was then fixed to the shaft with adhesive. The indexing does not matter at this point.

A squirrel cage was put in place around the shaft and the webs were arranged between the three bars of the squirrel cage, which are at 120deg. intervals, in the right order. **Photograph 26** shows the crankshaft at this stage.

Then the offset that was already fixed to the centre shaft was positioned against one of the bars of the cage and tied to it. Adhesive was applied to the centre shaft for a second offset and it was positioned and held against a second bar of the cage while the adhesive set. Setting takes only a few seconds. Finally this operation was repeated for the last offset.

Cylinder head

The cylinder spacing is 25mm as it was in the Step 2 engine. The overall length of the cylinder head is 83mm and is about as much as I can handle. Drilling the long passageways is not really a problem if you have a long drill. If not the passageways can be drilled from each end and the unusable ends plugged. However, if the reverser plug hole needs to be reamed, the length of the reamer will probably be too short to do the job from one end only. I use a 6mm hand reamer and it is not long enough to do the job from one end.

The 10mm rotor passage is too long to bore with my boring tools. I could have used a boring bar fixed between centres but these are very difficult to adjust so I decided to drill the hole. I corrected the start of the hole a couple of times by boring, and I finished drilling at 9.9mm. I then reamed the hole with a hand reamer. I used the tailstock to keep the reamer straight but I turned the work and the reamer by hand. My 10mm hand reamer is long enough to ream the rotor hole completely from one end and will just pass through the drive shaft bearing as well

As can be seen in photo 21, there is no external plumbing. All connections to the cylinders are internal and the reverser system is entirely within the cylinder head. This means that there are a lot of passageways inside the cylinder head. It looked a bit like a Gruyere cheese when all the holes had been drilled. **Photographs 27** and **28** show all the faces of the fully drilled cylinder head.

In many cases I was able to design the engine so that the holes needed for the passageways had a second useful purpose, for example as inlet and exhaust ports for the cylinders, or could be covered by another part but in some cases the open ends of the holes need to be plugged.

Squirrel cage placed around the crankshaft.

In total about eight holes need to be plugged in the cylinder head and a couple more in the valve rotor. I turned up a length of brass rod to use for plugs in the cylinder head and a piece of stock steel was used for the rotor plugs. The plugs are held in place with an anaerobic adhesive. It takes a good eye to find the plugs!

Valve rotor

The valve rotor carries four slots for each cylinder. I set a minimum clear space between slots on the cylinder surface of 2.5 millimetres.

Figure 22 in the last part gives details of all the slots with their sizes. Start and end points are indicated for each slot. Holes of the appropriate diameter are drilled at these points.

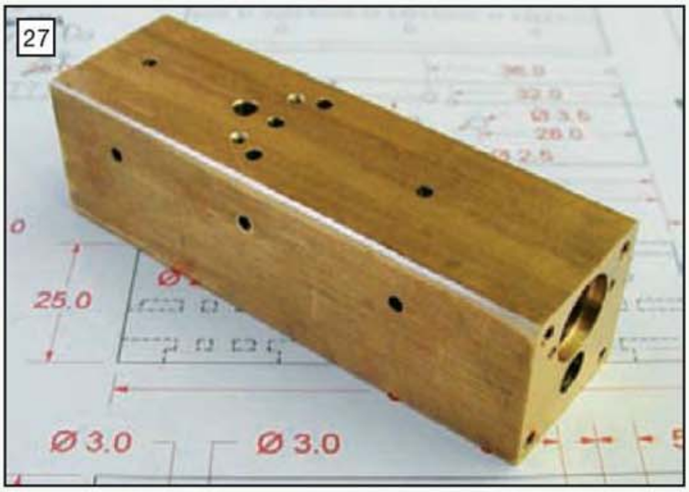
The exhaust slots all have a hole leading to a central passageway in the shaft. The outer end of this central passageway is plugged. One slot, marked as 'x' in the drawing, allows all the exhaust to escape to the atmosphere. It has two holes to the centre and they are of different sizes. I have specified the larger hole to be at 0 degrees. At 0deg. this hole should line up with the port in the top of the cylinder head that exhausts all the spent air to atmosphere. When the engine is assembled the rotor cannot be seen but it must be set in the correct position relative to the crankshaft. The rotor can be set in the 0deg. position by placing a suitable sized drill down through the exhaust port into the 0deg. hole. Then the crankshaft can be set in the correct position relative to the rotor. My indexing notations have 180deg. (6 o'clock) at the point nearest the crankshaft and 90deg. is at 3 o'clock with the engine turning clockwise as seen from the timing belt end.

The 'x' slot was provided because when I was designing this engine I was planning to feed all the exhaust air from the high-pressure block to the low-pressure block in the Step 4 engine via one pipe.

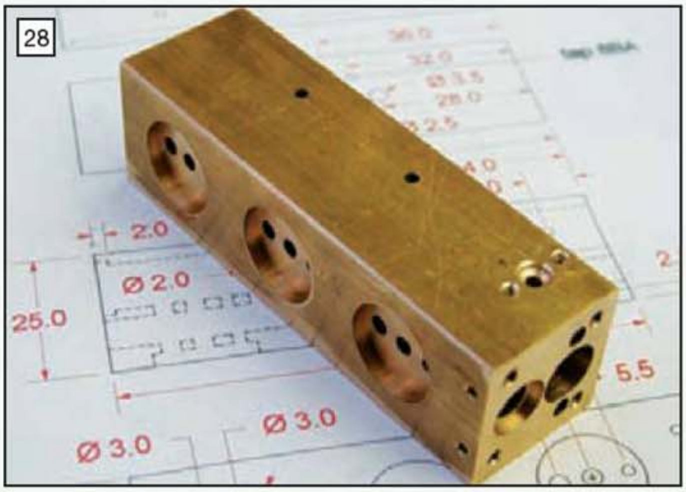
Big ends

There are three big ends so it is worth making them as a batch. I used the following method and the same method was used to make the six big ends for the V-6.

First, two strips were cut from a piece of 6mm

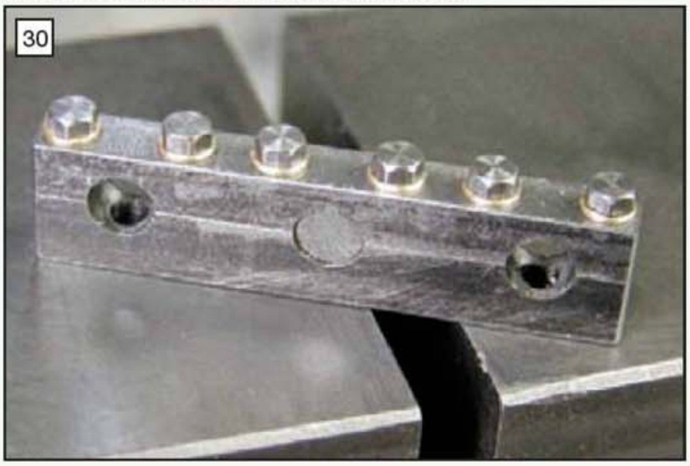


Three faces of the drilled cylinder head.



A view of the other three faces of the cylinder head.

Drilling down on the joint line to make three big ends.



Three big ends ready and waiting for the last operation.

by 25mm flat stock. These two strips were brought to finished height for the top and bottom parts of the big ends. One end of each strip was faced for use as a reference face.

Next, the two strips were clamped together, flat and horizontal in a vice with the faced ends flush. The three holes for the crank pins were then drilled down exactly through the joint line. The drill size was increased in steps to the finished 6 millimetres. **Photograph 29** shows the drilling in progress.

For the next operations the two pieces had to be turned through 90 degrees. To keep them in the correct relationship to each other a short piece of 6mm stock was place in one of the holes. The holes for the connecting rods could then be drilled and, after turning the holes for the fixing screws, could be drilled and tapped. **Photograph 30** shows the strip of three big ends waiting for the final separation and cleaning up.

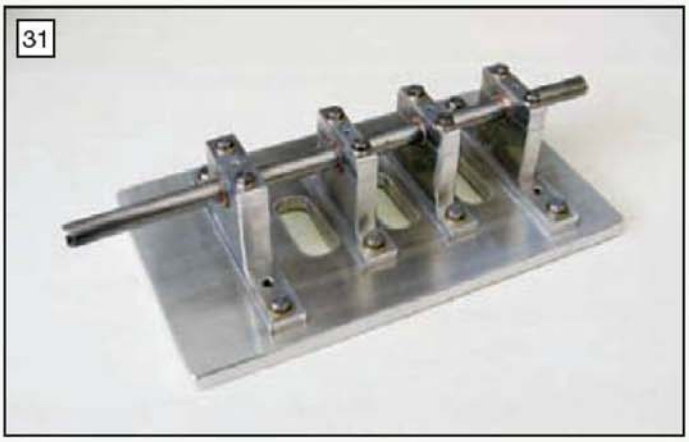
Connecting rods

When the reversing system was installed the cylinders had to be moved closer to the crankshaft and the connecting rods were shortened by 5mm. I re-calculated the clearance between the connecting rods and the inner edge of the bottom of the cylinders. This clearance is now 0.4 millimetres. This is perfectly suitable but if there has been some variance in the dimensions the clearance may become insufficient. Should interference occur the simplest remedy is to bevel the inner edge of the cylinder or to just file a dimple where the con-rod touches the cylinder.

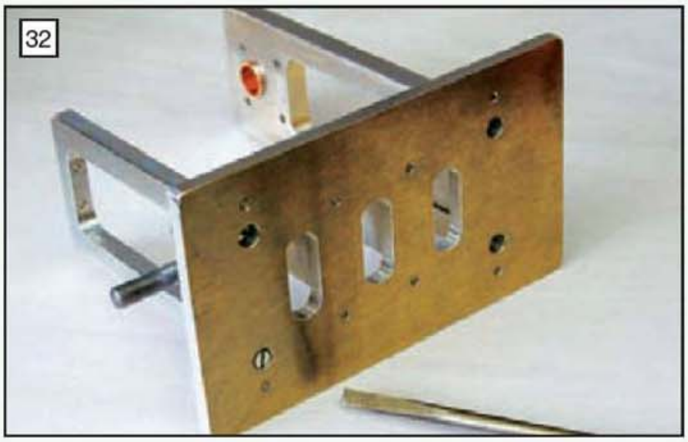
Assembly

Assembly is straightforward and these notes are simply to explain the presence of some large holes in the base plate of this, and the following, engine.

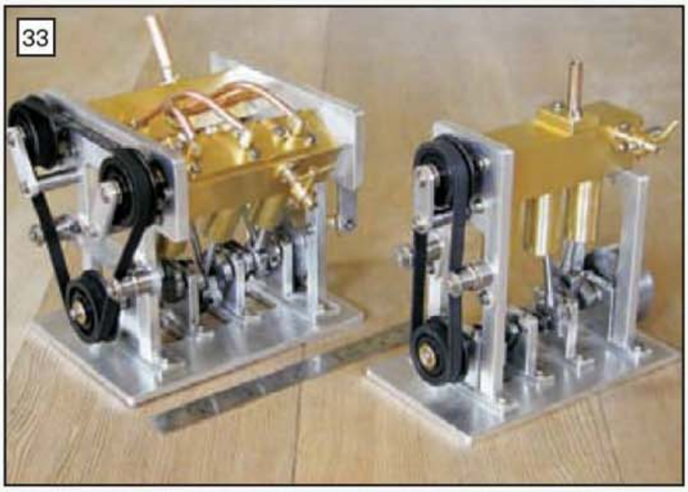
All the engines use sole plates under the frames and bearing supports. I have found these to be very useful and they help assembly operations because they allow these frame elements to be pre-mounted and then slid into ▶

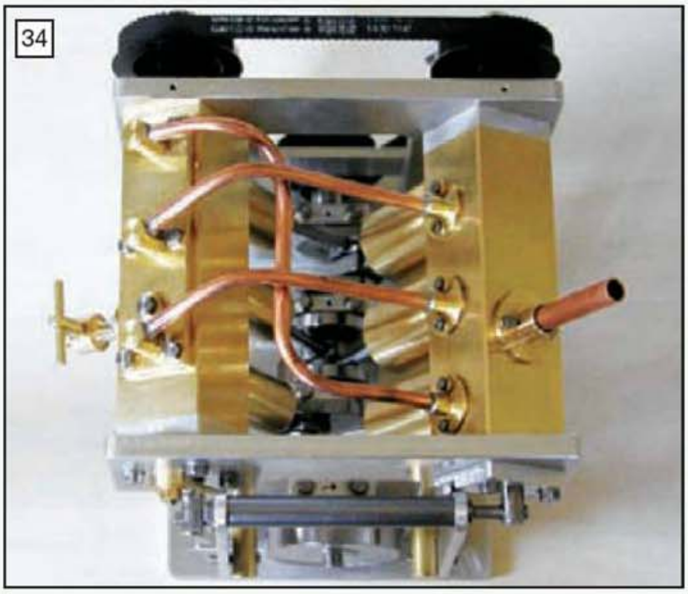


Aligning the crankshaft bearings.



The frames can be mounted without disturbing the alignment.





(Above) The V-6 engine developed in Step 4 with its predecessor Step 3b.

(Right) An overhead view of the Step 4 engine.

position. Purists might argue that the frames should be fixed to studs coming up from the floor but I do not use studs because they would prevent the parts from being slid into position. In this engine some sole plates carry two frame elements and to allow easy assembly I have provided access holes through the base plate.

Photographs 31 and **32** show how the crankshaft can be aligned before the front and rear frames are mounted. This alignment will not be affected when the front and rear frames are mounted. The countersunk fixing screws pass through the access holes.

Step 4 - a self-starting, reversing compound engine

This is a triple-compound engine. By this I mean that it is basically three Step 2 engines working together, and it is not the same as a triple-expansion engine. The configuration was designed so that no receivers would be necessary

The three high-pressure cylinders are all arranged to work in line in the same cylinder head. The three low-pressure cylinders are in line in a separate head. The two banks of cylinders are arranged in a V-configuration and the angle of the V is 60 degrees. Three external cross-flow passageways are provided to lead the gas exhausted from the high-pressure cylinders to their partner low-pressure cylinders. **Photographs 33** and **34** show different views of the engine.

The choice of the V-6 at 60deg. disposition needs to be explained. Earlier I mentioned that in triple-expansion engines, the designers had to find a way to store the steam before it could be used in the intermediate cylinder and again before it could be used in the low-pressure cylinder. This was because when a cylinder was at bottom dead centre and ready to exhaust, the next piston in the downstream cylinder still had 60deg. to go before reaching its top dead centre.

The general solution to this problem was to provide reservoirs or receivers between the pressure stages.

A similar problem exists in a simple compound if the pistons are not arranged so that the low-pressure piston is at top dead centre when the high-pressure piston is at bottom dead centre. In the arrangement I have chosen, there are only three crank offsets but the cylinder banks are at 60deg. apart. One bank has all the high-pressure cylinders and the other has all the low-pressure cylinders.

Let us call the high-pressure cylinders A, B and C, similarly for the three low-pressure cylinders and for the three crank offsets. If we start off with high-pressure cylinder A at top dead centre with its piston connected to the crank pin A and define the crankshaft to be at 0deg. at this time then, when high-pressure piston A reaches bottom dead centre, the crankshaft will be at 180 degrees. The next piston in the high-pressure bank, call it HP-B, has already started to work (since 120deg.) but what about the low-pressure pistons? When crank offset A is at 180deg., crank offset B is at 60deg. and C is at 240 degrees. It does not matter which offset has which letter. There is a low-pressure cylinder with its piston connected to the crank at 240deg. and this piston is at top dead centre so we can exhaust the steam from A into it and it will start to push, aiding high-pressure piston B. A similar sequence occurs after every high-pressure piston stroke. The engine geometry has removed the need for any receivers.

The low-pressure cylinder, which receives the exhaust from high-pressure cylinder A, is not the one opposite but this does not matter. In my engine high-pressure cylinder A exhausts into low-pressure cylinder C, HP B into LP A and HP C into LP B.

Slave cylinders

Early on I thought that the low-pressure head would be something like the high-pressure head but then I realised that the low-pressure cylinders could be made true slaves of the high-pressure cylinders. In fact the three high-pressure cylinders can turn the engine on their own. **Photograph 35** shows the engine being turned by the high-pressure cylinders. The low-pressure cylinders are complete and the pistons are connected but they are not being fed.

The separated exhausts from the high-pressure side provide synchronised inlet air to the low-pressure side so no inlet slots are required in the low-pressure valve rotor. No reversing plug is required in the low-pressure block and the low-pressure cylinders need only two ports each but the exhaust path for each cylinder needs to be adapted for running in two directions. I decided to adopt this slave approach for Step 4.

In the original approach all the exhaust from the high-pressure side was to be collected in one place as in the Step 3 engines and then a rotor system and reverser plug would distribute this air to the low-pressure cylinders. The attraction of this approach is that there is only one copper tube between the high-pressure head and the low pressure head and the reversing control is simpler.

The Step 4 engine running with just the high-pressure side active.

The valve drive is basically the same as for the single bank engines. The front frame is the same thickness as in Step 3 and outboard bearings are provided for the valve drive shafts. In order to maintain the same shaft centre-to-centre distances in the V-configuration, a longer belt is required. Larger pulleys had to be used in order to be able to use a stock belt.

The centre-to-centre distance between the crankshaft and the valve rotors is actually slightly increased but the change is handled by a 0.5mm increase in the length of the connecting rods and as a bonus, the con-rod to cylinder end clearance is slightly increased.

The engine is self-starting and reversible at any speed.

●*To be continued.*

FOR YOUR BOOKSHELF

How (not) to paint a locomotive

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By: **Christopher Vine**

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How (Not) To Paint A Locomotive

Those lucky enough to see Christopher Vine's Gold Medal winning LNER B1 locomotive, *Bongo*, will welcome this book, and rush to buy a copy. This stunning 4-6-0 head turner will stay in the memory of those that saw it at the Model Engineer Exhibition, not just because it is a fine model, but also for the immaculate finish achieved.

How many times have we seen good models spoiled by a paint job that does not match the engineering excellence? After spending six years building *Bongo* Chris Vine was determined that it would have a top finish. That was easier said than done, starting with zero knowledge.

Learning as he went along, the complete process of painting and lining took no less than two years of *"frustration, mistakes and wrong directions."*

With such a successful outcome, he fortunately decided to incorporate his experience, trials, and tribulations in a book. Nothing academic here. Just pure practical advice.

The reader is taken through all the necessary stages and processes to paint a piece of model engineering. It is thorough.

The author includes information on things which he investigated, and although he did not use them, may be useful to others.

This book is as thorough as the finish on Bongo. It has 168 information packed pages, with 130 high quality colour illustrations and 30 diagrams. To the average reader it seems absolutely comprehensive.

To give an idea of the content, let's just summarise the book's introduction to the painting process. First is the advice to work out your own process. Using plenty of test pieces, practice mixing the paint, putting it on, trying one paint on top of another, putting them in an oven at various temperatures, and checking how dust-free your environment is.

"You are trying to find a series of steps which combine to make a process which will give you success. Trying to start on intricate parts of the model without practice is asking for trouble," the author advises. That is followed by one of the most important tips in the book to keep a record of everything you do. A sample record form is thoughtfully included.

You are strongly advised to research which paint to use, as once started it is difficult to change paint types. He helps to decide what you require from the paint, and what he decided to use on *Bongo*.

Once you have decided on the paint to use, and ideally having planned painting things while you were making them, you will need to decide how many coats of paint. How thick should the paint be? How many layers? Should you brush it or spray it? Spray can or spray gun?

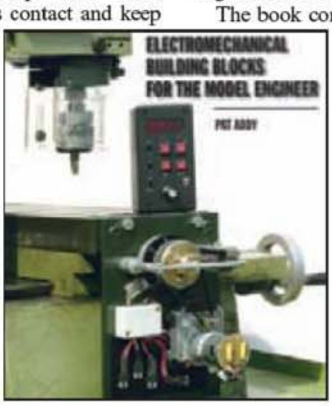
Individual sections of the book deal in detail with all those aspects, plus: how to fix blemishes; lining; transfers, and looking after the paint. It concludes with a most useful list of suppliers. While some of them are familiar as advertisers in *Model Engineer* others will be new to the modelling fraternity.

All in all it is difficult to think what else the author could have put in this book. It is quite simply the best practical book for model engineers we have seen for decades. **DC**

Electromechanical Building Blocks for the Model Engineer

Some years ago I had occasion to walk through a machine tool factory with its somewhat formidable managing director. In common with most modern, industrial machine tools, those seen under construction all relied heavily on the latest electronic technology to give them the performance expected by the firm's customers. Indeed, all seemed to have an electrical cabinet as large as, if not larger than, the machine itself and were controlled via a panel containing a multitude of buttons and switch gear. The managing director confided that he often felt overwhelmed by the pace of technological change and added that he was old enough to remember when machine tools only had two electrical buttons - one to switch the machine on and the other to switch it off.

Many model engineers perhaps have some sympathy with my old business contact and keep the pace of technological change in their own workshops to an absolute minimum. Some, perhaps, still rely on hand for foot power to drive their machines. However, there is a growing band of home based enthusiasts who embrace modern electronics with vigour and seek to explore how it can simplify machining tasks and accomplish operations beyond those normally thought to be within the scope of the amateur's workshop. If you fall in the latter category then this book should be of interest to you.



Electronic Building Blocks for the Model Engineer aims to provide those interested in electronics with the building blocks needed to construct drives for stepper motors, DC motors and a range of other electromechanical devices. Also dealt with is the control of these devices. There is a small amount of theory and mathematics but this is restricted to that which is essential to understand the practical concepts explained in the text. In the publisher's release documents the author is introduced as an expert in the field of electronic and computerised control of industrial machinery but that should not intimidate the less well-qualified reader. The aim of the book is to bring modern machinery control technology within the reach of the model engineer, robotics enthusiast and experimenter.

The book comprises 187 pages divided into 24 chapters. Chapter one is an introduction to the subject and is followed by four chapters dealing, in sequence, with basic electronic theory, stepper motor drives, DC motor drives and servo systems. Chapter six is about relays and chapter seven, solenoids and related devices. Chapter eight deals with other electronic devices not covered in the previous chapters.

The next five chapters cover interference suppression, heat sinks, fuses and circuit breakers and inputs. Chapter 13 discusses light emitting diodes and there then follows chapters on speed measurement in the workshop, power supplies and regulators, power from batteries, no-volt releases and interlocks, ancillary test and driver modules and basic electronic building blocks. The final five chapters deal with practical building issues, etching processes, making prototypes from strip-board, pin-outs and information sources.

Each chapter is well illustrated with photographs and circuit diagrams and the book was found to provide useful coverage of subjects otherwise only accessible through specialised textbooks more tailored to the needs of academia. **NR**

Electronic Building Blocks for the Model Engineer

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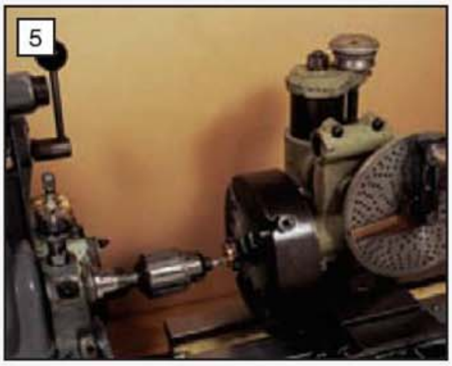


Using a dividing head to locate the four holes in the feedscrew nut.

A simple home-made, piloted, countersink bit.

Completed feedscrew nut together with the hole gauge used in its manufacture.

A COMPACT RATCHET BRACE

Bill Steer continues with the construction of a precision version of a simple tool.

●*Part II continued from page 675 (M.E. 4288, 8 December 2006)*

The four No. 32 holes, for the fixing screws, can now be drilled. The best way of doing this is with the aid of a dividing head. If this is set up in a lathe or milling machine, co-ordinate methods can be used with advantage to locate the diametric position. In order that the drill can pass cleanly through the workpiece, (which should be supported by its smaller diameter section) the latter will need to be held in a 4-jaw chuck; the gaps between the jaws providing the necessary clearance. Carefully centre the workpiece with the chuck first mounted in the lathe and then transfer the whole assembly to the dividing head. Don't forget to place some soft packing beneath the jaws to prevent bruising. **Photograph 5** is of the set-up that I employed to drill the holes for the fixing screws, using a Turpin dividing head (*M.E.* 2634, 15 November 1951).

If you haven't got a dividing head, then carefully mark out and drill in the usual way. We shall be using the feedscrew nut as a jig, later on, to locate the corresponding screw holes in the feed applicator, hence any loss of accuracy at this stage won't really matter.

The countersinks should be fairly deep and are best produced with the proper size, three or five fluted bit, equipped with a pilot; unfortunately, these no longer seem to be listed in the catalogues I have at hand. They are not difficult to make though (I have one, with four flutes, in front of me as I write, shown in **photo 6**), but I suspect that the extra time involved may not appeal to many readers. Failing all else, take the remains of an old or broken No. 9 drill, cut it down so that its business end is no more than 1in. long (grind nicks in its sides and break off) and then grind the point to an included angle of 90deg., providing the usual clearances. This will give satisfactory results so long as it is used at a fairly low speed to prevent chatter.

Once countersinking has been completed, the workpiece can be released from the chuck and any fine burrs thrown up as a result of drilling, removed. An easy way of doing this is simply to twiddle a very sharp and slightly larger drill in the entrance to the hole (using the thumb and forefinger).

Photograph 7 shows the completed feedscrew nut together with the hole gauge used in its making.

Mainshaft

The mainshaft is shown in **fig 4**. Since this forms the heart of the tool it needs to be carefully made and, as such, is best turned between centres. This will enable us to remove the workpiece from the lathe during its making, test various fits, and return it without any loss of accuracy.

Begin by taking a length of bright mild steel rod, 3/4in. dia. and just a little over 2 1/4in. long. Holding this in the 3-jaw chuck, face one end and lightly centre using a 3/16in. dia. Slocombe (centre) drill. The resulting hole should be no more than 9/64in. dia., where it meets the faced end. Reverse the work in the chuck and face the other end, bringing the total length of the workpiece to 2 13/64in. Centre this end as before, but this time continue drilling until the opening is just a shade under the full 3/16in. diameter. Do not remove the workpiece from the lathe at this stage.

Swap the Slocombe drill for a No. 43 and continue drilling to a total depth of about 7/16in. Open up the first 1/8in. length of this hole with a 5/32in. dia. drill. Finally, tap the remaining portion of the original hole, 6BA, giving a full thread length of at least 3/16 inch. The workpiece can now be removed from the chuck and the lathe set up for turning between centres. Screw a catchplate onto the mandrel nose, and after carefully cleaning out both the head and tailstock tapered sockets, firmly insert a pair of centres; soft in the headstock and a hardened one in the tailstock. If necessary, set the top-slide over to an angle of 30deg. and take a very light cut over the headstock centre, to clean it up and ensure that it is running true.

Fit a small carrier over the end of the workpiece containing the 6BA tapped hole, and set up between the centres. Don't forget to put a drop of oil on the tip of the fixed centre! Working from the right-hand end, turn down to 5/8in. dia. for a length of about 3/4in. As well as defining the largest diameter of the mainshaft this also provides a datum that is concentric with the axis.

Next, turn the workpiece around, fitting the carrier to the recently turned end. Again, working from the right-hand end (with respect to the lathe), rough turn to 3/8in. dia. for a length of 1 9/16in., then finish the first 1 1/16in. to 1/4in. dia. and the next 1/2in. to a diameter of 0.350in. (this latter dimension is just slightly less than the length of the diagonal of a square with 1/4in. sides). Put in the little recess, between the two sections, as shown in the drawing; this should be approximately 1/64in. deep. Broken Slocomb drills provide a useful source of material from which small recessing tools, as required here, can be ground. They do of course need to be held in a suitable holder.

Screwcutting fine threads

We now need to put the thread on the mainshaft and ideally this should be cut with a single point tool. Set up the leadscrew gear train on your lathe to produce a thread of 40tpi and carefully sharpen a tool to the required 55deg. cutting angle. Since 40tpi threads are very shallow, use an eyeglass to check that the correct profile extends all the way to the tip of the tool; a fine Arkansas slip stone can be used to provide a slight radius at the very end.

For these small threads, I usually dispense with the power drive to my lathe and rotate the work by means of a handle that plugs into the rear end of the mandrel; this gives a much greater control. With the leadscrew engaged, a light cut can be taken and at the end of its travel the tool is withdrawn by a small amount (this is to overcome any lateral displacement caused by backlash in the gear-train during the return traverse). Without disengaging the leadscrew, the handle is then rotated in the reverse direction until the tool is once again at its starting position; a further

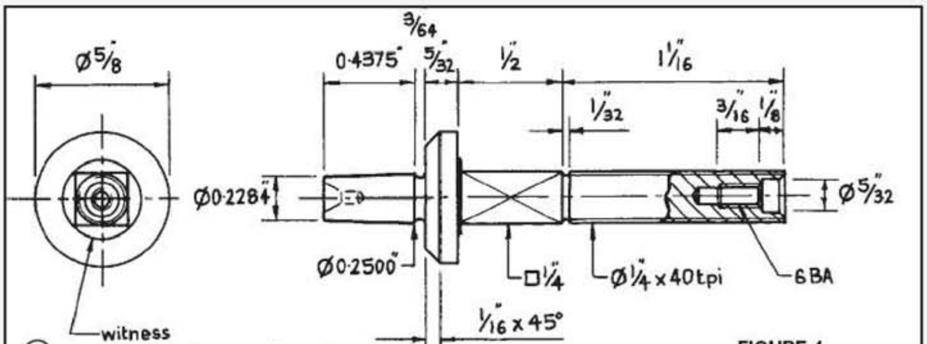


FIGURE 4
MAINSHAFT (MATL: bms)

Cutting the screw thread on the mainshaft, held between centres.

Using a file guide, set up in the lathe, as an aid to producing the square section on the mainshaft.

A close-up of the interface between the square part of the mainshaft and shoulder, showing the small witness left to the original round section.

cutting pass is then made. This process continues until the required depth has been achieved. The main advantage of this method is that it avoids any possibility of mis-engaging the leadscrew (not that this presents a problem with this particular thread and an 8tpi leadscrew). When cutting larger threads I normally use the well known method of setting the top-slide over to half the thread angle and then use this, rather than the cross-slide, to provide the in-feed, but this is hardly necessary for this particular application.

Returning to the job in hand, and with the work still held between centres, proceed to cut the thread using which ever method you are happiest with, taking it to a depth of about 0.012in. **Photograph 8** shows screw cutting taking place. The thread so far produced will not quite have the full depth, neither will it have the correct form. We can now though, safely use a die as a chaser to obtain a good working fit with the feedscrew nut. The easiest way of doing this is to remove the workpiece from the lathe, grip it, by its larger diameter end in the 3-jaw chuck, sitting upright on the bench, and run a die down it. The die should be held in a conventional stock. The already partially cut thread will guide the die whilst float will be provided by the hand held stock. Take great care in adjusting the die; to begin with set it so that it barely removes any metal at all. Further adjustments can then be made, gradually increasing the cut and testing each time with the feedscrew nut until the correct fit, very slightly on the tight side, is obtained. If the workpiece is now thoroughly cleaned with concentrated detergent, rinsed with water, dried and oiled you should find that the nut rotates with a really nice smooth silky feel. Any remaining tightness will soon work out in service.

Producing the square section

Several techniques could be used to produce the square section, including milling and shaping — both used in conjunction with a dividing head. Alternatively the work could be returned to the lathe (taking advantage of the accurate relocation offered by setting up between centres) and the flats filed using a guide such as has been described in these pages many times before. With this method, indexing is achieved by means of a gear linked to the rear end of the lathe mandrel.

Since it takes very little time to set up and, with care, is capable of producing results more than adequate for the purpose in hand, I used the latter method. **Photograph 9** shows a filing guide attached to the cross-slide of the lathe, the embryonic mainshaft set between centres and the square section nearly completed. When using this method, it is particularly important to make allowances for any backlash within the indexing system. One way of overcoming this is to adopt the habit of pushing the top of the chuck or, in this case, catch plate, in a clockwise direction against the locking action of the detent, each time a new position is indexed. The torque, transmitted by the action of filing, will help to maintain this position. For the finishing strokes, best made with a fine Swiss file, I often keep my left hand on the top of the chuck to ensure that pressure is maintained against the indexing stop. If using a catch plate, it is also helpful to snap an elastic band over the drive pin and carrier for the same reason.

Whichever method you use, note that the square section ends just before the edge of the flange — something like a 0.005in. thick witness to the original 0.350in. dia. section should be left (**photo 10**). This will ensure that the surface of the flange is undamaged and remains true and perpendicular to the rest of the shaft.

Turning the tapered section

The taper we require is standard for a Jacobs No. 0 chuck and its equivalents; it has a nominal angle of 2.82deg. inclusive. I am aware that some folk are slightly nervous of producing fitted tapers; too much haste is the usual problem but provided time is taken to work carefully and methodically there should be no difficulty. Since this is a near final operation, and we certainly don't want to spoil anything at this stage, I suggest that it is worth spending a few minutes making a trial run. By doing this, several attempts can be made, if necessary, to get the correct fit. Once this has been achieved, and providing the settings haven't been changed in the mean time, it is then easy to repeat the result on the job itself.

Trial run

To make these tests simply grip a piece of $^5/_{16}$in. dia. mild steel rod in the 3-jaw chuck, with just over $^1/_2$in. protruding. Set the top-slide of your lathe to about 1.4deg. (the use of an eyeglass will help to get a good interpolation of the graduated scale, assuming that it has one). Ensure that your chosen tool is really sharp and then carefully set it up with its cutting edge exactly on the lathe centreline. Lock the lathe saddle and, starting from the right-hand end of the test-piece, take a number of fine cuts using the top-slide to make the traverse. Continue to the point whereby, if the drill chuck is offered up to the work the taper just begins to enter. Bearing in mind that for this angle of taper, a reduction in diameter of 0.001in. will cause the mating section to penetrate by a further 0.020in. (approximately), take a few more shallow cuts, until the taper enters the chuck for a distance of perhaps $^1/_4$ inch.

Use of engineer's blue to help obtain the correct taper on the test-piece.

We can now test the chuck on the taper, but first give both surfaces a good wipe with a piece of clean paper towel, since even the tiniest speck of swarf will affect the fit. To begin with you will probably be able to feel a slight wobble and it will not be difficult to assess which way to rotate the top-slide in order to make a correction.

A simple way of making these small adjustments is to slacken off the top-slide holding down bolts and then give it a gentle sideways tap with the handle of an old screwdriver. At the same time watch the graduations on the angular scale (again using an eyeglass) to ensure you don't go too far. Finally, re-lock the slide. Having made an adjustment, take another cut of maybe no more than 0.0005in. depth, and test again, making further corrections as necessary. As the fit gets better it becomes increasingly difficult to determine which way the error lies; the way around this is to coat the taper with a thin layer of engineer's blue (this is *not* the same as blue marking out fluid). The chuck can then be twisted about the taper and on withdrawing, the tighter region will be a lighter shade. **Photograph 11** shows a trial taper just about to be tested with the drill chuck.

Proceeding with the job

Once you are happy with the trial result, restore your lathe set-up for between centres turning, taking care not to disturb the top-slide setting. The workpiece will need to be positioned with the threaded portion nearest the mandrel. To prevent the threads from being damaged by the carrier we could use normal soft packing but this will invariably screw its way along the shaft under the influence of the cutting forces. To overcome this either slip on a pair of lock nuts or, do as I did, and screw a $^1/_4$in. x 40tpi brass union nut on to the end of the shaft and let the carrier bear on that. If you do choose the latter method, it is imperative that that the hole in the end of the nut is large enough to ensure that the lathe centre properly engages with the workpiece and does not merely ride within the nut.

When all is set, reduce the diameter of the end that is to receive the taper to about 0.255in., finishing to a length of $^{31}/_{64}$ inch. This section

Producing the tapered portion on the mainshaft.

Completed mainshaft, with feedscrew nut and end stop.

Undercutting tool, shown alongside a dressmaker's pin for size comparison.

Producing the undercut on the thrust transfer sleeve, using the specially ground lathe tool.

Severing the embryonic thrust transfer sleeve from the parent material. Note the use of a parting tool held in a rear tool post.

The finished thrust transfer sleeve.

should initially be turned parallel (use the lathe carriage to traverse the tool) and since we are working at the far end of what is now a fairly slender rod, it is advisable to take light cuts. Put in the 3/64in. wide recess next to the shoulder forming the side of the flange. The diameter of the mainshaft at the bottom of this recess should be about 13/64in. Carefully re-sharpen the lathe tool and again check that it is set exactly at centre height in preparation for turning the taper. This time, traversing with the top-slide, take cuts that are no more than 0.001in. deep and check progress by testing frequently with the drill chuck. Stop when the face of the chuck comes to within 3/64in. of the flange. **Photograph 12** shows the taper in the process of being turned.

Finally, set the top-slide over to 45deg. and chamfer the edge of the flange. Remove the workpiece from the lathe, wash thoroughly, dry and coat with oil.

Should the drill chuck become inadvertently jammed on the taper at any time during testing, it can be removed quite easily by levering with a pair of screwdriver blades. These should be placed diametrically opposite each other, between the chuck and flange. An extra purchase may be obtained by removing the workpiece from the lathe and gripping the square section in the bench vice. Of course, once the chuck has been finally fitted, and bedded down, only proper wedges should be used for its removal.

End stop

The end stop is shown in **fig 5**. To make this component hold a length of 5/16in. dia. mild steel in the 3-jaw chuck. Face, centre and drill No. 32 to a depth of about 1/4 inch. Turn down the outside to 5/32in. dia. for a length of 3/32in., and 9/32in. dia. for a further 5/32in.-or-so. Part off a shade over 3/16in. long. Reverse the workpiece in the chuck, gripping it carefully by the smaller diameter and face to length. Lightly chamfer the edge and countersink the hole. The stop is attached to the mainshaft by means of a 6BA countersunk Allen screw. **Photograph 13** shows the completed mainshaft fitted with the feedscrew nut and end stop.

Thrust transfer sleeve

The thrust transfer sleeve is located within the feed applicator and it supports the centre. Its primary function is to act as a seating for the thrust race, however its lower portion, which is guided by means of a bronze bush set within the body of the feed applicator, provides added stability against the sideways acting forces of the ratchet action. Details of the transfer sleeve are given in **fig 6**.

This item could be made from a length of 3/4in. dia. bright mild steel rod since the largest finished diameter required is 0.745in. — however, drawn materials are generally slightly undersize and so to ensure a good finish to the edge of the flange it might be preferable to start with something a little larger, e.g. 7/8in. diameter. Whichever you chose, the piece should be long enough to be held in the 3-jaw chuck with about 1in. protruding. Face the end, centre and drill 3/16in. to a depth of 1 inch. Open up with a letter 'B' or a 6mm dia. drill (reaming size for 1/4in. dia.) to full depth. Open up again with a 19/64in. dia. drill, this time, to a depth of 9/16 inch.

Turn down the outside to 0.390in. dia., working to a tolerance of + 0.000, - 0.001in., for a length of 9/16in. Aim for a good smooth finish, since this part acts as a journal within the bushed hole in the feed applicator. Having completed this operation, take a skim over the face of the shoulder, just to ensure that it remains flat and true. The little recess at the interface of the shaft and shoulder is to ensure that the hardened raceway rides squarely on the shoulder and is not subjected to any undue stress that could result from a rounded corner in this region. It is easily

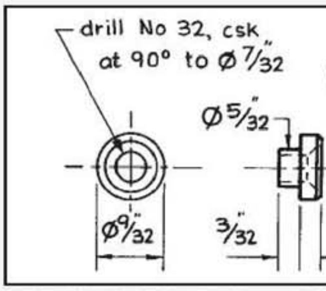


FIGURE 5
END STOP
(MATL: bms)

put in with the lathe running at a fairly low speed (I simply pulled the chuck around by hand) using a specially ground tool. **Photograph 14** shows the tool alongside a dressmaker's pin (for size comparison), while **photo 15** illustrates the recessing operation.

Next, turn down the remaining 1/4in.-or-so of stock, to bring its diameter to 0.745in. Touch all corners with a tool set over at 45deg., to break the sharp edges, and part off to just over 3/4in. long. **Photograph 16** shows this taking place, using a parting tool held in a rear tool post. This useful accessory is in constant use with my lathe and lives permanently at the far end of the cross-slide. It is a great aid to stress-free parting operations, which should of course be undertaken at slow lathe speeds with the carriage locked.

Reverse the work in the chuck, gripping by the smaller diameter portion (place a single turn of thin card between the workpiece and the jaws so as not to spoil the surface). Face, bringing the flange to a finished length of 3/16 inch. Open the hole to 1/4in. dia. with a reamer, and finally, having set the top-slide over to 45deg., turn the chamfer on the corner. As always, thoroughly wash, clean and oil the workpiece before setting it aside for final assembly. **Photograph 17** shows the completed thrust transfer sleeve.

●*To be continued.*

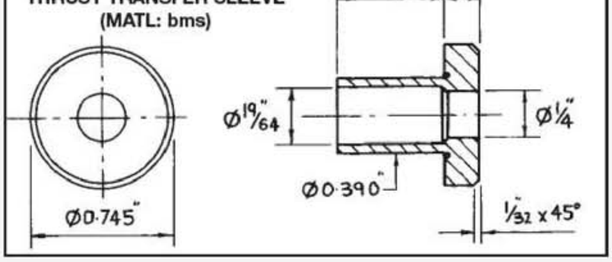


FIGURE 6
THRUST TRANSFER SLEEVE
(MATL: bms)

MACHINE TOOLS

CENTEC MILLING MACHINES

Tony Griffiths

reviews the Centec range of milling machines, and sings their praises.

Centec milling machines are small, well made, and versatile.

Well-known since the early 1950s, and still popular today, Centec milling machines were originally manufactured by the Central Tool & Equipment Company at the Centec Works in Maylands Avenue, Hemel Hempstead, Hertfordshire, England. Beautifully constructed, compact and versatile they have long been respected by enthusiasts who appreciate a small but high quality machine tool. The original design dates back to the early 1940s when the first model was introduced as a development of the V.E.C. or Victa horizontal miller, a machine sometimes found badged as a Warwick. During the 1940s and early 1950s Victa also manufactured lathes using the Warwick name on a model-engineering 3.5in. x 18in. gap bed, backgeared screwcutting lathe and a quite different and rather advanced range of geared-head lathes sold using the Hobson brand. Later, having moved to Poole in Dorset, they also built the Eagle surface grinder, a model originally manufactured by Dronsfield Brothers, a company well known as the makers of Marlow milling machines.

Rarely found today, and probably built in limited numbers, the first Centec was a small horizontal miller intended for bench mounting. It was manufactured from 1943 to approximately 1949 and featured flat-belt drive from a side-mounted countershaft, a 12in. x 3.75in. table, a round overarm and no facility to fit a vertical head.

The next development, the Centec 2, was a substantially modified machine with the round overarm replaced by a much more robust and rigid dovetail fitting - a move also reflected on larger machines in the wider machine-tool industry as cutting speeds and rates of feeds continued to increase. While the same design of side countershaft was used for both early models the No. 2 benefited from a V-belt drive. In 1949 the No. 2 evolved into the Model 2A, with changes that included a slightly larger table of 16in. x 4.25in. and, of greater importance, a completely revised drive system consisting of a 6-speed gearbox built into the body of the column.

The new drive gave spindle speed ranges of either: 85, 195, 395, 595, 890 and 1400 rpm or alternatively (with a 2800 rpm motor), 170, 390, 790, 1190, 1780 and 2800 rpm. Some versions have also been found fitted with 2-speed, 3-phase motors offering twelve speeds from 85 to 2800 rpm. The modification of the drive system not only allowed much greater power to be transmitted to the cutter but also allowed for the fitting of a vertical head, the drive being arranged to pass upwards by V-belt from an extension to the gearbox main shaft.

In 1958 the 2B was announced, a miller that offered a number of improvements over earlier versions including a much more useful 25in. x 5in. table and the repositioning of the knee elevation handwheel, from an inconvenient location at the rear of the column's left-hand face, to the front - where not only could it be more easily manipulated but the micrometer dial read as well.

Table sizes and travels of the various models was as follows:

2A - longitudinal 9in., cross traverse 4.5in., vertical 6in.

2B - longitudinal 14in. (less 1.25in. with power feed) cross traverse 5in., vertical 9.5in.

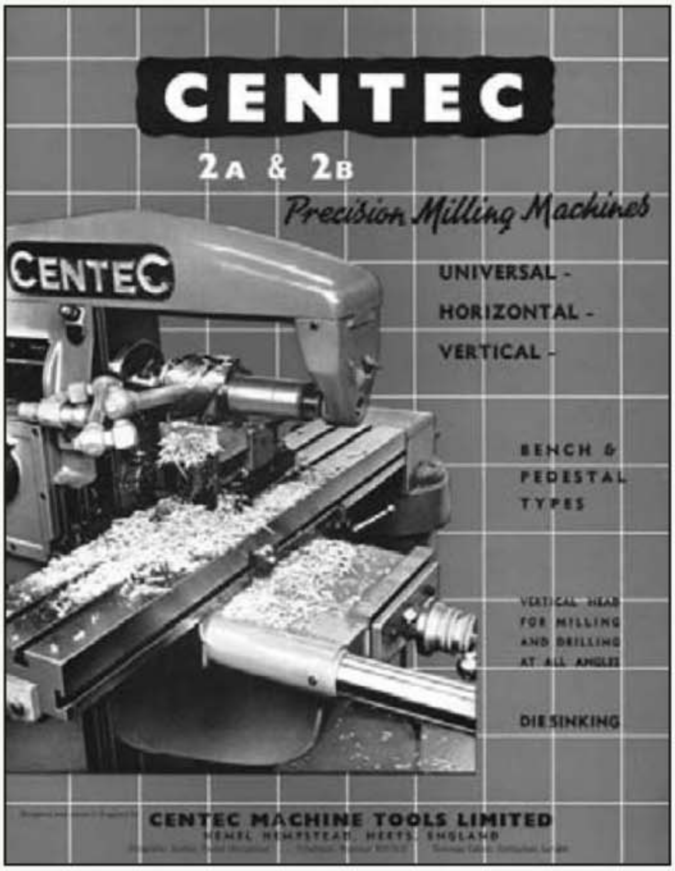
2C - longitudinal 14in. (including power feed), cross traverse 4.5in., vertical 11.25in.

2A - maximum distance from spindle centre to table 6.625in.

2B - maximum distance from spindle centre to table 10.5in.

2C - maximum distance from spindle centre to table 11.25in.

The 2A for bench mounting weighed approximately 360lb - the 2B 500lb and the 2C, a comparatively rare and much more massive model stand fitted with a heftier main column, longer and wider table with a feeds gearbox (and only supplied on a heavy cast-iron stand),



Centec catalogue showing a machine capable of hard work.

"CENTEC" 2A

BENCH (OR PEDESTAL) TYPE All geared

ALL DIMENSIONS ARE GIVEN ON PAGE SIX

SPINDLE DRIVE:

TABLE—Longitudinal Traverse: THERE ARE THREE POSSIBILITIES, NAMELY—

1. BY SEPARATE DRIVE MOTOR, PEDESTAL MODELS ONLY (See page 4)
2. BY HAND LEVER, THROUGH RACK AND PINION.
3. BY BALANCED HANDLE AND LEADSCREW.

Cross Traverse: BY BALANCED HANDLE AND LEADSCREW.

Vertical Traverse: BY BALANCED HANDLE, THROUGH WORM AND WORMWHEEL TO RACK AND PINION, SITUATED ON LEFT-HAND SIDE OF COLUMN.

NOTE:

2

Centec 2A was available as a bench or pedestal model.

weighed in at nearly half a ton. One important Centec accessory was very desirable indeed, the vertical head, by which means the ordinary horizontal versions from the 2A onwards could be transformed into very much more useful vertical and (when equipped with the optional swivelling table), universal models. The vertical head slotted into the same dovetail as the overarm and (being rather short of clearance as standard), could easily be raised in height by using a suitable distance piece with dovetails top and bottom.

Three versions of the Centec vertical head have been discovered: the Mk. 1 carried an enclosed bevel box at the back which turned the drive through ninety degrees - from where it was taken by an exposed V-belt forwards to the spindle; the Mk. 2 had its drive completely enclosed within the body but unfortunately, like the first, had no quill feed.

The Mk. 3 version (by far the most eagerly sought after type) was a beautifully constructed unit that incorporated both a fine down feed through worm-and-wheel gearing and a quick-action drill action by rack-and-pinion. The change from one feed to the other was through a metal-to-metal cone-clutch that, if properly set up, could be flicked into and out of engagement using finger pressure only.

As a point of interest when a Centec is changed from horizontal to vertical drive the spindle will turn in the wrong direction – solved by using a reversing switch on the motor.

While table power-feed assembly was standard on the 2C it was an option on the 2A and 2B. Four rates of feed were provided: 0.65, 1.19, 2.18 and 4 inches per minute with each selected by combining any two from four pick-off gears under a cover on the right-hand end of the table. All later Centec milling machines had large, easily gripped, chrome-plated balanced handles on their table feed screws and clearly engraved, angled-faced micrometer dials.

The design of the feed-screw nuts varied from a simple rectangular and semi-circular bronze block to a version that hinged down (aided by a cast-in handle) to allow a quick-action, lever-feed rack-and-pinion assembly to be engaged for use in slotting and similar work. Besides the longer tables the 2B and 2C both had a more robust knee, with a front rather than side-mounted operating handle, and a wider cross slide. While most models were usually supplied fitted to underdrive stands, the 2A was also available as a bench model with motor mounting provided in the form of 4 raised T-slots cast into the side of the main body. Early stands (even the first under-drive version) were very compact affairs, constructed from steel plate and very little wider or deeper than the base plate.

Later machines were fitted to what can only be described as cavernous stands with enormous chip trays - some of which had wings extending to the full width of the table. These latter types, whist ideal in an industrial location, can be difficult to accommodate in an amateur's workshop and, as a result, many have been cut down. However, if you buy a Centec on an unmodified large stand, before selecting your hacksaw blade it's worth knowing that, even though they are rather cumbersome, it's still possible to manoeuvre them through an ordinary household door. All the large-stand examples seen by the writer have been equipped with 3-phase electrics and a problem arises when fitting then with a single phase motor – an annoying drumming noise caused by the stand acting as an amplification box.

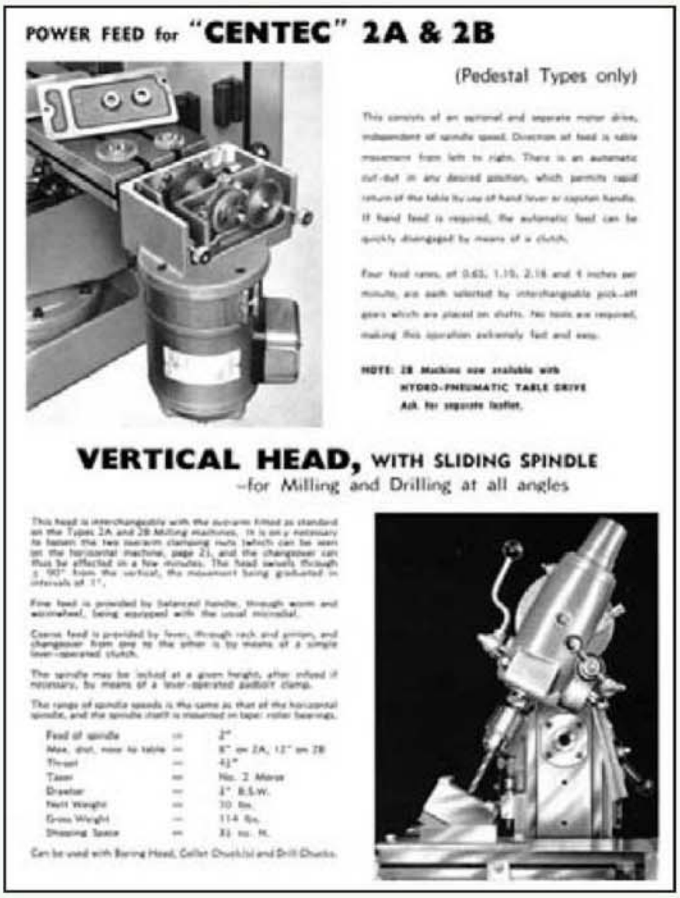
However, by fitting a length of threaded rod between the left and right-hand walls - with a couple of nuts at each end to adjust the tension - the resonance can, with a little experiment, be quickly eliminated. Rather than change the motor it is now far better to take advantage of the falling prices of 1-phase to 3-phase inverters and fit one of those instead.

While most 2B and 2C models were built as conventional machines they could also be ordered in a modified form as the Automill with a hydro-pneumatic drive to the table. This model was made in much smaller numbers than the ordinary type and, while more commonly found on a heavy cast-iron stand as a conversion from the 2C, it began life on the ordinary sheet-steel cabinet as a modified 2B. If you find an Automill it is reported to be (though the writer has never attempted it), a relatively simple task to convert it to manual 2B/2C operation. While the normal spindle fitting (both horizontal and vertical) for the 2B was a No. 2 Morse taper examples have also been found with a 30 INT, as specified for the 2C and Automill.

Another Centec produced in smaller numbers - and one of the last machines made - was the No. 4. This was a much larger and heavier machine than the 2A and 2B and supplied as a horizontal miller only with a program-controlled and hydraulically powered 10.5in. x 40.5in. table with 18 inches of longitudinal movement, 7 inches in traverse and 13 inches vertically.

Powered by a 1.5 hp motor, and using principles outlined in patents (applied for, but either not granted or pursued), the table-drive system had a very high thrust capacity, a stepless feed that ran from 0.5 to 50 inches per revolution of the spindle and a 300-inches-per-minute fast-traverse. Rigid stops, with micrometer adjustment collars, were fitted at each end of the table to allow precise settings for dead stop and reversing - as might be used in plunge cutting -

Centec 2B had a usefully increased table traverse from the 2A.



Longitudinal power feed was available on pedestal models.

while the spindle was also arranged to stop automatically during rapid table returns in either direction.

So that the required horizontal program could be quickly and easily set four slots were cut into the front face of the table to take adjustable trip dogs and, to cope with the high rates of metal removal, one end of the table was left open so that swarf and coolant could drain away quickly into a detachable collector.

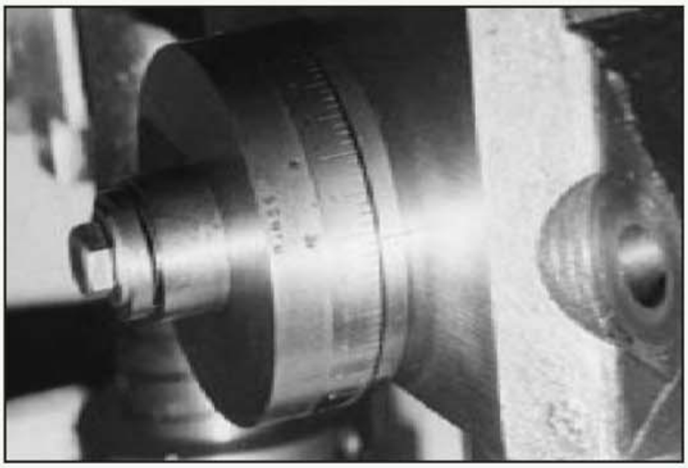
Strengthened, and enlarged sufficiently to take a robust 40 INT nose fitting, the spindle ran in three precision bearings with that at the front being a taper-roller type with an inside diameter of 3in. Ten speeds were provided, ranging from 50 to 2000 rpm, by either a 3 or 5 hp motor. In line with its intended industrial use lubrication was provided by a centralised, one-shot, operator-activated system that also supplied oil to both slideways.

Other specialist versions of the Centec included the 3 and 3R; these had programmed control of the horizontal table motion - with the R also gaining a vertical motion to the horizontal (or vertical) milling spindle that made it possible to combine more than one consecutive milling operation in each automatic cycle. Centec also manufactured a range of

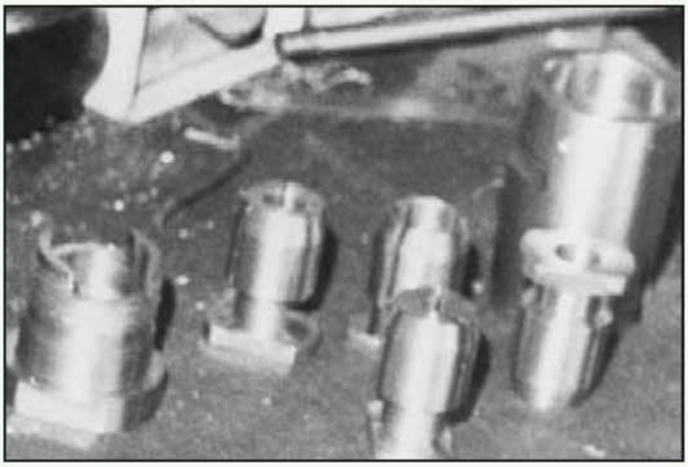
Centec 2C is now rare, most having been scrapped.

milling machine accessories including indexing units and quick-action swivel-base vices, a Senior router for wood and non-ferrous metals, profile (tracer) controlled millers, auto-pneumatic indexing tables for third-party fitting and could offer complete rotary-transfer machines built to a customer's specific requirements. They also appear to have had a hand in either the development or production of the Omlor 70, a high-precision single-spindle automatic lathe advertised for a time during the early 1950s. This machine incorporated automatic backlash elimination and was able to produce complicated profile parts as well as shafts, bolts, screw and nuts of the kind commonly used in the watchmaking, optical, instrumentation and similar industries.

While the 2A and 2B are the most commonly encountered models, every type of Centec miller is difficult to find. The C is especially rare, as are the specialist machines which, once their productive life was over, would have been unceremoniously scrapped. Because there is nothing available today that combines the versatility, quality and compact design of the Centec it remains a highly sought-after machine on the second-hand market. If you can find a good one, you will not be disappointed.



Quill feed index fitted to the author's Dore Westbury milling machine and graduated with 128 divisions.



The Arnold Throp style milling chuck designed to screw directly on the spindle nose of the Dore Westbury shown with a set of collets.

WORKSHOP PROJECTS

Bill Farmer

shares his experience on several projects for popular items of workshop equipment.

The one drawback with the Dore Westbury milling machine has been the lack of a depth stop when drilling, although I managed to incorporate one on the Mk.1 version. The Mk.2 version is perfect for adding a drill depth index. When I had completed mine and tested the down feed, I found that the quill moved down exactly 3.2in. with one full turn of the cross-shaft. I was hard put to find a fractional dimension to fit into this, and had the same problem with a metric version. In the end I adopted the increment of 0.025in. for indexing on the periphery of the quill spring cover (part number 435). Of course you have to interpolate for drilling to fractional depths, but it becomes second nature with regular use. I have used it for many years with no bother.

The dividing head was set up for 128 divisions and I am sure that owners of Dore Westburys do not need me to instruct them how to do that. The index is resettable to zero and repeats perfectly every time. There is a convenient gap between the inner face of part number 435 and the face of the head, a little more then 3/16in. wide, which is perfect for fitting a part ring with two zero index lines on it, roughly at the 3 o'clock and 5-30 positions (my machine is the long column version). The ring was made from an off-cut of 3in. dia. heavy walled tube bored out to 2 11/16in. diameter. The two lines were engraved, and then it was parted off to finish 3/16in. thick.

To fit it the head must of necessity be laid on its opposite side, the ring placed in position under 435 and the part adjacent to the back of the head, marked and cut away to conform to the shape of the head casting. It was finally fixed using Araldite Rapid. This is amply strong, as there is no weight on the ring. When doing the final fitting, place part number 435 on top of the ring to align both parts and then remove 435 without disturbing the ring. Leave overnight for the Araldite to set. Surplus Araldite can be easily scraped off with a scraper or penknife after it is set.

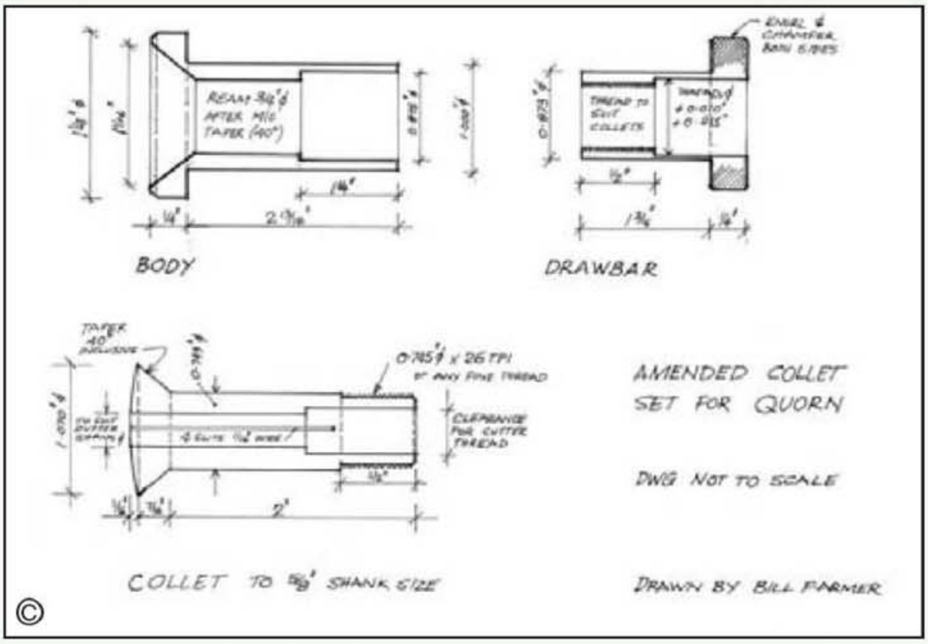
Quorn

During the construction of another Quorn it occurred to me that, since making my original machine, I had accumulated a quantity of cutters which had 5/8in. dia. shanks but had no means of holding them with my range of collets. Accordingly I redesigned my collet system to include one for cutters having 5/8in. shanks. Drawings for the new system are given, and the method of making them is exactly as I described in the issue of *M.E.* 3682, 4 June 1982. It should be noted that although the counter bore at the rear (threaded) end of the collets is not critical for the smaller diameter cutters that for the 5/8in. collet should be held to a nominal +0.004 to 0.010in. clearance due to the lack of wall thickness. Future builders of Quorns should also note that in *M.E.* 3784, 5 September 1986, page 273 there are a couple of errors. The missing dimension, adjacent to the 3/32in. dimension on the work head base, is 5/16in. and the 7/8in. length on the bolt should be 3/4 inch.

At Ivan Law's suggestion, I took the fabrication of the Quorn's rotating table a stage further by making the main body as a separate item and fitting two rings machined to form the circular T-slot. The whole lot was assembled with Loctite to make a complete unit. However, the entry slot for the T-bolts was milled in the lower ring prior to assembly. In use the cut ends tended to spring open and accordingly the ends were clamped and the ring drilled and tapped radially near the ends and over-length 8BA studs screwed in. They were made over-length because of the necessity of providing a screwdriver slot. Afterwards the over-length bit was cut off and the end filed flush. No drawing details are given because Professor Chaddock's drawings of the unit in *M.E.* 3784, 5 September 1986 are self-explanatory.

Milling chuck

A few years ago I made, as a gift for a friend, one of Arnold Throp's Clarkson type collet chucks (see *M.E.* 3756, 5 July 1985) and four collets to match (1/4in. to 5/8in.). My friend loaned this chuck out, and it was returned with the main body fractured at the spanner flats. So, I made a replacement from 1 5/8in. dia. bar increasing the spanner flats to 1 5/16in. across flats.

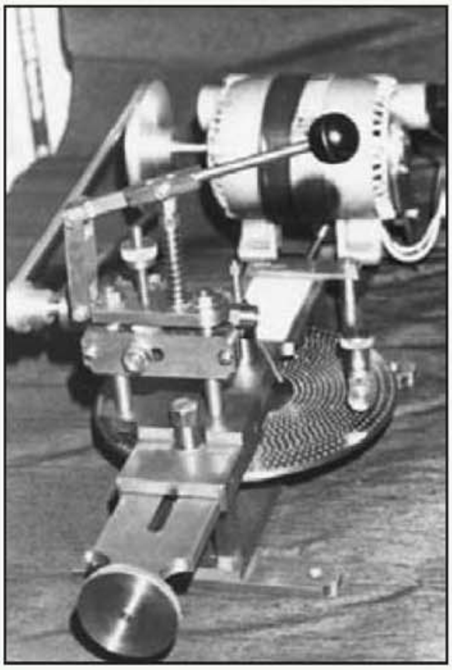


The finished item looked a bit stark to my eye so I modified the outside a little (drawing given); the internals are unchanged from the original drawing in *M.E.* except for the thrust plate which on mine is inserted from the thimble end and Loctited in place. In his article Mr. Throp gave detail drawings of Clare type collets but omitted drawings for the Clarkson and Osborn types. My version of a suitable collet for the Clarkson is given starting off with 1$^1/_8$in. round bar a $^1/_4$in. longer than the finished length, I used a steel called Hiten Speed because I had a few off-cuts in stock. It machines almost like free-cutting mild steel and gives a good finish without much effort and was described to me as a good quality mild steel capable of being used for hard work. Intending buyers should note (I am told) that it can only be bought with a minimum order of a ton at a time so probably it is best to stick to EN3 or EN6 for your collets.

Put the cut blank in the 4-jaw with about $^7/_8$in. length protruding. Set up to run true by placing the dial test indicator adjacent to the jaws and again at the outboard end then back to the jaw's position and again to outboard, repeating as necessary until the two readings match. Face the end and turn to 1.1in. diameter for at least $^5/_8$in. length. Transfer *en masse* to the dividing head and mill the two flats to 0.740in. +0/ -0.005in. across. They must not be a close fit in the slot in the thimble (i.e. the nosepiece). Machine the width of flats as close to $^1/_2$in. as you can get. Transfer the chuck to the lathe, centre drill and drill tapping size all the way through; No.6 for $^1/_4$BSW, $^{21}/_{64}$in. for $^3/_8$BSF, $^{29}/_{64}$in. for $^1/_2$UNF and $^9/_{16}$in. for the $^5/_8$ inch. All threads are 20 threads per inch. That for the $^5/_8$in. will have to be screw-cut to completion using a $^5/_8$in. slot drill or end mill as a gauge. Tap no deeper than to give $^3/_{16}$in. length plus the surplus extra length. The tap should be fitted with a tap wrench and supported by its centred end on a back centre in the tailstock. The end should then be inserted in the drilled hole and the tap turned by hand and guided by light pressure from the tailstock.

It is highly dangerous to tap this way under power even at extremely low speed. I once saw a three (yes three)-foot tap wrench smashed this way and the damage to the lathe shears was spectacular to say the least. Remove the collet blank from the chuck and insert the next one and repeat the performance remembering that the next collet will have a different size thread. Do all four then turn the first blank end for end in the chuck and, holding by the surplus length, rough out the external shape including the waist, which was formed with a 60deg. screw cutting tool.

Do the bore next and finish with an appropriate size reamer or D-bit. Finish turn the outer diameter and transfer the chuck (again *en masse*) to the milling machine for cutting the slots. Mine each have three slots. This was achieved by positioning the circular saw under and close to one of the four jaws for the first cut with a minimum amount of blade in the bore and cutting only as far as the first half of the V-shoulder in the waist using a 2in. dia. x $^1/_{32}$in. slitting saw blade. With the slitting



The horological wheel cutting engine built as a gift for a friend.

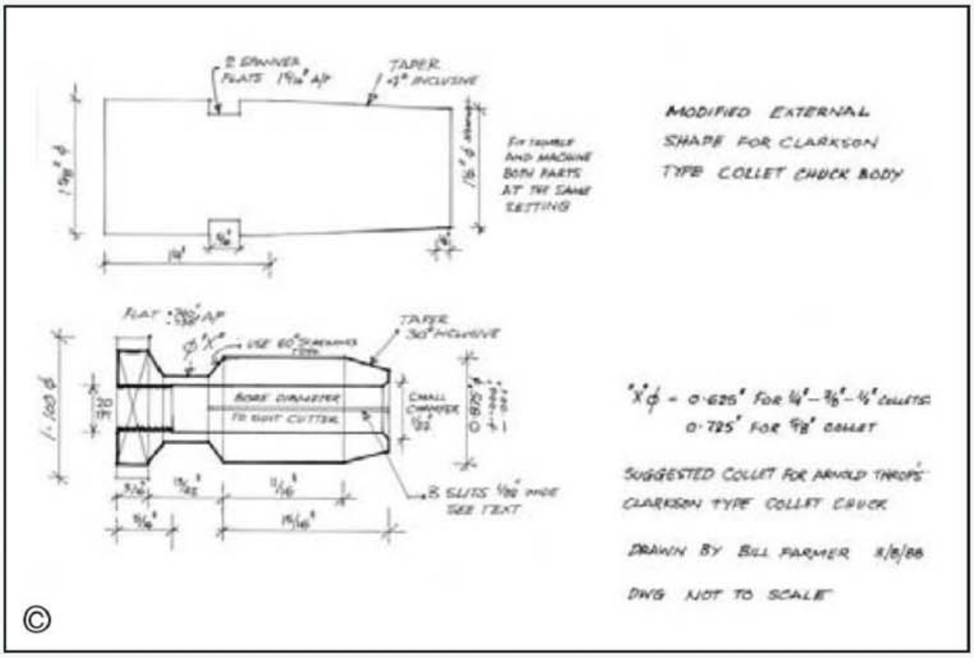
completed, transfer back to the lathe. Flood the collet with coolant and again ream the bore as far as the thread. Polish the OD with very well worn emery cloth and remove from the chuck. *Ditto repeato* for the others. To finish the collets off, insert a steel dowel a little longer than the collet and put into the self-centring chuck ensuring that the previously machined face at the threaded end is running true then face back to overall finished length. I suggest that you do not try parting it off to length because a parting tool disaster at this stage means probably having to remake the whole collet again. Incidentally I have made five of these chucks and collet sets to date and all are still going strong.

Wheel cutting engine

My next workshop project began when I was loaned a book called *The Clock Workshop, volume 2.* In this was a chapter on making a wheel cutting engine by George E. Lloyd-Jones ATD FBHI., which to the uninitiated is a combined, limited (very) dividing head and clock wheel cutter in horizontal form, which I thought would make a nice gift for the friend who got the original collet chuck. I, therefore, went ahead and made it. The author made use of fabrication techniques for everything and no castings were used in its construction. At times I had to try putting my mind into the designer's head to figure out what was intended. But my first two real frustrations came in making the division plate. The original as designed was 8in. diameter with 16 circles of holes (a total of 1,371 of them) which was impossible to swing over the bed of the Super 7 when drilling from the headstock with dividing head mounted on the cross slide. So I made it 6$^{31}/_{32}$in. so it just cleared the lathe shears. The second frustration was in trying to make a circle of 59 holes and with my equipment, which at the time was an impossibility.

I have two dividing heads, the Myford type and George Thomas versatile dividing head (VDH), neither of which would index 59 divisions. So I handed over the engine as it stood with only 14 circles. Then came a third difficulty, which had not occurred to me. The detent could not reach the two innermost circles! This only came to light while the engine was in use. So I started to improve and develop the machine but the problem of the 59 circle holes remained. The magic number of 59 is used, I gather, for making lunar and date wheels so it was important to have it. Finally, I managed to add this prime number plus some others!

It seemed logical to use the VDH with its micro-attachment because this had been used to generate the circles of holes on my original division plates. However, my micro-attachment had long gone in the supposition that I would never need it after making my plates. So the first thing was to make another. Out came the calculator, pencils and yards of surplus computer



53 circle = 1 + 7/60		
00	64	64
92	57	21
85	49	13
77	42	06
70	34	98
62	26	91
55	19	83
47	11	75
40	04	68
32	96	60
15	89	53
17	81	45
09	74	38
02	66	30
94	58	23
87	51	15
79	43	08
72	36	00

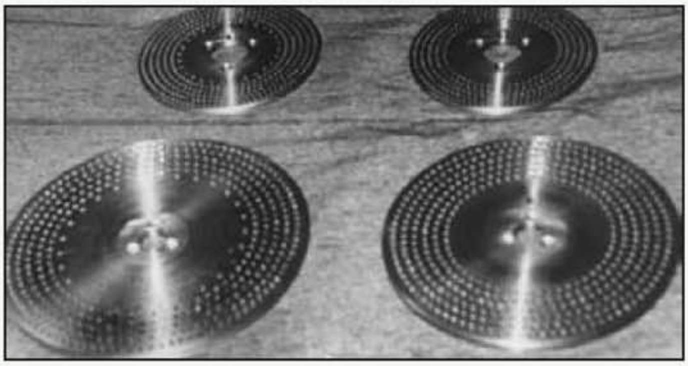
59 circle = 1 + 1/60			
00	30	63	94
02	31	65	95
04	33	67	96
06	35	69	97
07	37	71	98
08	39	73	00
10	41	75	
12	43	77	
14	45	79	
16	46	80	
17	47	82	
19	49	84	
21	51	86	
23	53	87	
25	55	89	
26	57	91	
27	59	92	
29	61	93	

61 circle = 59/60			
00	28	58	88
02	29	60	90
03	31	61	92
05	33	63	94
06	35	65	95
08	36	66	97
10	38	67	99
11	40	68	00
13	42	70	
14	43	72	
16	45	74	
17	46	76	
19	48	77	
20	50	79	
22	51	81	
23	53	83	
25	55	85	
26	57	87	

67 circle = 53/60			
00	16	33	50
73	90	06	23
46	63	79	96
20	36	53	69
93	09	26	42
66	82	99	15
39	55	72	89
12	28	45	62
85	01	18	35
58	74	92	08
31	48	65	81
05	21	38	54
78	94	11	27
51	67	84	00
24	40	57	
97	13	31	
70	87	04	
43	60	77	

73 circle = 49/60				
00	68	35	03	69
32	99	67	34	00
64	31	99	65	
96	63	30	97	
28	95	61	29	
59	26	93	60	
90	57	25	91	
22	89	56	23	
54	21	87	55	
85	52	19	86	
16	83	51	17	
28	15	82	49	
80	47	13	81	
11	78	45	12	
42	09	77	44	
74	41	08	76	
06	73	39	07	
37	04	71	38	

79 circle = 45/60				
00	25	50	75	01
57	82	07	32	58
14	39	64	89	15
71	96	21	46	72
28	53	78	03	29
85	10	35	60	86
42	67	92	17	43
98	24	49	74	00
55	81	06	31	
12	38	63	88	
69	95	20	45	
26	52	77	02	
83	08	34	59	
40	65	91	16	
97	22	48	73	
54	79	05	30	
11	36	62	87	
68	93	19	44	



Some of the plates made to enable large prime numbers to be indexed directly on both the Myford and VDH dividing heads.

83 circle = 43/60				
00	71	46	17	91
38	09	83	55	28
76	46	20	93	66
14	83	58	30	03
51	21	95	67	40
88	59	33	05	77
25	96	70	42	14
62	33	07	80	51
99	71	44	17	88
36	08	82	54	25
73	46	19	91	62
10	83	56	29	00
47	21	93	67	
84	58	30	05	
21	95	68	43	
59	33	06	80	
95	70	43	17	
33	08	80	54	

89 circle = 40/60				
00	10	19	27	36
45	55	64	72	81
90	99	09	17	26
35	44	54	62	71
80	89	99	07	15
25	34	43	52	60
70	79	88	97	05
15	24	33	42	50
60	69	78	87	95
05	14	23	32	40
50	59	68	76	85
95	04	13	21	30
40	49	58	66	75
85	94	02	11	20
30	39	47	56	65
75	84	92	01	10
20	29	37	46	55
65	74	82	91	00

97 circle = 37/60				
00	25	52	79	06
11	37	64	90	17
23	48	75	02	28
34	59	86	13	39
46	70	98	24	50
55	82	09	36	62
66	93	20	47	73
78	05	32	58	84
89	16	43	69	96
01	27	54	81	07
12	39	66	93	18
23	50	77	04	29
34	61	88	15	41
46	73	99	27	52
57	84	11	38	64
68	96	22	49	76
80	07	33	61	88
91	18	45	72	00
03	30	56	83	
14	41	67	94	

paper and the calculations began and continued during the evenings after my workshop time was finished. Eventually I arrived at finished figures for the micro-attachment.

I made eight prime number division plates two each for the Myford dividing head, VDH and wheel cutting engine and two spares. This was lucky because the first two attempts ended up as scrap. I had supposed that it was logical to assume that because the micro-attachment was turning clockwise the detent arm should also turn clockwise around the plate. With the first plate the holes were just under 1mm apart but between the first and last holes the space was nearly 3mm.

Unlike George Thomas I do not have a phone in the workshop to disturb me so I could not blame that. But, what with being called to talk on the phone in the lounge, being called to talk at the front door, the wife coming out to try and talk me into redecorating the front bedroom, visitors and the dog coming for affection at odd times, I merely thought I had miscounted. I therefore put the second plate on the head with the same result. This was when I noticed that the micro-attachment was turning the division plate anti-clockwise and partly cancelling out the movement.

So, that is the first thing for the reader to note – namely that the detent arm should move anti-clockwise when using the micro-attachment. My original prime number division plates for the VDH were made from 5mm sheet steel trepanned to $4^1/2$in. dia. and turned to size on a mandrel, one being finished at $4^7/16$in. diameter for the 97 hole circle the other at $4^3/8$in. for the 89 circle.

All the rest of the VDH Plates are exactly as described in the book *Workshop Techniques* by George H Thomas. In passing, do not mesh the micro-attachment too tightly with the secondary wheel. I made that error and have the blisters on my right thumb to prove it! Also my original plates had a 27 hole as standard so I substituted a 28 circle for it on the new VDH plates, which was needed to make a 120 hole circle for the wheel cutting engine. Plates for the Myford head I had flame cut from $^5/16$in. thick boilerplate with the burnt edge dressed on a grinding wheel, a little service I had not asked for but which was much appreciated.

In facing these plates I found that I got a better finish at the slowest open speed (Super 7) without coolant and a 0.005in. per rev. feed. Myford type plates were made one at $6^1/2$in. diameter for the 97 circle and one as standard for the 89 circle, the largest circles on each plate. Both finished at $^1/4$in. thick. For the mounting holes, which are 3BA clear, I could have worked out the pitch circle diameter (PCD) but instead inserted a short length of silver steel in both bores, clamped the plates together and drilled (sacrilege!!) through the original plate which I thought permissible with care on a one off job. I have yet to figure out what the $^1/4$in. dia. hole in Myford plates is for unless it serves as a register to align the circle numbers. The distance between each PCD is $^7/32$in. and the circle holes are $^1/8$in. diameter.

Drilling the plate for the horological wheel cutting engine on the Myford lathe.

28 circle = 2+8/60
00
57
14
72
29
86
43
00 repeat 3 times

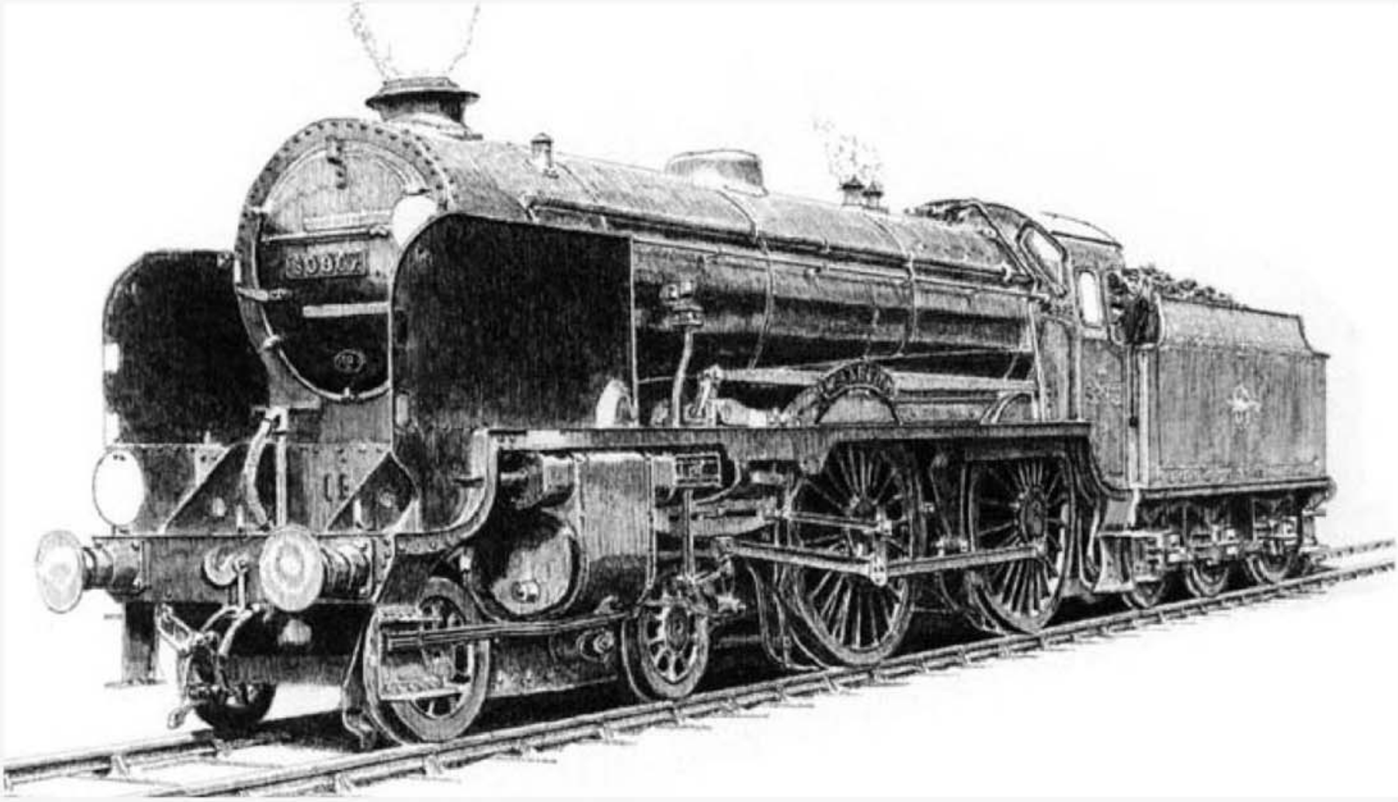
Micro-drum settings for the prime number division plates are provided but do remember to use the 60 hole circle in conjunction with the micro-attachment to produce all the circles. Each vertical column in the tables should be read downwards before moving to the next column to the right.

These hole circles, used in conjunction with those already made for the VDH, will index all numbers from 1 to 100, plus of course other derivatives.

An explanation of the figures at the head of each set of columns, using the 97 and 28 circles, as examples is: 97, index every 37 holes on a 60 hole circle followed by turning the micro-attachment drum to the appropriate number in the column with the numbers always rising. For the 28 circle the figure before the plus sign means two full turns of the index arm on the division plate.

This is followed by the number of holes used on the plate and then the micro-attachment movement. Circle numbers in sequence from the plate periphery are, for larger plate: 97, 83, 73, 67, 61, 27 (and/ or 28) The smaller plate : 89, 79, 71, 66, 59, 53.

Incidentally my sister in law gave me a nice compliment about my new division plates. She reckoned that she had never seen such nicely made mincer plates!



STOWE
SOUTHERN RAILWAY 'SCHOOLS' CLASS LOCOMOTIVE

Neville Evans
discusses the connecting and coupling rods for this handsome locomotive.

●*Part VII continued from page 568 (M.E. 4286, 10 November 2006)*

For the first time we are faced with a multi-cylinder locomotive, which perforce needs to have a split big end for the inside connecting rod. Incidentally, the LMS had a bit of trouble with split big-ends, as they seem to have had with most things, and the newly formed research department was asked to look into the problem. One of their number was heard to remark that, as they had no trouble with the outside, solid big-ends, why didn't they fit those on the inside as well? The mind boggles.

The inside rod on the Schools carries a marine type big end which I like to think comes down from the great William Stroudley, who was of course a marine engineer. A picture of the connecting and coupling rods for Dereck Tulley's locomotive appeared in *M.E.* 4286, 10 November 2006 and a lovely job he has made of them. He tells me that he found manufacture to be quite straightforward and to present no problems. We have a choice of either bronze or Meehanite, a lovely centrifugally cast iron, for the inside big end brasses; my personal choice for this part and indeed for all locomotive bushes would be cast iron. I was given this tip by Doug Hewson many years ago and I find, as he does, that cast iron bushes outlast bronze by a factor of three, or even four, when used in conjunction with hardened steel.

The two outside rods are quite simple by comparison. Note the small bolt that goes

Inside valve spindle guide on a full size Schools class locomotive complete with full size oil and dirt.

The left hand guide on Cheltenham. *The photograph was taken at the York Railway Museum.*

underneath the big end - I assume this to be a locking feature to stop the big end bush from rotating. Can anyone confirm this?

Before commencing any operations it is vital to ensure that all the stresses locked up in bright mild steel, if that is the material to be used, are relieved by annealing the metal. Just bring the pieces up to red heat and allow to cool slowly. If we are using black steel, which has not been rolled however, we don't need to go through this annealing process. The downside is that we now have to machine the unfinished flat faces of the steel to bring it to accurate dimension.

I have included a photograph of one of *Stowe's* coupling rods. Please note that the corner of the fluting is about one inch radius in full size. This is quite an important feature of a rod and is achieved by rounding the edges of the cutter, which also accounts for the rather attractive quarter elliptical curve to be found at the ends of the fluting.

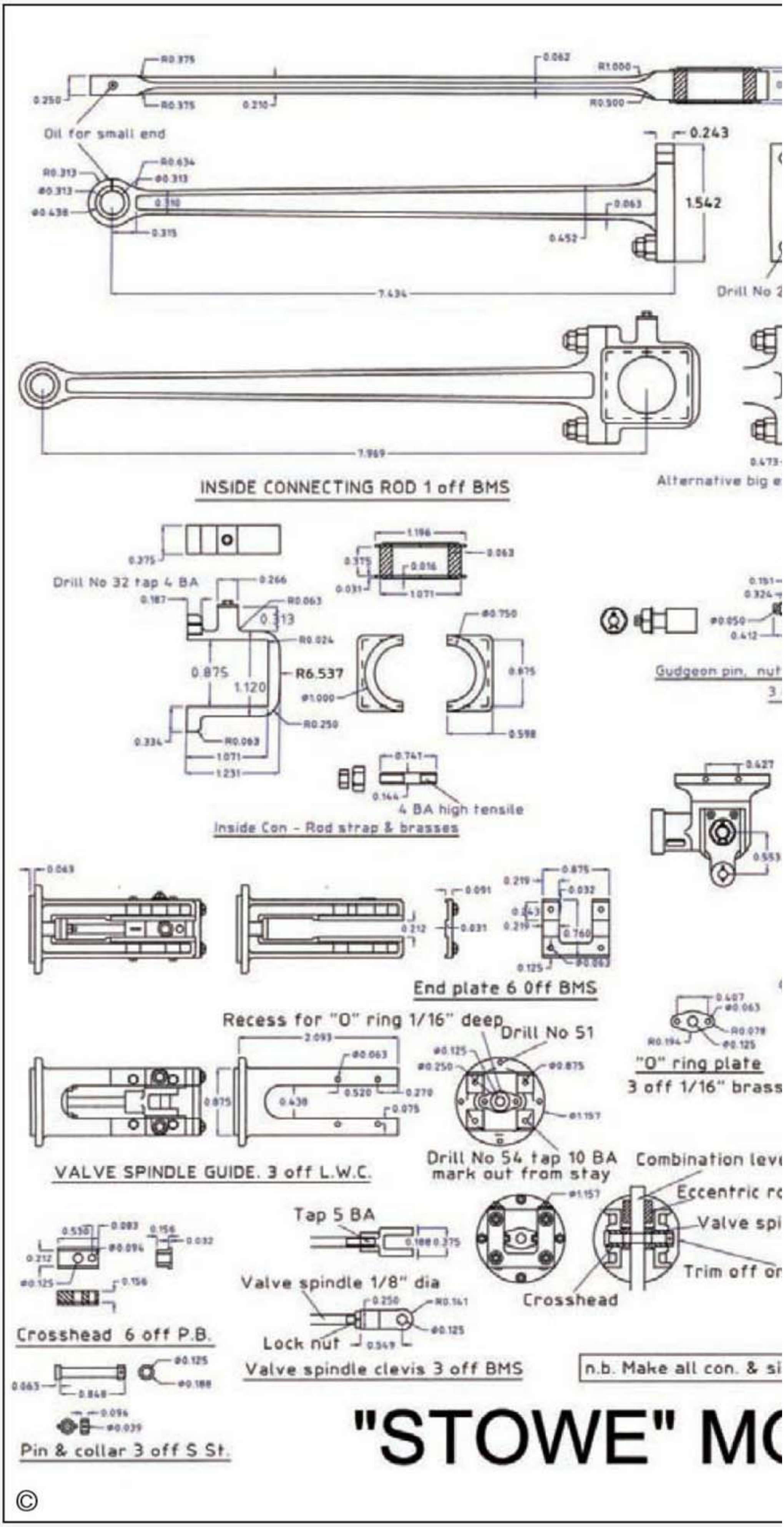
Please note, while on the subject of fluting, that the coupling rods are fish bellied and that the fluting follows the fish bellying, leaving a thickness of 0.100 inch. All the edges of the rod between the bosses are rounded and then polished to avoid the onset of cracking, which leads of course to embarrassing rod failures. The leading boss on the coupling rod is much larger than the trailing boss because it has to accommodate the larger driving crank pin, which also carries all the stresses involved in driving the valve gear.

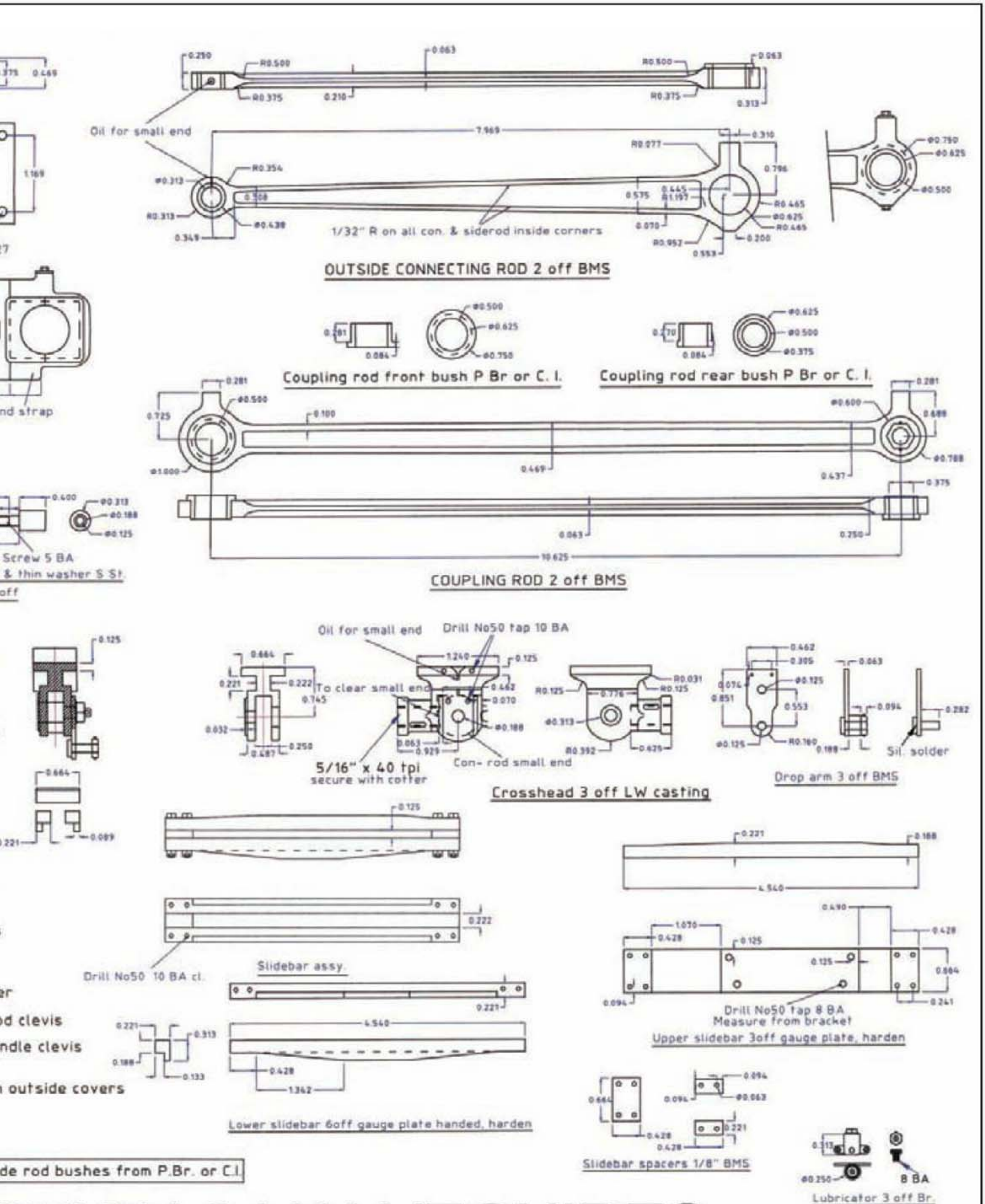
One of the great myths connected with side rods is the large amount of slack necessary in the bushes at either end. In fact with a $10\frac{1}{2}$in. coupling rod the extra length required by a $\frac{1}{4}$in. lift at one end is only 0.004 inch. If the axle boxes and horn cheeks were perfectly accurate, the rear bush would have to be elongated by this amount towards the rear of the locomotive. The driving crank pin bush can be given about 0.002in. running clearance.

Many methods of determining the centres of coupling rods have been mentioned in these pages over the last 40 or 50 years. Some of them use jigs, fixtures, fittings and gadgets that are so complex that they take longer to make than the rods themselves. I simply slide the axle boxes complete with roller bearings into the horns and clamp them in position. A centre line is then scribed down the coupling rod material and a 0.375in. hole drilled on the centre line at one end. A short stub of $\frac{3}{4}$in. round material is turned down for $\frac{1}{4}$in. to fit the hole. A second short piece of the material is turned to a sharp point and inserted in the trailing axlebox. The front stub is pushed into the leading axlebox and an arc is then described by the embryo side-rod at exactly the correct centre. Centre punch, drill and open up as required.

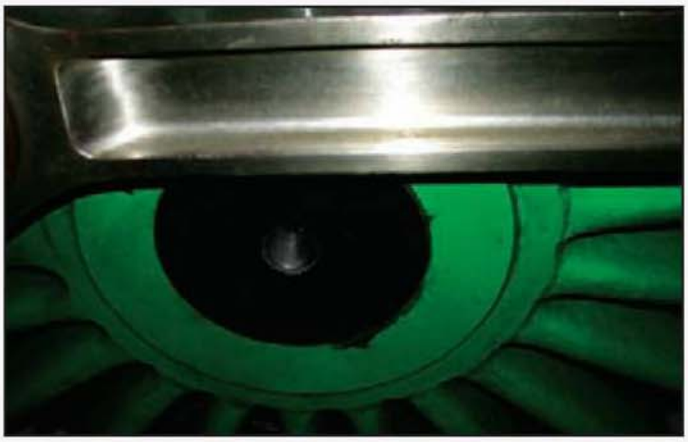
Crossheads

Lovely light little fellows these, which came down I think from American practice, particularly on the Pennsylvania Railroad. These crossheads are only really suitable for express locomotives, which nearly always run forwards. When running forward of course, all the loads are taken on the top-slide bar via the large top portion of the crosshead. Continental practice was usually to use a single slide bar which was enclosed by the crosshead. The last use of this application in Britain was, as far as I can remember, on the





OTION & VALVEGUIDES



Rear view of a coupling rod. Note the pronounced curves on the corners of the fluting.

Right hand valve guide on a Schools class locomotive. All the photos in this article were taken by Peter Thomas.

David Aitken's latest creation* Aberporth Grange *in 7¹/4in. gauge. Close to perfection - need I say more?

South Eastern and Chatham Moguls, the U and N classes, which were modified to the Laird type of three slide bars later in their lives. I would hope that lost wax castings will be shortly available in stainless steel for these little items. These, as with our GWR and HR crossheads will require very little work to finish.

Slide bars

These items are built up from gauge plate, a chrome vanadium steel, which may be flame hardened after machining and quenched in cold water. I have never suffered any distortion when hardening gauge plate. There is no secret to it, simply try to heat the steel evenly and plunge it end on into the water. Make sure that the slide bars are made accurately, and that they are positioned on the frames within very close limits, as these artifacts are some of the most important parts of a steam engine. The Maunsel slide bar which was later taken up by British Rail for their express locomotives is suspended in the centre, which is where the main vertical thrust forces are found, by means of slide bar brackets. These will have to wait until the next gripping instalment.

Valve spindle guides

Little marvels of complexity, which like the crossheads will be available as lost wax castings. As it happens, there has to be a hole into which the metal is poured during the casting process, this hole will be located in the back of the flange so as not to disturb any of the working detail. We can therefore make a virtue of necessity by using this spigot to hold the casting in the vice to clean up the four flat surfaces that the valve spindle crossheads run on. Draw file them with a clean, smooth Swiss file using a piece of material approximately 0.212in. thick as a guide. I'm sorry about the somewhat strange thickness of this piece, but it is the scale size and, as with so many other parts you must make a decision whether or not to go for scale or to compromise a bit. I'm all in favour of compromise provided that it is unnoticeable. In this case I don't think that it would be. The packing piece will come in handy later. It will be possible to hold these rather delicate parts in the 4-jaw chuck with the end cover facing outward in order to machine the rear face, to turn the register, and to drill and ream the ¹/8in. hole for the valve spindle which of course has to be concentric with the register.

We now have to decide on the form of seal to be used, bearing in mind that we are only dealing with a few pounds of exhaust steam. We have the choice of an O-ring in front of the gland or a lip seal behind in the steam space. I would favour the latter, I've tried it and it works a treat on the 'fit and forget' principle. The front of the stuffing box may be machined with the aid of a long ¹/8in. dia. end mill, fed in from the front. The recess for the O-ring can be cut with a home-made¹/4in. dia. D-bit, and the O-ring plate is held on by means of two little 10BA studs. The four end faces of the spindle guide are recessed ¹/32in. deep where the end plate fits on. These recesses can be machined with an end mill, the spindle guide being held in a machine vice with the packing piece still in position (I would hold it in *pro-tem* with one drop of instant glue) to avoid squeezing up the four rather fragile jaws. All should be made plain by a brief perusal of the art work, and a careful study of Pete Thomas' lovely photos, taken of *Repton* on the North Yorkshire Moors railway and *Cheltenham* which is in York Railway Museum. *Repton* is the one with the red painted motion brackets.

●*To be continued.*

ROAD STEAM

The late Stan Nipper and Martin Wallis
begin the description of the gears for this delightful wagon but start with some more *Out and About 2006* photos.

●*Part XXVII continued from p. 693 (M.E. 4288, 8 December 2006)*

Howard Farmer's Engine No. 110 of 1876, rated at 8nhp, reg. AP 9197. Note the two pulleys under the ash pan so the cable could be payed out either to the left or the right (photo: M Wallis).

SAVAGE'S *UNIVERSAL CARRIER*

Before engaging in any narrative I would like to wish all readers a happy New Year. Readers may recall the difficulty we had last time squeezing in all the *Out and About 2006* pictures into the allocated page space. To avoid some pictures being postage stamp sized I am grateful for the chance to carry two of the illustrations and a little text across into this issue.

Howard Farmer's Engine

J. and F. Howard Ltd. traded from the Britannia Iron Works in Bedford. Happily two Howard engines have survived into preservation. To mark the 50th Anniversary of the Bedford Steam Engine Preservation Society, their annual Old Warden Rally gathered together as many engines manufactured in their county as they could. As part of their display I was delighted to be able to inspect Howard Farmer's Engine No. 110 of 1876, rated at 8nhp, in pristine condition (**photos 270** and **271**).

In the rally catalogues the J. and F. Howard Farmer's Engine is categorised as a ploughing engine, although it could equally well drive a thrashing drum or perform other duties via the flywheel. The established market leaders in terms of ploughing engines were Fowlers. The engines were built in pairs. In operation, one engine was sited at each end of a field and the plough pulled back and forth across the field by alternate engines until the job was complete.

However, most engine manufacturers, Fowlers included, had experimented with single engine systems where an anchor (or sometimes anchors) fitted with a suitable return pulley allowed the wire rope to be paid out across a field, run around a pulley, and then returned to the engine. In this way the plough might be powered in both directions by one engine. The Howard is one such example. My understanding is that the present owners are planning to re-manufacture an anchor so that single engine ploughing demonstrations may be undertaken. I am not familiar with the type of anchor system Howard employed but, in due course, hope to find out.

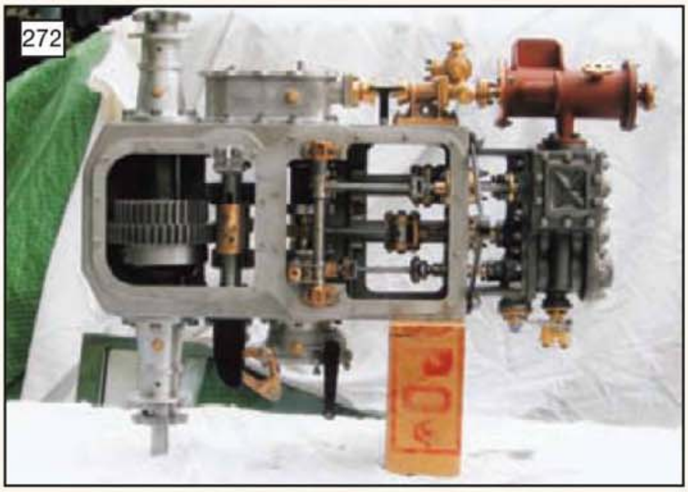
Little is known of No. 110's early life but it worked for Baldwin Bros. of Wadhurst, Sussex between 1916 and 1922, then after a period standing out of use it was purchased by the Henry Ford Museum in Michigan, USA, and exported. In 1991 it came back on the market and returned to the UK to be restored to full working order, taking countless hours over an eight-year period. A most interesting engine.

The two substantial cable drums fitted to the rear of the unusual Howard Farmer's Engine No. 110 of 1876 (photo: M Wallis).

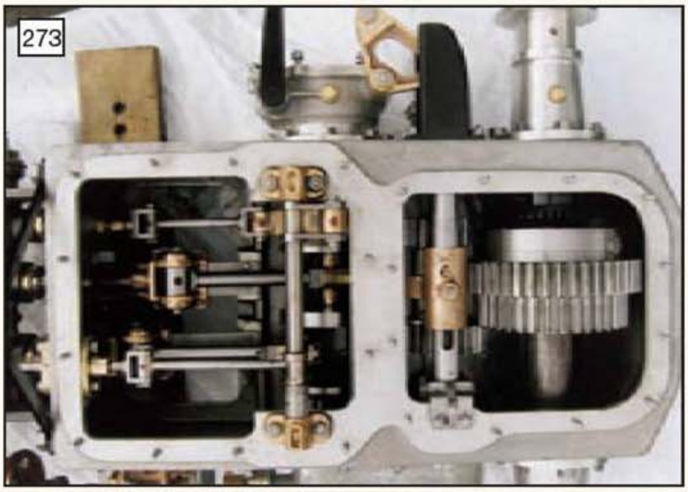
Wagon in black

Returning to our Savage *Universal Carrier*, many thanks to Roger Barnwell for providing the illustrations shown in **photos 272** to **275**. Readers with good memories will recall the excellent steel plate wheels Roger has made, and considerable progress since then has been made as readers may judge for themselves. Remember the wagon may be built with steel plate, wooden artillery, or cast wheels; as far as I know Roger's wagon is the only one with steel plate wheels.

I am particularly pleased to note from these pictures that Roger has had one eye on the scale drawings and the other on the surviving photographs, from which extra details and refinements have been taken. The result is a very fine model indeed, and one where the 'extras' collectively contribute to make a medal winner. An example is the deeply dished steering wheel, see photo 275. The published design is flat, which makes it both easier to cast and machine. Both designs are in fact correct and prototypical (for a flat steering wheel see works photo 256 *M.E.* 4286, 10 November 2006) but Roger has chosen the more complex and perhaps better-looking version.



The completed engine unit less the inspection covers. The red drum (top left) is the feed water heater (photo: Roger Barnwell).



The initial gear reduction from crank to second shaft is inside the casting at the bottom but the two speed gearing is visible (photo: Roger Barnwell).

The front wheels have been removed for easier access. The plate work is being assembled (photo: Roger Barnwell).

Note the dished steering wheel chosen by the builder and discussed in the text (photo: Roger Barnwell).

Electric wagon

Cyril Hayler has been making excellent progress on his radio controlled, electric Savage wagon. An electric motor has now been squeezed into the crankcase. The cast iron cylinder and covers have been fitted for effect but are devoid of pistons, etc.

The advantage of electric traction is that boiler certification is not needed yet the model may still be used to give the grandchildren a ride and so on. The radio control means rides may be given around the garden without the driver ever straying from his deck chair (see **photo 276**).

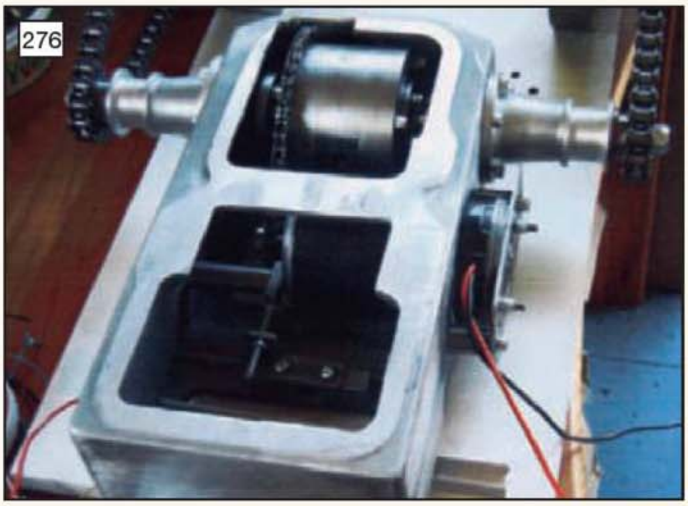
Universal Carrier gears

Now the engine part is complete it is time to turn our attention to the drive gears. Six straight cut gears are needed plus the four bevel gears that make up the differential. A pair of 16DP gears, one having 27 teeth and the other 47 teeth, provides the gear reduction between the crankshaft and the second shaft. These gears remain in constant mesh and reduce the engine speed to a more manageable figure for the feed pump.

On the second shaft two pairs of 14DP gears, a 16 tooth one driving a 44 tooth and a 23 tooth driving a 37 tooth, give the two road speeds. These gears are available either direct from HPC Gears or from Little Samson Models. The cost is the same; the modest discount Little Samson Models negotiated from HPC sadly evaporating in the carriage costs then added by HPC for delivery.

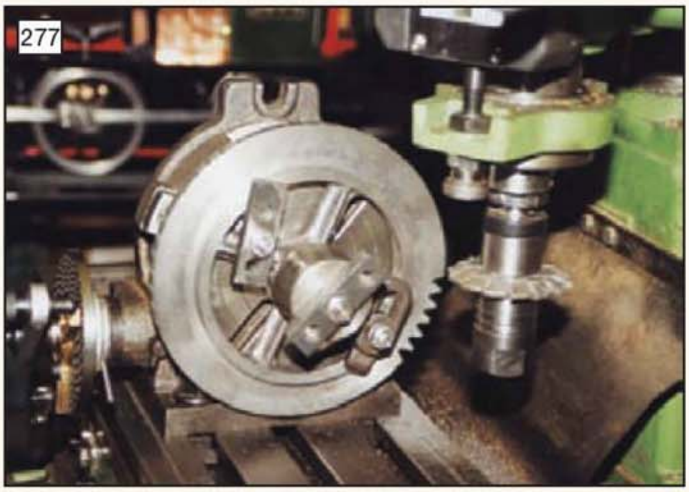
Cut your own

A minority of wagon builders may choose to cut their own gears using a dividing head and form cutters. This is, of course, highly commendable and will suit those wishing to do as much as they can 'in house'. **Photograph 277** shows an arrangement on a vertical milling machine using a rotary table set vertically. The gear in this case is for a 3in. to the foot *Little Samson*. **Photograph 278** is of a similar arrangement on a Bridgeport milling machine, the gear is one for a 4in. to the foot *Little Samson* final drive.

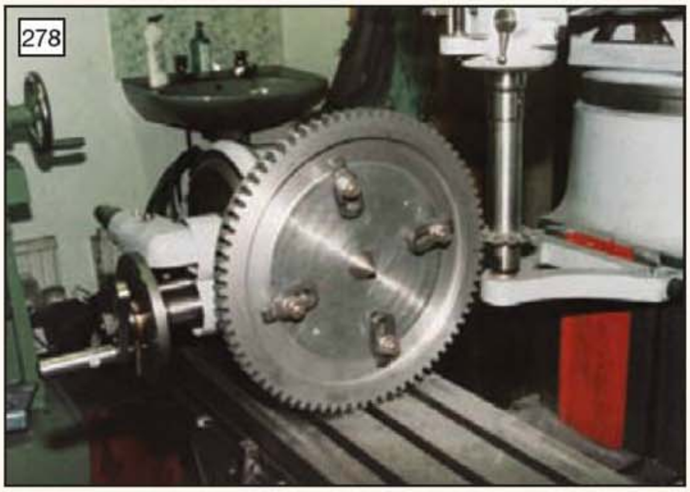


The crankcase adapted for a Parkside electric motor. The differential has been retained but without the two speed input gears (photo: Cyril Hayler).

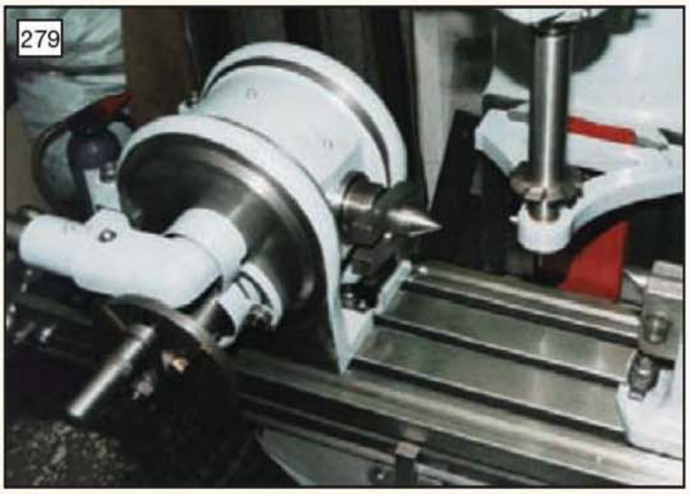
There is no reason why the primary reduction 27 tooth and 47 tooth gears should not be substituted with 26 and 48 tooth gears if it makes the dividing arrangements easier, the centres remain exactly the same. The slight change of ratio is never going to be noticed. The reason for these rather anti-social numbers is to ensure the gears wear evenly, as in due course every tooth will mesh with every other tooth. That is why, if the exact ratio is not important, a 60 tooth gear driving a 121 tooth



Gear cutting with a form cutter. An imported milling machine is being used with the work being indexed on a rotary table (photo: Stan Nipper).



A more substantial set up for a 1:3 scale Little Samson *final drive. A Bridgeport, dividing head and home made arbor support (photo: M. Wallis).*



The gear cutting arrangements before the Sykes machine was purchased (photo: M. Wallis).

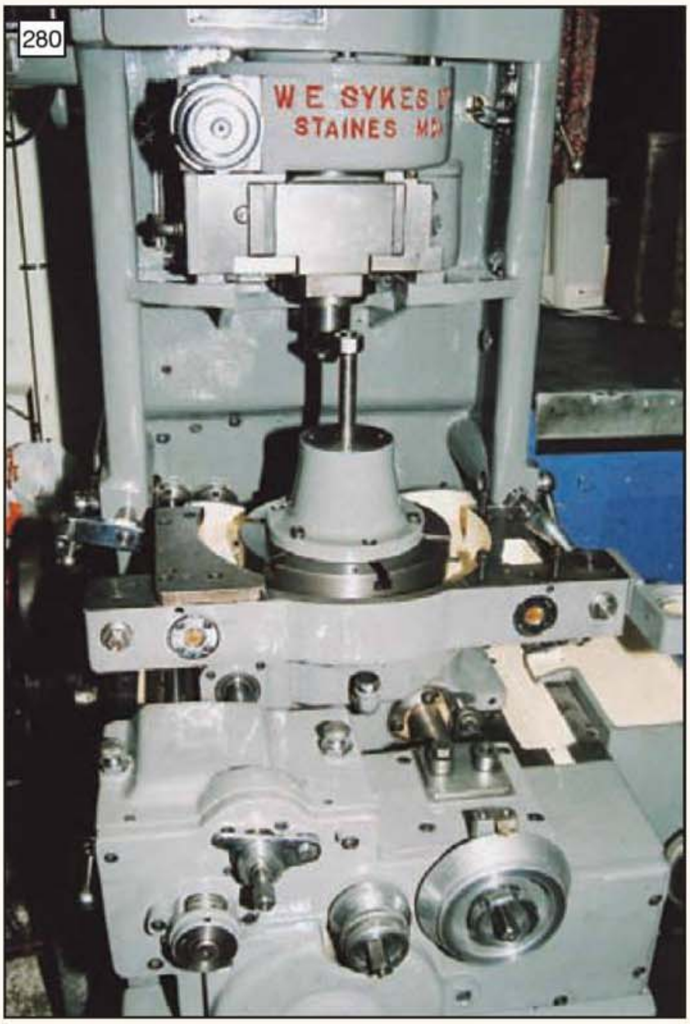
gear is better than one of 60 teeth driving a 120 tooth gear. The extra tooth is known as a 'hunting tooth'.

Form cutters are made in sets of eight, each cutter covering a specific range of teeth. For example the No. 4 cutter is suitable for cutting gears in the range 26-34 inclusive. Cutters are available in both $14^1/2$ and 20deg. pressure angle, either of which is fine but they must not be mixed. A fair amount of time will needed to be set aside for gear cutting, several passes may be necessary and the job needs careful indexing between each pass. The process, while fairly straightforward, is notoriously unforgiving. Who wants a gear with $47^1/2$ teeth?

Least favourite occupation

While the gears for the *Universal Carrier* are presently out-sourced from HPC, the gears for the *Little Samson* steam tractor are not. Your author makes them himself, using the set up in **photo 279**, taking up ever larger portions of the school holidays (day job is school teaching). After rather more than ten years cutting *Little Samson* gears the novelty has more than worn off. It was certainly my least favourite occupation. Something had to be done. The solution was to buy a specialist gear-cutting machine. That meant a second hand purchase - the eventual choice being of 1954 vintage.

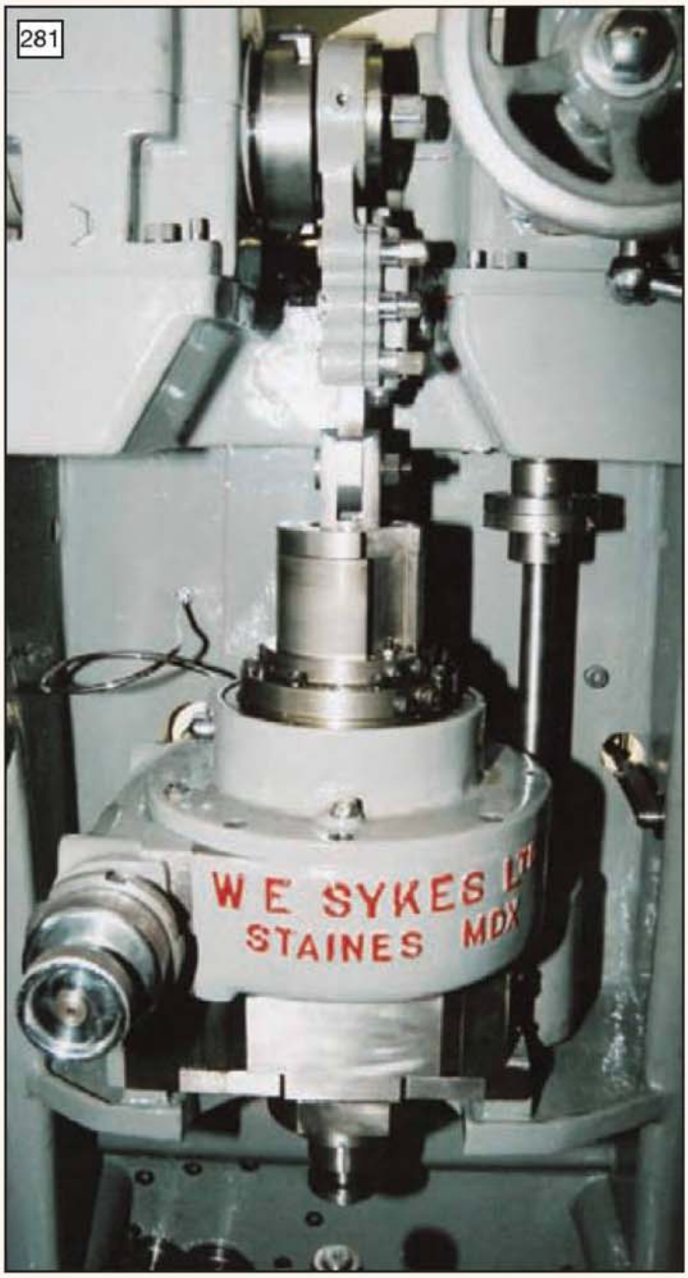
The capital outlay; the initial purchase of the machine, the transport home, replacing all the oil seals, sourcing extra change wheels to complete the set, and a coat of fresh paint; was rather more than £2000. Not an obvious move forward as, assuming the amount of work remains constant (i.e. cutting the *Little Samson* gears), the pay back time is going to be over 20 years assuming a zero payment for the many hours spent repainting and refurbishing the machine.



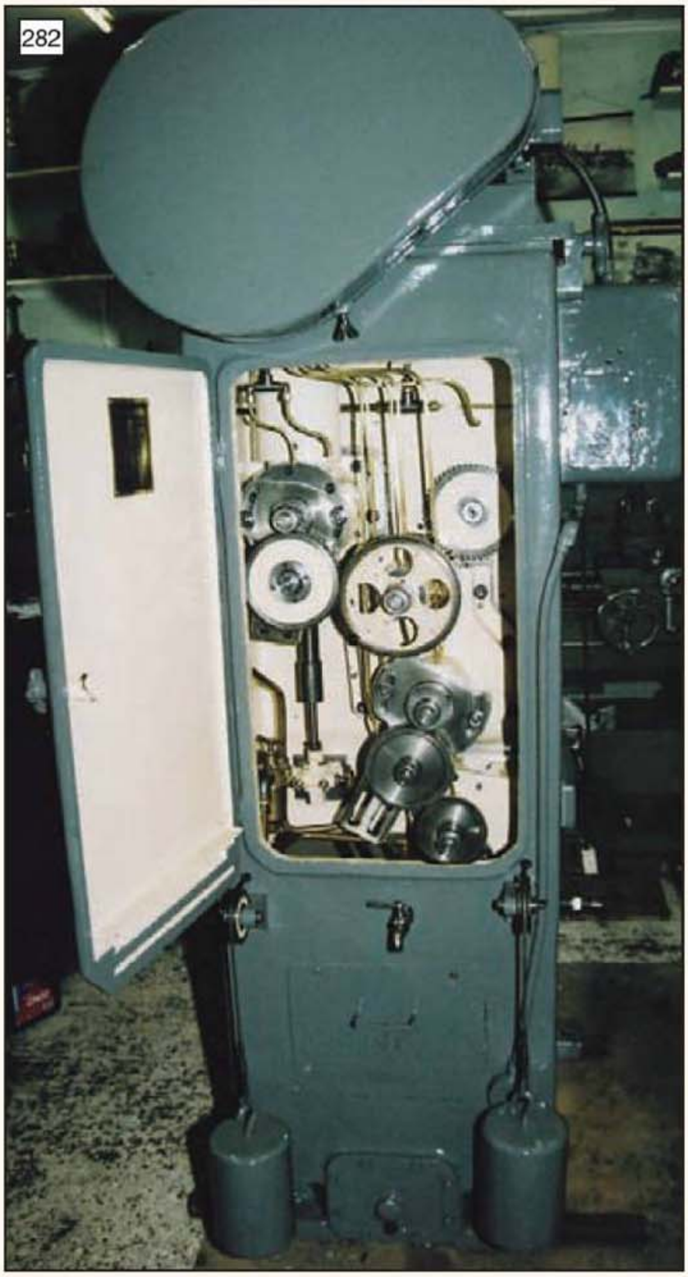
The Sykes V10A after major restoration. Behind the red lettering is a large worm and wheel to rotate the reciprocating cutter, a second worm and wheel beneath the table rotates the work (photo: M. Wallis).

W. E. Sykes Ltd

Happily Little Samson Models is not bound by business plans. The machine purchased was a W. E. Sykes Ltd. V10A gear shaper. The capacity is 14in. diameter, which was just perfect, but the sting in the tail was not the size but the weight of the machine. It weighs no less than 2,359kg or, in old money, a little less than 2.5 tons. Much pleasure was derived from its restoration, the machine was beautifully made. Every part is engraved or stamped with the machine's serial number, locating dowels are used extensively, and many parts were hand scraped. Overall, the engineering was most impressive; everything that could run on ball or roller bearings is so fitted. The main challenge was that the 'body' filler, of which there was no shortage, had absorbed oil like a sponge and all had to be removed.



The crank and connecting rod on the rebuilt Sykes gear cutting machine (photo: M. Wallis).



In the back of the machine are change wheels for selecting power feeds and to set the number of teeth on the gear to be cut (photo: M. Wallis).

A single sentence of explanation on how it cuts gears is not easy. The cutter looks like a straight cut gear, but has clearance angles ground on the sides of the teeth. It is driven up and down by a variable throw crank and, as it does so, it meshes with the gear blank, both the cutter and gear blank rotating together. As the cutter increases its mesh with the gear blank material is shaved away until the gear takes on its completed form.

If both the cutter and the work have 24 teeth the cutter and work need to revolve in unison, a ratio of 1:1. It therefore follows that if the work is to have 48 teeth the blank must rotate at half the cutter speed. This is achieved with change wheels, which are situated in the back of the machine, see **photo 282**. With the extra gearwheels purchased it is, I believe, possible to cut any number of teeth up to 100 including the prime numbers. The machine came with gear cutters for 6, 8, 10, 12 and 14 DP so there ought to be a fair amount of versatility.

Sadly my knowledge of W. E. Sykes Ltd, Staines, Middlesex, is limited but what I have found out runs as follows: W.E. Sykes himself was the principal designer of the V8 prototype (1938 I understand) and the V10, of which around 100 were made up to around 1948. It was then superseded by the V10A until 1963 when Jack Hopkins introduced the hydraulic V10B. The V10C was similar but an economy version less the hydraulics. The final model was the V400 (1973 to around 1981)

W. E. Sykes was sold and the property, close to London Airport, was re-developed. The designs, machines, spares etc. eventually went to David Brown who later sold some of them to Renown Gears of Blackburn. In turn, they sold them to Curdworth International who ceased trading. I understand the residue of the spares etc. are now owned by Brooklands Precision in Coventry.

15 minute conversion

Last year I had several enquiries about *Galanthus'* ability to appear at a rally as a road locomotive one day and a showman's engine the next. It is in fact not a particularly daunting operation; the model may be converted into a showman's engine in as little as 15 minutes.

There is really nothing clever about the conversion at all, the only possible exception being the small washers braised under the dynamo bracket mounting holes. By arranging for the diameter of these washers to be a little smaller than the diameter of the smoke box rivet heads the bracket retains a small air gap betwixt itself and the smoke box so there is no damage or bruising to the smoke box paint.

To raise the heavy dynamo a small winch was bought at a very modest cost from one of the many rally 'junk' stalls. It was beautifully made and sported several strange brackets and mounting lugs in odd places. Its purpose remained a mystery until a visit to an aviation museum revealed it to be a bomb-loading winch from a Second World War bomber. This explained the largely aluminium alloy construction. The sequence of pictures, **photos 283** to **289**, illustrates the method.

●*To be continued.*

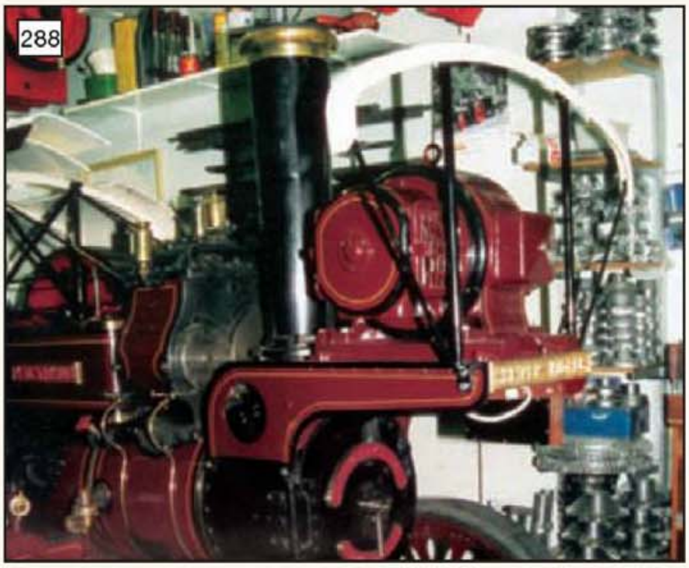
Your author's largest model **Galanthus***. Note the seat on the back to allow for passengers (photo: Mike Dyson).*

The same model in showman's form. The canopy sign writing has yet to be completed (photo: Mike Dyson).

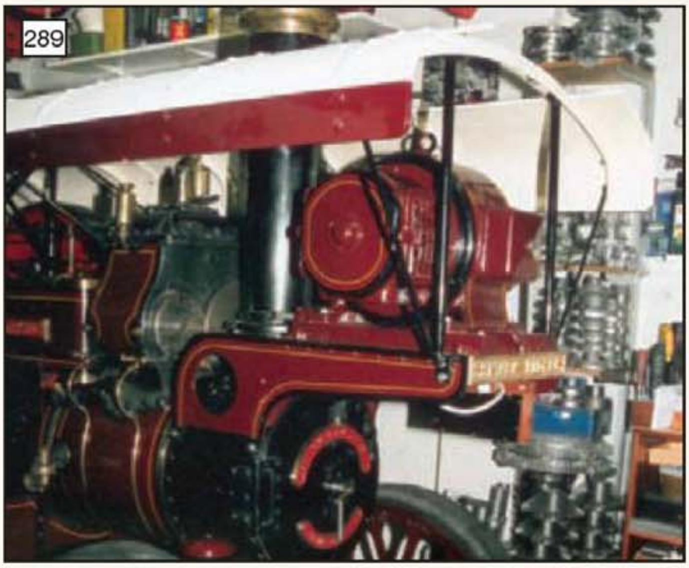
Road locomotive form, but five loose rivets in the smoke box have been removed.

The dynamo bracket is fitted with five 10mm high tensile cap head Allen screws (head inside).

The dynamo is winched up into position with a special hoist.



After the fitting of the dynamo the front awning support can be fitted to the dynamo brackets.

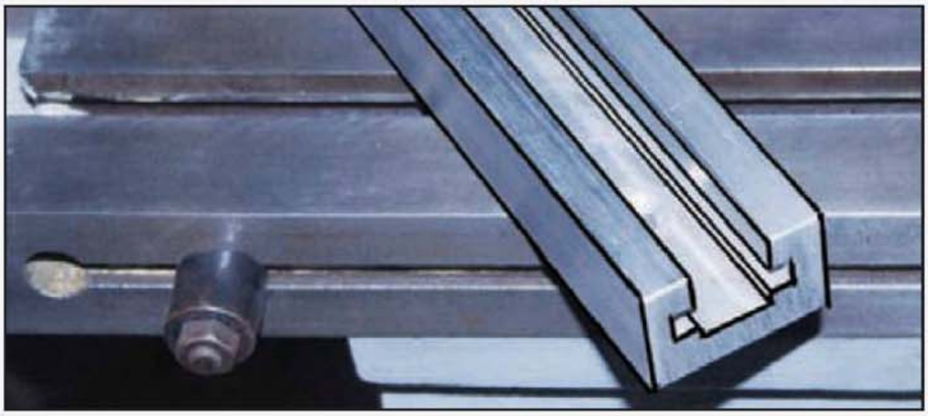


The final assembly operation in the conversion is the fitting of the roof or canopy extension.

PETE'S PAGE

Peter Spenlove-Spenlove concludes this short series on cutting T-slots.

●*Part II continued from page 703 (M.E. 4288, 8 December 2006)*



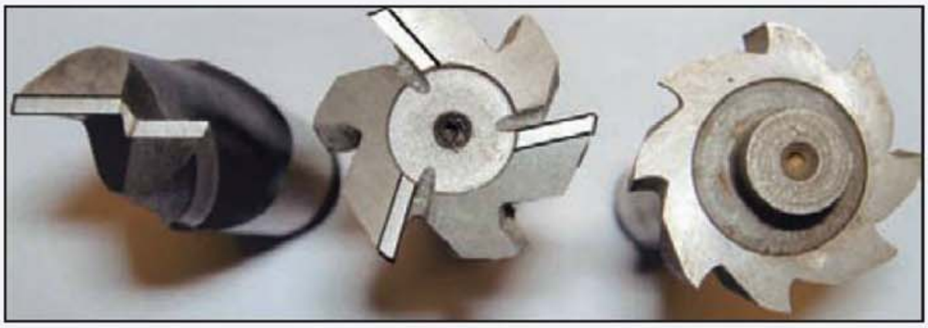
T-SLOT EXTENSIONS

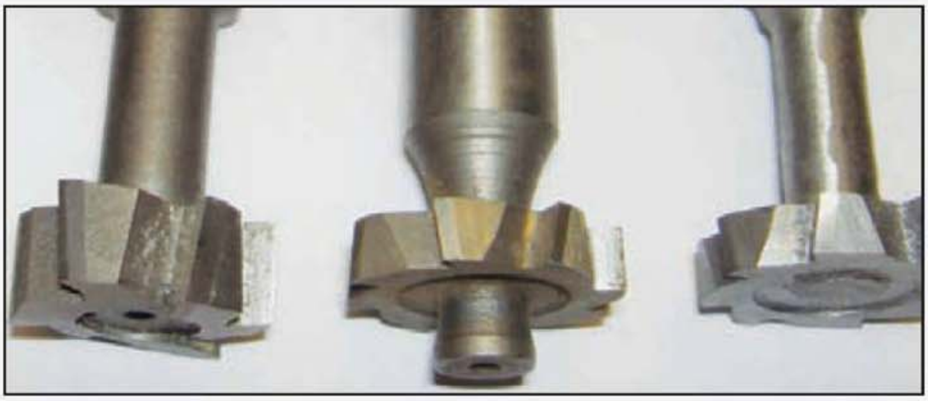
The next stage in machining the slots is to cut the two undercuts. In industry they use a T-slot cutter, which is a fairly delicate item. They tend to be costly and the non-standard model engineering sizes can be difficult to find. However, you can use ordinary Woodruff cutters. These are simpler than the T-slot cutters and easier to sharpen. If the cutter is a different size to the T-slot required then mill one side and then the other. It is best to work carefully and slowly. Swarf clearance is difficult in the bottom of a T-slot and we do not want to snap the cutter's shank. Use plenty of coolant and, if possible, set the flow to wash out the swarf. Do not try to brush it out while the cutter is rotating. It will grab the brush and maybe your fingers too.

You will notice from the photo that the first vertical slot is deeper than the cross slot by 0.03 to 0.05 inch. This clearance makes life easier for the Woodruff cutter, which might be a homemade one rather than a commercial item.

One tip, if you do make your own cutter to machine the undercuts in the T-slot, is not to space the teeth out evenly. Such even spacing can lead to chatter and vibration. I made a cutter using a file to cut the teeth at random with as much as 20deg. variation in the spacing. It works well. Industrial cutter makers would find this difficult (sharpening them might be too) although I recall a pre-World War II reamer maker who did space two teeth out of even spacing. If your first attempt at making a cutter is seen by an expert, who criticises your tooth spacing, then tell him it is 'a special anti-chatter cutter'.

If you have access to a suitable machine and cutter then the main slot can be machined using a horizontal milling machine fitted with a side and face cutter. These cutters tend to be expensive but they do enable the slot to be cut to depth and then the cutter can be moved sideways to give the required width. The photo shows a standard 4in. dia. side and face cutter with a 1in. bore. Like end mills and slot drills, these cutters can be re-ground on a suitable tool and cutter grinder when blunt though naturally this does reduce their diameter and width.





***Top:** A commercial side and face cutter. This can be used to open up the initial slot in the work if a suitable cutter and machine are available.*

***Centre:** Left to right is shown a slot drill, a T-slot cutter and a Woodruff cutter. The latter has a centre pip that should be removed for T-slot cutting work.*

***Bottom:** Left to right is shown a commercial T-slot cutter, the Woodruff cutter shown in the centre photo and another Woodruff cutter with no centre pip. The latter would be suitable for T-slot cutting work.*

REMAP

Do you fancy making something different in your workshop?

Dick Gays

asks if you would consider using your engineering skills to help disabled people enjoy a better lifestyle.

Are you the sort of model engineer that likes the challenge of doing something different, perhaps having to design and produce a product to meet a particular need? If so, there is a local branch of a National Organisation that would appreciate the occasional use of your skills, REMAP. (**www.remap.org.uk**) Remap is a national registered charity that has, for 40 years, provided one-off technical aids which help disabled people of all ages to enjoy a better lifestyle. Every aid is given free of charge to the user. Remap operates through a network of 1,500 volunteers. The professional engineers, technicians, and craftspeople - along with medical and paramedical staff from community services and hospitals - all belong to approximately 100 panels (groups) linked to regions across the UK, with Scotland and the Isle of Man operating separately.

Remap has its own yearbook, which is published by head office as a means of showcasing some examples of the work carried out by the panels.

Each year Remap turns out £2 million worth of individual aids that money just can't buy. That is because the charity only makes aids that are not available over the counter. It's one of the UK's most cost-effective charities and our engineers also think 'green' when it comes to choosing materials for the job. A defunct dishwasher or some old car parts will, in skilled hands, often become components of aids that open up new horizons for many hundreds of disabled people. Remap donors can bask in the satisfaction of added value - for every £100 (and pro rata) given will, if costed in commercial terms, enable £2,000 worth of lifestyle enhancing equipment to be produced.

I took up model engineering because I like making things, but soon found that after I made something and got it to work, I lost interest in it. Making a complicated engineering model was good fun, but when that model became just lumps of metal under a dust sheet on the shelf in the workshop, I started to question my motives. Perhaps this is because I am not one of you clever chaps who make those marvellous steam locomotives.

Like most model engineers, I had been aware of REMAP for some time, after all they often have a small stand at model engineering exhibitions, and get the occasional mention in

Board in the up position.

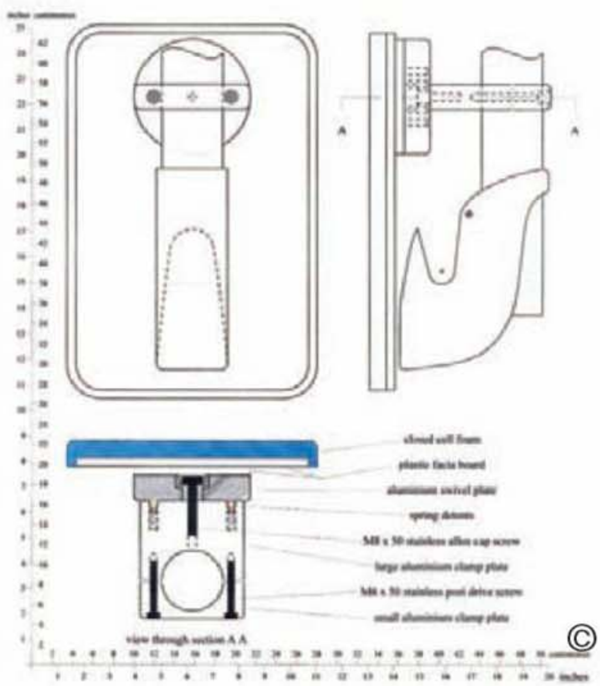
Board in the down position.

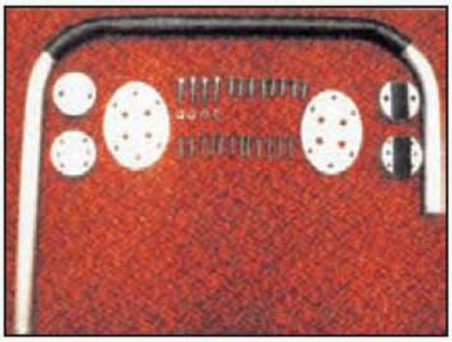
The chair engaged with the board in the up position.

Front view of the chair ready to lift.

Parts for the padded board layed out

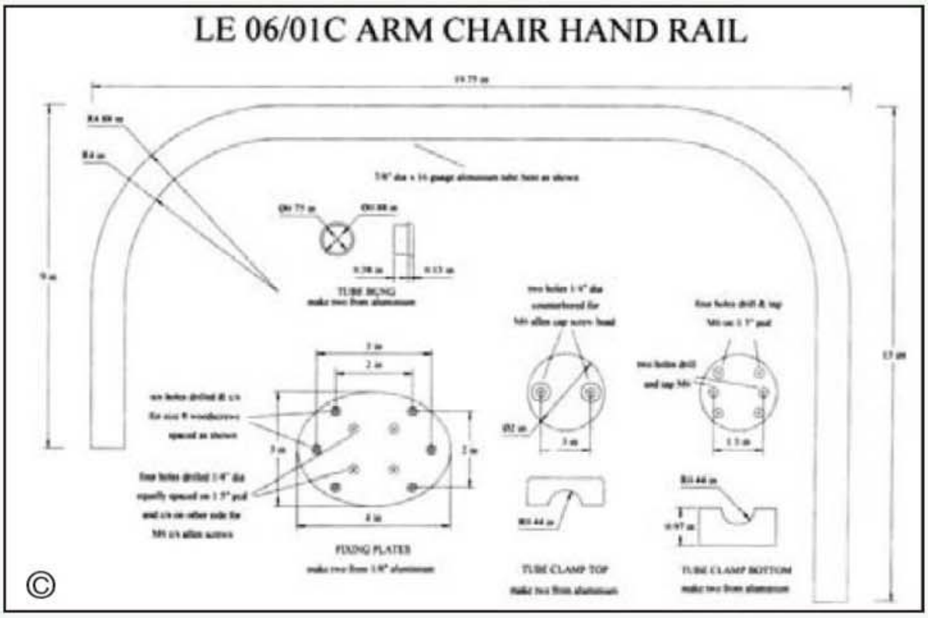
PADDED BOARD TO COVER SNAP HOOK





Layout of parts required for the Armchair Handrail.

The Armchair Handrail in situ.



Model Engineer and *Model Engineers' Workshop*.

Just over a year ago I joined the Leicestershire REMAP panel, not without some doubts and trepidation about my ability to work with and for persons with disabilities.

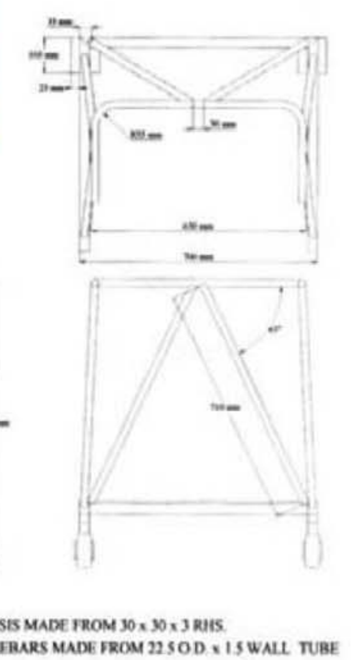
A padded board

At one of the panel meetings I attended, one of the 'referrals' was a request for a protective cover to go over a huge snap hook used to lift chair bound patients into and out of the bath in a residential home. The chair protected those who were confined to it, but those patients who were not confined to a chair could bang their head on it. This looked a simple job, well within my capabilities, so I volunteered to take on the job. A satisfactory solution - a swivelling padded plastic board - being in place within a few days.

Above left: the original walking frame without any diagonal bracing. Inset pic shows the many holes that allowed the ingress of water when in the shower. Above right: new walking frame features six diagonal uprights for increased rigidity.

PROPOSED HEAVY DUTY WALKING FRAME

Close-up of new castors.



A handrail

One of the next jobs undertaken was to provide a means for an elderly gentleman who had suffered from a stroke, to be able to get out of his manually propelled wheel chair, into his easy chair, and vice versa. The problem for him was that when standing he could not reach the arm of his easy chair as it was too low. A piece of 7/8in. (22mm) outside diameter aluminium tube was bent to make a raised hand rail, secured to the chair by two aluminium clamp brackets as shown below. A plastic shrink-wrap sleeve was added to stop the aluminium giving him 'black hands'.

A new walking frame

The next job I volunteered for at first looked very complicated indeed, when I visited the client to assess his needs. The occupational therapist for a 33stone (210kg) man who could only walk with the aid of a substantial walking frame, asked if the frame could be re-enforced. The walking frame was collapsible and adjustable and certainly lacked rigidity. It also had a number of holes in it that allowed for adjustments. However, it was made of steel, and since the client needed to take it in the shower with him, it tended to leak rusty water when he came out. The frame ran on two castors at the front, and two spring loaded wheels at the rear, arranged so that by pressing down on the frame, these rear wheels locked to prevent movement. A further complication was that the walker was on loan to the client from The Red Cross and could not be altered. The very easy solution was to use the dimensions the present walker was adjusted to, that fitted the

This shelf, to aid a Royal Mail sorter, was fabricated from aluminium and Perspex.

client, and then to make a completely new rigid frame with plenty of diagonal bracing.

The original adjustable frame had four uprights and no diagonal bracing in any plane. The handlebars are hinged on one side and free to lift on the other. The frame can go 'out of square' at the castor joints.

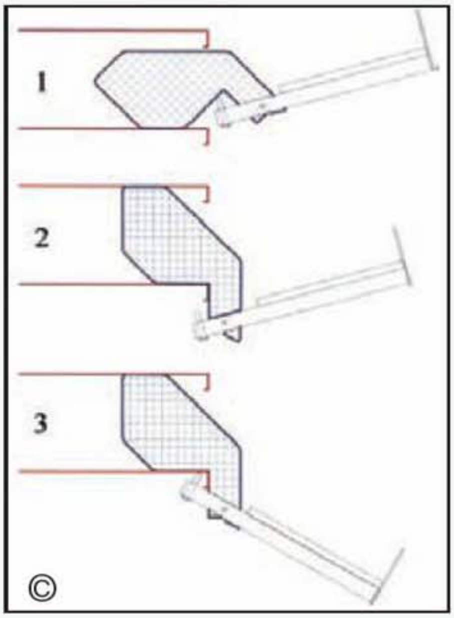
The new frame has six diagonal uprights welded to the lower chassis and the handlebars. The wheels and castors are stainless steel, and stainless bolts run in Oilite bushes for the stainless steel sprung suspension on the rear wheels.

A shelf for a Royal Mail sorter

By way of a complete change, another referral undertaken was to help a lady sorter who had suffered whiplash injuries, to cope with her work in a Royal Mail Sorting Office. During the course of her duties, she would hold a large bunch of letters in her left hand, read the address of the top one and then place it in the correct pigeon hole with her right hand (It would appear all final sorting is manual, after the automated system gets things into basic order).

The finished shelf in use wih a Royal Mail worker.

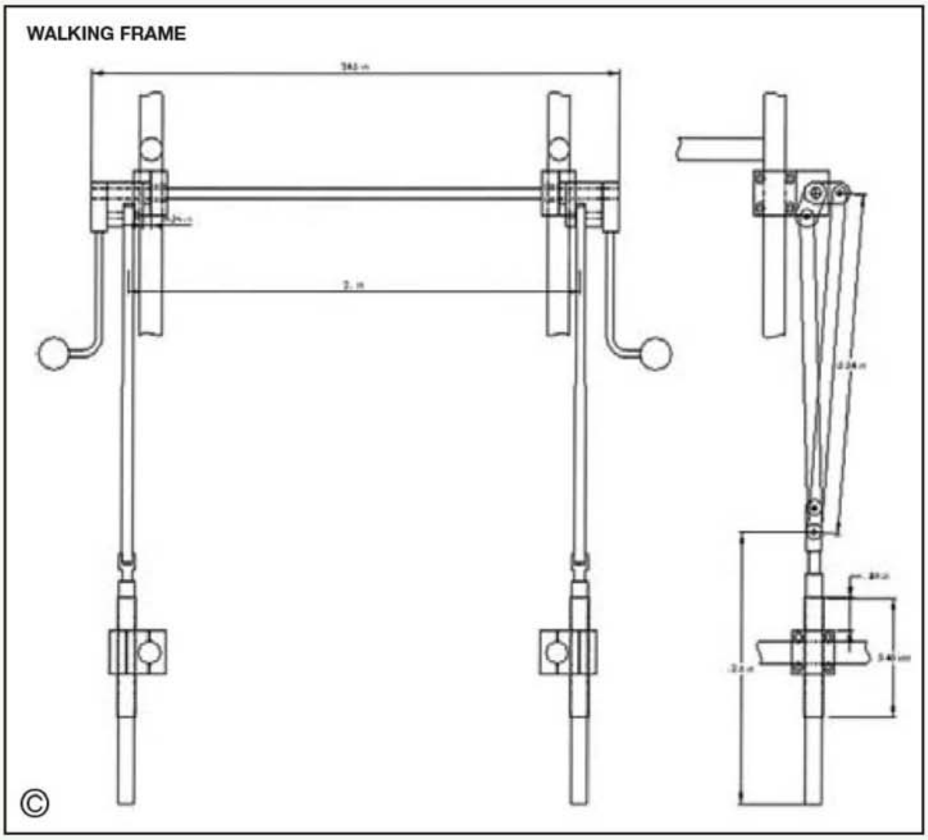
Her occupational therapist said holding the mail was painful to her, and asked if a raised shelf could be made to hold the mail being sorted. Further requirements were that the shelf must not obstruct the underlying work surface, must not obstruct any of the 63 pigeonholes at the workstation and had to be transparent. It would also have to be capable of very quick fitting and removal, and be able to be fitted at any of several hundred workstations.

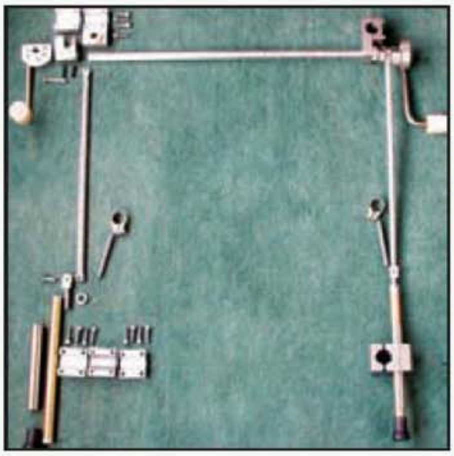


1. ***The shelf is fitted by pushing the side support plates into the pigeon holes in the position shown.***
2. ***The side support plates are then rotated 45deg. to touch the lower surface of the upper fixed shelf.***
3. ***The side support plates are pushed fully in, then the letter shelf is lowered so that the adjusting bolts make contact with the underside of the lower fixed shelf. The letter shelf is now locked in position, but the angle of it can be adjusted by screwing the adjusting bolts in or out. Removal is by reversing the fitting action.***

The workstations consisted of a trapezium shaped horizontal surface, long edge towards the sorter. The other three sides of equal length each had a rack of pigeon holes, in three vertical columns with seven rows. The pigeonholes were made of sheet steel, the horizontal shelves having the front edge bent down 1in. and with a further $^{1}/_{4}$in. return (25 x 6 mm).

A Perspex shelf was made, mounted on two 1 x $^{1}/_{2}$in. (25 x 12.5mm) aluminium bars. Hinged onto the outside of each of these bars was a $^{1}/_{8}$in. (3 mm) thick aluminium plate, so shaped that it could be slid into a pigeon hole, swivelled to rest on the lower shelf and also touching the underside of the upper shelf. Bolts





Parts for the walking frame brakes.

The walking frame with brakes in the 'off' position.

The walking frame with brakes in the 'on' position.

screwed into the aluminium bars provide a means of both adjusting the angle of the Perspex shelf, and locking it firmly in place. It was very pleasing to help someone prepared to work despite pain and discomfort, rather than to take sick leave.

Adding brakes to a walking frame

Another walking frame job that came my way was for a gentleman with Duchenne Muscular Dystrophy. His walking frame on loan from The Red Cross, had castors on all corners, the two rearmost being fitted with the usual type of castor brake. Since the client used the walker by supporting his body leaning over the padded top of the walker, and he could only look forwards, he could neither see nor operate these castor brakes, and needed an alterative braking system.

As mentioned before, items of equipment on loan from The Red Cross cannot be altered. This means no holes can be drilled, nothing can be cut off or welded on. However, brackets and attachments can be clamped on, provided that they can be completely removed to restore the appliance to its original condition, and whilethese attachments are fitted, they do not prevent the appliance functioning in the way intended.

The walker did have handle bars at the front to which it looked possible to attach cycle type cable brake levers, though the client said he did not use the handle bars and thought he could not use cycle brake levers either. Since he had a number of personal possessions attached to his walker by string, and could reach down to get hold of them, it seemed likely that some sort of handbrake lever below the padded top of the walker might be within his capabilities. It was decided to have a brake either side of the walking frame, roughly mid way between the front and rear castors. The 'brake' would be a tubular rod fitted with a rubber walking

Close-up of the walking frame's castor brakes.

stick ferrule that could be made to press onto the floor. Both of these brakes would be applied or released together by either of two hand levers, one on each side.

The brakes are operated by a crank each side, operating through 110deg., going 20deg. past bottom dead centre to lock on.

The walking stick ferules are a tight fit on some thin wall $^3/4$in. outside diameter brass tube, which is a good sliding fit inside some $^7/8$in. outside diameter stainless steel tube.

The brass brake rods are connected by an adjustable clevis to aluminium push/pull rods connected to aluminium cranks.

The aluminium cranks are on a $^5/8$in. outside diameter aluminium torque tube mounted on nylon bushes in aluminium frame clamps.

The hand brake levers can be set in six positions relative to the cranks to suit the client's limited range of movement.

All the jobs undertaken so far have been easy to complete once the way to tackle them had been decided. Most handymen could complete them if they have the facilities.

Being a simple sort of mechanics only chap, I doubt if I'll tackle anything more complex than the jobs described. However, what to me are more complex jobs are tackled by other REMAP panel members, some of whom have woodwork, sheet metal or electronics skills that I lack.

One fairly high profile job was recently completed by other members of the Leicestershire REMAP Panel, that allowed a young man who, following a climbing accident, became paralysed from the chest down, to climb Mount Kilimanjaro using a special hand propelled cycle. Readers having access to the internet may like to have a look at **www.jimmygoddard.com** and especially at the videos available therein.

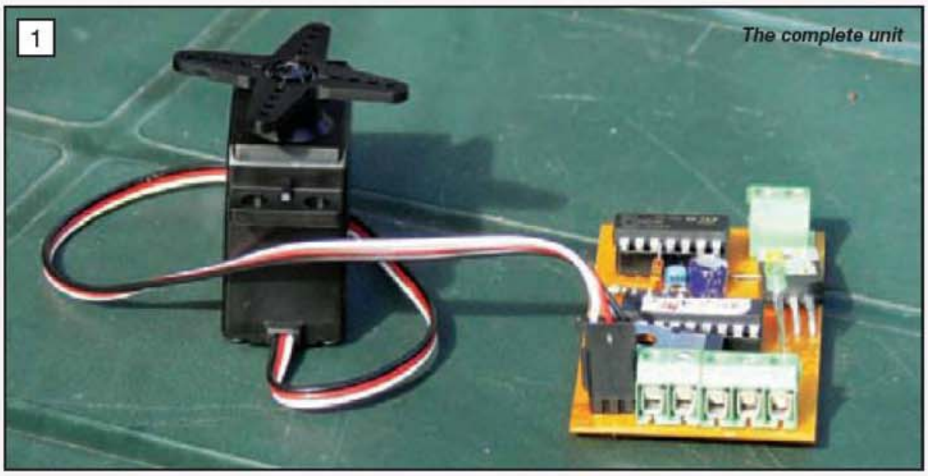
REMAP is a charity that relies on donations, and yet does not charge clients for the aids or adaptations provided. REMAP only makes what is not commercially available so every job is different and tailored exactly to the clients needs. Many appliances need fine tuning before the clients needs are met.

As a volunteer engineer you would not be paid for the time and effort you put into any task. You would not be out of pocket though as you are able to claim reimbursement of all expenses incurred, which might include car mileage for visits to clients etc, and the cost of all materials used. All you give is your time in exchange for job satisfaction.

I have found enjoyment and satisfaction in accepting what are often unique challenges to make or adapt a piece of equipment that will make someone's life easier. Wouldn't you like to do the same?

Contact details

REMAP Head Office, 9 Chaucer Business Park, Kemsing, Sevenoaks, Kent TN15 6YU. Telephone: 0845-1300456, Fax: 0845-



The complete unit

ELECTRONIC BOILER CONTROL FOR MODEL BOATS

Tim Greenwood returns to the subject with a new look at controlling water level.

Back in 2005, No. 4261, 25 November, *Model Engineer* published my article about Electronic Boiler Control for model boats (**ref. 1**). One of the main items discussed was the use of an electronic interface to allow the Cheddar Models Automatic Boiler Control (ABC) unit to be interfaced with an electrode in the boiler. Unfortunately with the demise of Cheddar Models the ABC unit appears to be currently unavailable. Stuart Models acquired the rights to the Cheddar range and whether they re-launch the ABC unit is yet to be seen.

Although the ABC unit also monitored steam temperature to change the gas burner flame from full to a pilot setting and *vice versa* the author has given the priority to the boiler water level control aspect. This is on the basis that if a reliable method of keeping the boiler water level correct is used, then loosing some steam from the boiler relief valve when the engine is stopped or running slow might be inefficient, but is not a safety issue. The author has some thoughts on burner control, which will be discussed later. It was decided that the following attributes were required of an Electronic Boiler water level Control system (EBC):

Boiler water level detection would be via an electrode in the boiler and would be connected to the interface unit described in the author's previous article. Certain electronic components need to be removed to change the output configuration.

The output of the unit to produce a 1 to 2mA output to drive a radio control servo (Futaba). This would give bypass valve control for engine-driven feed pumps.

A transistor output to directly drive an electrically driven feed pump, say up to 1 amp rating.

A selectable time delay, which allows pumping to be carried on after the water level has been detected as normal. This helps to prevent hunting i.e. the output switching on and off in quick succession. Four settings were chosen, one for one second, which allows for quick adjustment of the boiler electrode.

Light Emitting Diodes (LEDs) to indicate the status of the unit.

An alarm output, which is triggered after a set time delay, 120 or 240 seconds can be chosen. This indicates that excess pumping has occurred and therefore there must be a fault.

The electronics can be powered from a 4.8V supply or from the electrical feed pump supply. If from the latter a low drop out voltage regulator to be employed to create a 5V supply for the electronics.

The final circuit diagram of the complete unit is shown in **fig 1**. IC1 (integrated circuit) is a 4093B used as a water detector, the output from pin11 feeds into a PIC chip IC2. A PIC chip is a programmable chip, which can be programmed to carry out a number of logic operations, in fact a mini computer.

When water is in contact with the electrode in the boiler pin2 of IC2 is held at 5V by IC1 and the output of IC2 holds the servo in one direction and the output transistor is held switched off.

When the electrode is uncovered the output of IC1 goes to 0V and IC2 changes the position of the servo and causes the output transistor to conduct.

A timer within IC2 is started and the output status quo is maintained for the duration of the ▶

Water Level Control Component List:

Quantity	Description	Supplier	Code
1	R1 1M0 Resistor 0.125w	BVB	
3	R2,R6,R7 330R Resistors 0.125w	BVB	
2	R3,R4 47K Resistors 0.125w	BVB	
1	R5 10K Resistor 0.125w	BVB	
3	C1,C2,C3, 33n ceramic capacitors	Maplin	RA46A
1	C4 100mF 6.3v electrolytic capacitor	Maplin	AT97F
2	C5,C6 100n ceramic capacitors	Maplin	RA49D
1	D1 IN4148 diode	Maplin	QL80B
1	D5 IN4001 diode	Maplin	QL73Q
1	D2 8mm high effy Red LED	Maplin	UK21X
1	D3 3mm Yellow LED	Maplin	YY38R
1	D4 3mm Green LED	Maplin	WL33L
1	14 pin DIL socket (for IC1)	Maplin	BL18U
1	18 pin DIL socket (for IC2)	Maplin	HQ76H
1	Pin strip 3 pins required cut off from strip (Required for servo, if used)	Maplin	JW59P
2	16A pcb mounting 3w terminal block	AC	CTB33
1	16A pcb mounting 2w terminal block	AC	CTB32
1	Slimline 4w DIL switch	Maplin	JH08J
1	IC1 4093 logic IC	Maplin	QW53H
1	IC2 BVB845 PIC	BVB	
1	Q1 output MOSFET	BVB	
1	Q2 LM2940 1A low dropout regulator	Maplin	AV22Y
1	Printed circuit board	BVB	
1	T2 plastic box	Maplin	KC91Y

BVB = Barry Blyth
www.kleefeld.freeserve.co.uk

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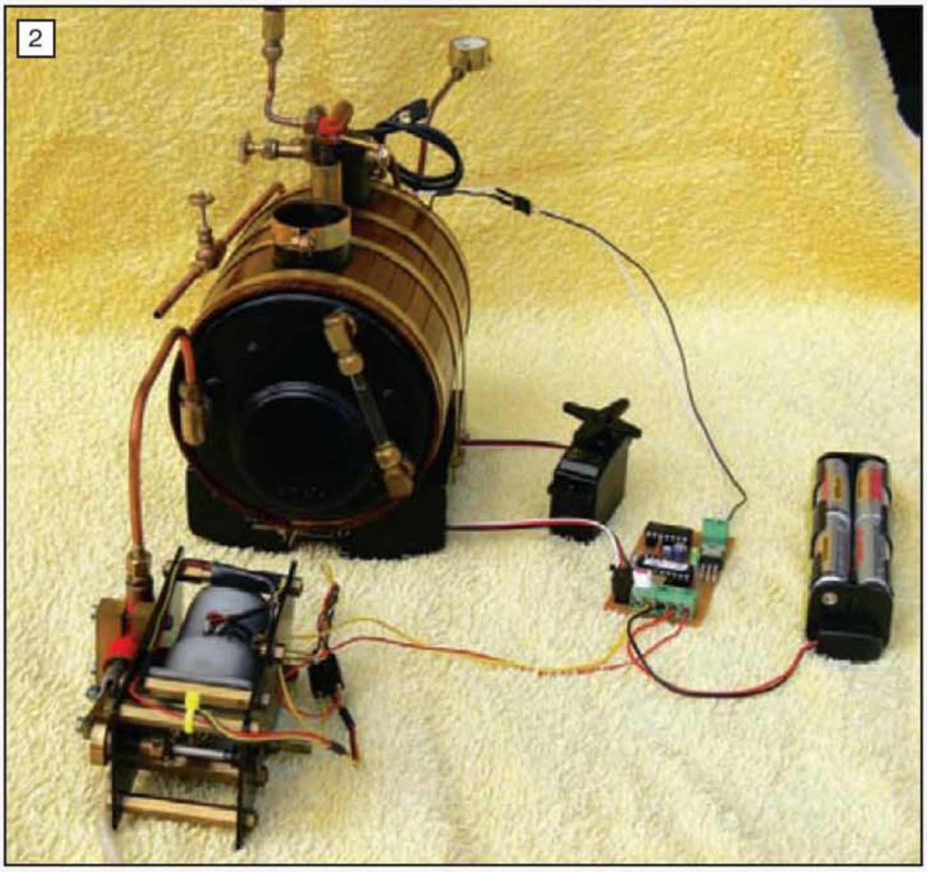


Prototype under bench testing.

timing period. If the water does not reach the electrode in that time the timer is re-initiated. This cycle is repeated until water is detected then and after a predetermined time delay the servo is returned to its initial position and the output transistor rendered non-conducting. Obviously if the water level is rapidly re-instated then only one timing cycle occurs.

IC2 is programmed with four time delay periods 1 second for set up purposes, as described in my original article. 15,30 and 60 seconds time delay settings are also available. These can be set up by various combinations of DIL switches SW1 and 2 as indicated on the circuit diagram. If one wishes to change the servo operation direction then this can be done by SW3.

IC2 via LEDs D2, D3 and D4 indicates the status of the unit. When the unit is in the quiescent condition i.e. water level correct, D4 flashes at about two per second, diodes 2 and 4 are extinguished. When no water is detected D3 also lights indicating pumping in progress. When normal water level is detected the flash rate of D4 doubles indicating the final timing cycle is in progress. When this cycle times out D3 is extinguished and D4 reduces its flash rate.

Should an abnormal condition occur such as, no water in the pump storage tank, pump failure or other condition, which prevents the boiler level being re-instated, then an alarm is annunciated. A second timer is initiated when low water is detected for a preset period, its time can be switched by SW4 from 120 to 240 seconds and if the water level is not sensed as normal within that time D2 will flash.

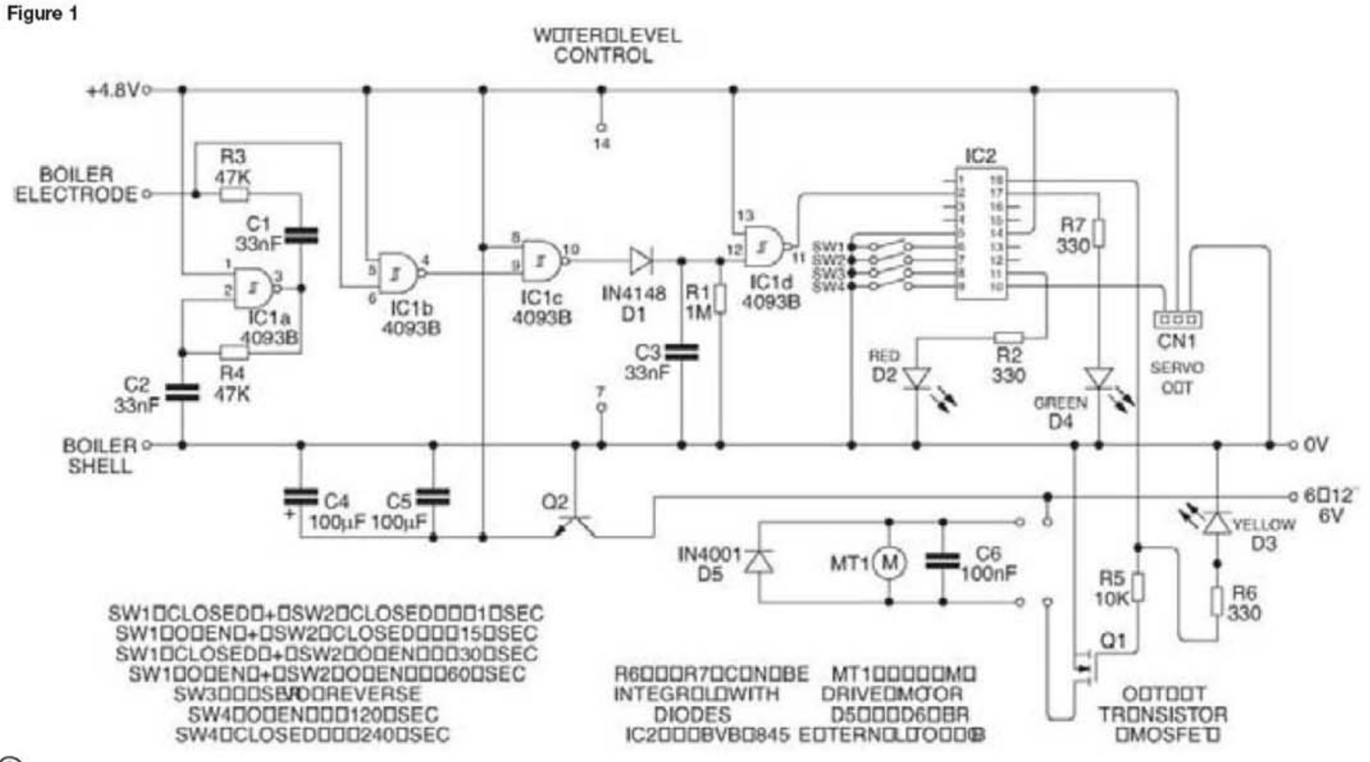
This alarm output is brought out externally and can be a high intensity LED or even a loud buzzer (remove 330R resistor R7), output 11 can support 25mA.

The whole unit can be supplied from a 6 to 12Vdc power source (NiMH rechargeable cells, lead acid battery etc) this would supply the electronics via an LM2940 low dropout voltage regulator and support an electric feed pump.

Should only a servo output be required then the LM2940 should be removed and the top rail supplied at 4.8V (4x1.2V rechargeable cells).

The above unit should be a fairly simple construction project to a model engineer with reasonable ability to solder a printed circuit board (PCB). The unit will fit into a 75 x 57 x 24mm black plastic box from Maplin (see parts list). By having LEDs D3 and D4 bases 15mm above the PCB then holes can be drilled in the lid for them

Figure 1



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to show through. A colleague of mine at the Mid Thames Model Boat Club has under taken to programme the PIC chip IC2 and sell it from his website **www.kleefeld.freeserve.co.uk**. Also available from this site will be a low impedance Mosfet output transistor and a PCB (see parts list). The PCB is produced by myself and will be left undrilled, life is too short for me to drill them all. I am sure most model engineers will accept the challenge, guidance on drill sizes will be given. Care should be taken, if using a servo to plug it in the correct way, the white wire should be nearest the edge of the PCB. The servo plug is designed to be an interference fit with the power terminals if plugged in the wrong way round but too much force can cause it to be plugged in incorrectly.

The PCB is designed to use 0.125W 5% carbon resistors soldered in horizontally these can be obtained from the website indicated on the parts list.

LEDs D3 and D4 used in the prototype were 3mm 5V standard LEDs which have internal resistors. The PCB also allows for normal LEDs and series resistors if preferred, the colour range is greater with the latter LEDs. **Photograph 1** shows the fully equipped PCB.

The prototype unit has been bench tested as can be seen in **photo 2** using the boiler, electrode system and the author's own design electrically-driven feed pump as described in the previous article.

The above electronic system is offered as a basis for experimentation with electronic boiler control. As described earlier the unit has been thoroughly bench tested and will be connected into the author's steam-driven picket boat boiler system (**ref. 1 photos 4 & 5**). This will allow a season's practical experience on the water and hopefully give a high degree of confidence in the design.

It was mentioned earlier that the Cheddar Models ABC unit incorporated automatic gas control to the burner. The author has found this control a mixed blessing for the following reason. The main servo operated gas control valve gives either full gas pressure or none. There is a pilot needle valve, which has to be set to bypass some gas to the burner to keep the flame at a low level i.e. a pilot. The author has found that setting this level is difficult as it is often done when the gas canister is full. This gives satisfactory operational changeover from pilot to main flame and *vice versa* until the boat has been sailing for a while and the gas pressure reduces, if the pilot setting is a bit on the low side the flame is extinguished. One tends not to notice this on a silent burner until the boat slows down, no steam! If one increases the pilot valve setting much the burner runs at full flame and the effects of gas control are negated. Even using a pressure regulating valve has not helped in solving this problem.

It has occurred to the author that a system akin to lighting up a modern domestic gas boiler might be appropriate, the use of an ignition coil. It is also possible to detect the presence of a flame from the resistance of the igniter spark gap and carry out multiple shots until the main gas burner ignites.

To this end a small ignition coil used on model petrol engines has been purchased for further experimentation.

I have just bought a copy of the book *Model Marine Steam* by Stan Bray (**ref. 2**) which has some interesting information and food for though on burners and automatic control.

I hope this article is of use to model steam boaters and will help in achieving full automatic control of marine steam boilers. I am indebted to my club colleague Barry Blyth for his expertise in the programming and use of PIC chips. Without this the alternative of using discrete integrated circuits would have been rather bulky.

References

1.: *Electronic Boiler Control For Model Boats* by Tim Greenwood, *M.E.* 4261, 25 November 2005.

2. *Model Marine Steam* by Stan Bray, published by Special Interest Model Books, ISBN 1-85486-245-6.

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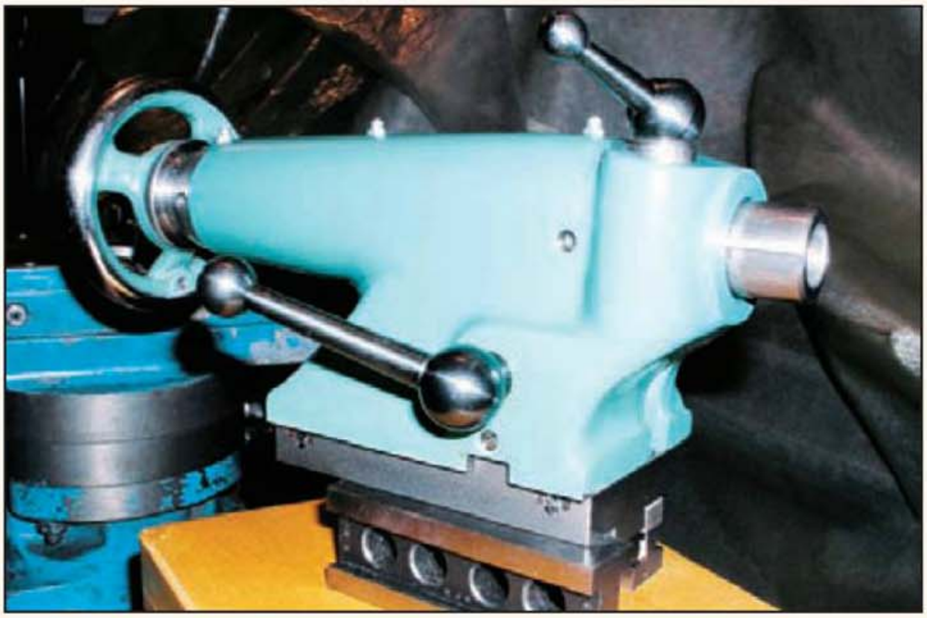


A Myford Series 7 tailstock. The gib strip adjusting screws are on the unpainted base and the rear alignment screw just below the locking lever.

TAILSTOCK ALIGNMENT

Inchanga
of South Africa explains how he got his lathe to turn parallel.

Many owners of small lathes seem unable to spot faults and, worse still, how to rectify them when spotted. As the old saying goes *"If all else fails read the manufacturers instruction manual"*. Most, if not all, lathes purchased new will be supplied with some sort of documentation covering setting up and regular maintenance procedures, such as lubrication, adjustments etc. For someone who purchases a lathe secondhand it is a good plan to obtain the correct version of the manual from the manufacturers or the importers for the correct details if the previous owner has misplaced it.

Some time ago the writer purchased a secondhand Myford Super 7 and the previous owner had recently repainted the machine after the bed had been reground by a professional facility. It looked first class and the writer paid the asking price without any quibble.

However, as time went on I was aware that some things were not quite right and a considerable time was spent going over the machine with the manual adjusting various slides etc. until it was somewhere near perfect.

One of the things discovered was that although the bed had been reground, as the previous owner had told me, he omitted to tell me the saddle hadn't been reground, only the top face of the bed was touched. This showed up as a distinct slackness and the saddle moved a lot under a heavy cuts. Once identified the saddle front and back strips were ground to eliminate the shake and a set of new shims purchased from Myford to adjust the saddle to bed clearance.

On some lathes the headstock is not mounted directly on an extension of the bed. If the bed is then reground the tailstock will sit lower and may not line up with the headstock. Under these circumstances the tailstock may need to be shimmed up to restore alignment or some material may need taking off the underside of the headstock casting

On most simpler lathes the headstock mounts directly on the bed shears so if the bed is ground on the top face both the headstock and the tailstock are lowered by the same amount and no error occurs.

The one thing I could never get right was the tailstock alignment. It seemed to drift out over a period of time. The tailstock on a small lathe has a hard life and is often being moved up and down the bed for various machining operations. Eventually it got beyond a joke and I was determined to fix this gremlin once for and all. What follows is how I tackled the job.

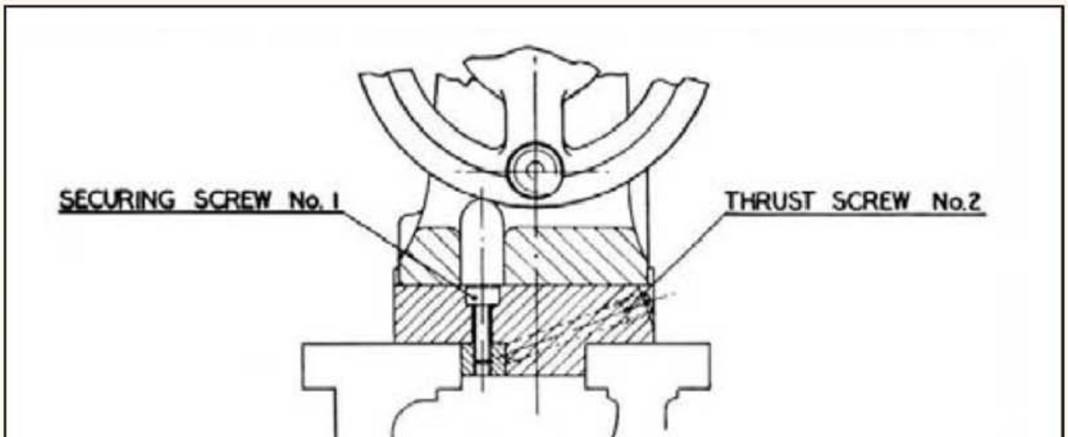
Adjustment

The Myford Series 7 tailstock is carried on the top shears of the bed and it has a gib strip to control the sideways movement that bears against the vertical shear faces. The gib strip is adjustable with two screws on the rear face. Before one can adjust the gib strips the gib strip clamping screws need to be slackened and then just nipped so they are stiff to move (**fig 1**). It is a good idea to pull the tailstock off the bed and clean out any bits of swarf that may be trapped between the tailstock and the bed before starting. Wipe away any oil with a rag so the mating faces are dry.

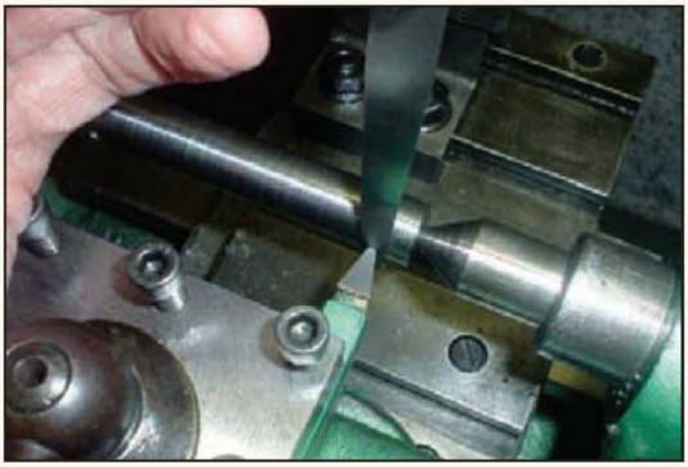
On the Myford 7 series these are two 2BA cap screws at each end of the tailstock accessed by a cut away in the top casting (fig 1). Before adjusting, slacken the tailstock-clamping lever so the tailstock is free to move and grasp the tailstock firmly in both hands, push down hard and try to twist it relative to the bed. If it is the slightest bit slack you will feel it knocking against the bed vertical shears.

By adjusting the screws the clearance between the gib strip and the bed shears can be set. However, on a lathe that is of advanced years like mine, it was made in 1973, the vertical shears will be worn more at the tailstock end of the bed than the portion near the headstock. So having set the gib strip to obtain the correct clearance at the back end of the bed, when the tailstock is moved closer to the headstock it is too tight. The vertical shears were slightly tapered, admittedly not a lot, probably only a couple of thou but enough to be noticed. This occurs because the tailstock spends most of life near the far end of the bed and very rarely is it moved close to the headstock end.

Photograph 1 shows the gib strip adjusting screws. They are the ones mounted low down on the unpainted part. The front gib strip clamp screw is hidden away in the pocket below the barrel. There is one at the front and one at the



Setting up the test bar and dial test indicator to check the alignment of the tailstock with the headstock.



Using a feeler gauge to check the position of the test bar with reference to a round nose turning tool if no dial test gauge is available.

rear. The screw just below the tailstock clamping lever is the alignment screw for setting the tailstock over relative to the axis of the bed. A similar screw is provided on the front face to move the tailstock in the opposite direction.

The clamping lever has an eccentric shaft, which causes a bottom plate to be pulled into intimate contact with the lower part of the bed. This prevents the tailstock from moving when drilling or holding a piece of work between centres. A nut adjusts the amount of clamping pressure. The nut is a self-locking (Nyloc) type and once set will hold the setting indefinitely.

Tailstock alignment

This can be done several ways depending on what degree of accuracy is required. A rough check is to fit centres in both the headstock and tailstock and then run the tailstock up to the headstock and visually see if the two points line up. It helps to put a piece of white paper on the bed so you can see the points better. If you have good eyesight this method will work. But this test only tells us if the centres are aligned when the tailstock is close to the headstock. We will see later that this does not guarantee the tailstock is correctly aligned when it is at the far end of the bed. For a more accurate setting we need to resort to some measuring instruments.

One method is to place a test bar in the 3-jaw chuck and to clamp a dial test indicator (DTI) in the tool post. The test bar is a piece of silver steel of about 25mm diameter and 300mm long that is perfectly straight and round and has centres drilled in each end. With the test bar held by just the 3-jaw chuck the DTI tip is placed near the tailstock end of the bar and the cross-slide handle adjusted so the DTI needle reads zero. Now the tailstock is run up to end of the test bar with the barrel as far into the tailstock as possible and the centre placed so it is about to enter the centre hole and the tailstock clamping lever set. By winding the tailstock barrel forward so that it fits in the centre hole we will see if the DTI needle moves. If it does when the centre is wound forward then the tailstock is not truly aligned with the headstock and must be corrected. Rocking the tailstock barrel feed handle so the barrel moves backwards and forwards to enter the centre drilling should not cause the DTI needle to give the merest twitch.

If you do not have a DTI, no problem, do what I did. Find a thin feeler gauge about 0.25mm (0.01in.) or a piece of thin shim stock and mount a round nose tool in the tool post. Run the tool up to the end of the bar and slip the feeler gauge between the tool tip and the bar. Adjust the cross-slide handle so the feeler gauge is not quite fully trapped, it should be able to move but a bit stiffly. It is hard to describe in words, it feels like it is just dragging between the tool and the test bar. Now wind the tailstock centre so it goes full depth in the hole and see if the feeler gauge is tighter or looser. If it is tighter then that tells us the tailstock is pushing the test bar closer to the tool. If it is looser it is pushing it the other way. You can measure the error using the cross-slide feed handle and the graduated dial.

On my lathe the error was 0.004 inch. So having ascertained which way we need to move the tailstock we can make the necessary adjustment and then check the test bar is now unaffected by the tailstock centre entering the hole. One of the tailstock alignment screws are shown in photo 1 and there are two of them, one at the front and one at the back under the clamping lever shaft, which push or pull the tailstock across the bed on its slide way. The chances are you will overshoot the correct setting and need to make several attempts to get it spot on. When you have got it perfect lock everything up tight and we move onto test number two. You thought you were finished? No sir, there is one other important test we have to do.

Headstock alignment to bed

Remove the test bar and find a piece of 25mm round bar, preferably steel, and about 150mm long. Grip this in the 3-jaw chuck and ensure it is running as true as possible. Do not use the tailstock centre to support the work. Take a very light finishing cut (about 0.002in. deep) along the bar for the full length using the self-act on the saddle with the slowest feed. If the tool chatters reduce the spindle speed, we need a perfectly smooth surface to measure the alignment. It doesn't matter if it takes several minutes to traverse the length of the bar we must have a smooth surface to make an accurate measurement.

Now measure each end of the bar with a micrometer to see if it is tapered. If it is exactly the same diameter at each end then you are done. However, most likely you will find the bar is slightly tapered along its length. Suppose the end near the headstock is smaller in diameter than the other end. This means the bed is twisted and the headstock is not correctly aligned along the bed. In this case the end of the bar nearest the tailstock is pointing towards the back of the lathe bed. If the end nearest the tailstock is smaller then the bed is twisted in the opposite direction. No need to panic this a perfectly normal situation and can easily be corrected.

Lathe beds twist for a variety of reasons, the major cause is the stand they are mounted on. If the lathe is mounted on a wooden bench you will need to check more often than if it is mounted on a substantial metal stand. Even a good metal stand will distort over a few years and so this is a measurement you should perform once a year if not more often.

To correct the twist we need to slacken off the holding down bolts at the tailstock end of the lathe and slip a piece of shim stock under the feet. If the bed is twisted so the tailstock end is closer to the front (shown by the end of the bar being smaller at the tailstock end) then we need to pack up the rear edge of the lathe mounting foot. The 'front' of the lathe is the part facing the operator. If the bed is twisted in the opposite direction then we need to pack under the front of the foot. Lift the tailstock end slightly and slip in a piece of shim stock and tighten the bolts down in gradual steps. When both are fully torqued down take another light skim along the test bar and check the diameters again. If the difference in diameter is less then you are heading in the right direction, if not then you have placed the shim under the wrong part of the foot. The thickness of the shim and its position will need to be adjusted to get the bed 'untwisted'.

This takes a little time but do not rush this part, it is vital the bed is under no strain. If it takes you all evening to get it correct it is time well spent and you will learn a lot about machine alignment in the process.

When you have it as close as possible put the original test bar back in the 3-jaw chuck and run the tailstock up to the far end. Repeat the measurement in the first part to see if the DTI needle or feeler gauge is different with the tailstock centre in or out. In the writer's case the taper along a bar 300mm long was less then 0.001in. which was considered good enough.

If no perceptible change is found you are now done and can celebrate with your favourite beverage. However, it is quite possible that the tailstock alignment may now need resetting if the bed was badly warped.

In a case such as this it is preferable to do the second test first, before adjusting the tailstock, as the two adjustments inter-react. A little time spent checking alignment every so often is time well spent if the highest precision is required.

CLUB CHAT
With Malcolm Stride

Owen Chapman on his Natal 16Da SAR locomotive at the North London SME. Photograph: Bryn Morgan.

UK News

Ascot Locomotive Society continues to make good progress with works around the site. Progress includes a 10ft. track and push bar for the traverser, electric lights and power in the locomotive shed, a turnout and diamond crossing laid out at the terminus/turntable junction and 180ft. of 60ft. radius curves laid in the west loop area.

The cover of the **Maidstone MES** newsletter carries the winning picture from the club photography competition. The winner was Martin Parham with his fine photograph of *Mayflower* on the Nene Valley railway. Keith Spenceley was awarded second place with his photograph from the Kent and East Sussex Railway. We extend our congratulations to them both. The club has gained ten new members so far this year with some more still to be notified.

A group of members from the **Model Engineers Society (NI)** joined a trip to Drumawhey Junction, Bangor, visiting the **North Down Model Railway** to join in the birthday celebrations. The group report that they were made most welcome and enjoyed the hospitality and the barbecue.

Progress on the new extension to the gauge 1 layout at **North London SME** is moving at a fast pace. The outer loop of the gauge 1 track is being combined with the gauge 0 track to make a section of dual gauge track. Is this the first dual gauge track in these scales? The society has also formed a ground level railway section under the leadership of Peter Funk. The newsletter has a picture of Owen Chapman's Natal 16Da South African locomotive in action on the track. These SAR prototypes seem to be becoming popular, they certainly provide a large locomotive, even in $3^1/2$in. gauge. A good selection of members turned out to hear Colin Gent's presentation on the Rolls-Royce *Merlin* engines.

Rochdale SMEE is planning the celebrations for its 75th anniversary in 2007. The main event is likely to be a 75th Anniversary open day on Saturday 9 June. We will publish more details as we receive them.

Saffron Walden DSME organised a coach trip to the Midlands Exhibition and the 20 members who took part had an enjoyable day with many "*useful items*" purchased at the trade stands. The report states that the most of the visitors were drawn to the smell of bacon and a full English breakfast as soon as they arrived. Let's hope that those in charge of the diets are not reading this!

After a day walking round the show, there was no energy left for a sing-song on the way home. More serious activities at the club have centred round the new fire regulations which have resulted in some changes to working and storage practices around the site. The newsletter contained the following report of a recent incident on the railway:

"The Duty Supervisor was recently faced with a new problem. Two young women of Eastern European origin requested rides. They were 'undressed' in extremely revealing attire which left very little to the imagination! Their skirts were so brief that one of them was unable to cover herself adequately when sitting astride the passenger trolley. The other just managed to cover the 'situation' and the Supervisor was asked to provide a 'modesty cloth' *for the first one. The Duty Crew were able to find a suitable cover but the oily rag was rejected, so another club member went on a further search. Naturally he returned with a much smaller piece, so the Duty Supervisor waved the train off with the two ladies clutching their skirts between their thighs and the* 'modesty cloth' *doing a rather inadequate job!"* Such are the perils of operating miniature railways!

MMES01 – Martin Parham's wining entry to the Maidstone MES photography competition.

World News

Australia

The year at the **Steam Locomotive Society of Victoria** is reported by President Graeme Fedley as *"different to say the least"*. Among other reasons for his comments is the fact that in spite of suffering the biggest drought for 100 years, the society has *"had the most rain affected running days for many a year"*. Because of the dry conditions the planned re-planting of the cutting has been placed on hold until better weather arrives. The recent gathering, centred around the garden gauge railway, was a great success with visitors from **Melbourne SME** enjoying the night run with the members. Requests have been made to make it an annual event. A new double glass door refrigerator has been purchased for the kitchen *"at a very good price"*.

Canada

British Columbia SME achieved a new milestone for public running in 2006 with a total of 33,944 passengers carried during the year. Work carried out during the year has included a new access track to the South Parking Yard and a new cross-over at the east interchange. Future plans include an extension of the track into the Off Leash Park which will involve the addition of about a mile of double track. The society is waiting approval of the plans from the Burnaby Parks Board. The vegetation clearance at car barn hill has continued and requires approximately one more days work to remove the remaining blackberries from the southern and western slopes. Some members would like to see a picnic area on the top of the hill whilst another group would like a switch back track provided so that Shay and other geared locomotives can have something to climb. Can I suggest a picnic area with transport to and from provided by trains pulled by the geared locomotives, that way everyone is happy?

At the recent meeting of the **Toronto SME** member Dave Sage talked about powder coating. Dave described the equipment needed for a home set-up as: A charging unit capable of 40,000 to 100,000 volts. A spray gun with a powder paint container is hooked up to a high volume, low pressure (10 to 15psi) compressor. The item to be coated must first be prepared – for steel – with iron phosphate, aluminium – etched. The item is then connected to the charger as is the paint gun. The spray powder picks up the charge and adheres very strongly to the 'target'. After coating the item must be baked at about 400degF. A polyester tape is used for masking (it must be able to withstand the 400degF). Castings can be a little tricky as they will probably outgas and cause bubbling of the coating: this can be greatly reduced by spraying while the casting is hot. There are many different coating types and colours. This sounds like one of those processes that will result in domestic strife following the baking process!

Martin Myer's 3 1/2in. gauge Stanier Pacific being given the once over by Messrs. Gaal, Fedley, Ousey and Faccenda at the Steam Locomotive Society of Victoria. Photograph: Dave Smith.

New Zealand

Members of the **Hutt Valley MES** were entertained by Ken Orman at the October meeting. Ken talked about his wooden model ships which are made to a scale to suit the size of the piece of wood selected for the hull. Ken was also involved in drawing up the wreck of the *Hyderabad* with the drawings being included in a book on the subject by Edwin Fox. John Antliff showed his end mill grinding stand which he constructed as a project from our sister journal *Model Engineers' Workshop*. John had added fittings for various other cutting tools and the whole lot stored away in a fitted storage box.

The track at **Maidstone MES (NZ)** has been damaged by contractors carrying out maintenance work on the park. As a result a small section of track needs to be cut out and replaced. In the meantime the track is unusable. Both of the running days in October were washed out because of the continuing very wet weather during the winter season. The battery electric locomotive is to be re-powered with a petrol engine in order to provide a reliable and adequately powered club locomotive for the running season.

In Memoriam

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

Harry Boneham	*Toronto SME*
Peter Gray	*Steam Locomotive Society of Victoria*
Malcolm Hall	*Saffron Walden DSME*

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

5 **Maidstone MES (UK).** *DVD & Video Night.* Contact Martin Parham: 01622-630298.
5 **Portsmouth MES.** *Members' Videos.* Contact John Warren: 023-9259-5354.
5 **Romford MEC.** *Competition Night.* Contact Colin Hunt: 01708-709302.
6 **Isle of Wight MES.** *Track & Pond.* Contact Malcolm Hollyman: 01983-564568.
7 **British Columbia SME.** *Frostbite Meet.* Contact Sean Laurence: (604) 931-1547.
7 **North London SME.** *Film Night.* Contact David Harris: 01707-326518.
7 **Reading SME.** *Public Running.* Contact Brian Joslyn: 01491-873393.
8 **Bedford MES.** *Bits and Pieces.* Contact Ted Jolliffe: 01234-327791.
10 **Chingford DMEC.** *Members' models on display.* Contact Ron Manning: 020-8360-6144.
10 **High Wycombe MEC.** *Derek Harrowell: Digital Photography.* Contact Eric Stevens: 01494-438761.
10 **St. Albans DMES.** *EGM & Brains Trust.* Contact Roy Verden: 01923-220590.
11 **North Wiltshire MES.** *Meeting.* Contact Les Stiff: 01249-814732.
11 **Worthing DSME.** *Bits & Pieces.* Contact Bob Phillips: 01903-243018.
12 **Brighton & Hove SMLE.** *New Year Party Night.* Contact Mick Funnell: 01323-892042.
13 **Glasgow & S.W. Rly Ass'n.** *George A. Davidson: LNER Locomotive Policy.* Contact Bruce Steven: 0141-810-3871.
14 **Maidstone MES (UK).** *Annual Sunday Lunch.* Contact Martin Parham: 01622-630298.
14 **York City & DSME.** *Running Day.* Contact Pat Martindale: 01262-676291.
16 **Romney Marsh MES.** *John Snell: Railways Around The World.* Contact John Wimble: 01797-362295.
16 **Taunton ME.** *Model Boats.* Contact Don Martin: 01460-63162.
17 **Bournemouth DSME.** *Bits & Pieces.* Contact Dave Fynn: 01202-474599.
17 **Chingford DMEC.** *Martin Masterson: Chingford from the Air.* Contact Ron Manning: 020-8360-6144.
17 **Leeds SMEE.** *Malcolm High: Laser Cutting.* Contact Colin Abrey: 01132-649630.
18 **Isle of Wight MES.** *Bits & Pieces.* Contact Malcolm Hollyman: 01983-564568.
19 **Newton Abbot & District MES.** *Meeting.* Contact Graham Day: 01626 772739.
19 **Romford MEC.** *AGM.* Contact Colin Hunt: 01708-709302.
19 **Romney Marsh MES.** *DVD/Video Evening.* Contact John Wimble: 01797-362295.
20 **York City & DSME.** *Auction.* Contact Pat Martindale: 01262-676291.
22 **Bedford MES.** *Welding methods and techniques.* Contact Ted Jolliffe: 01234-327791.
24 **Bournemouth DSME.** *Annual Dinner.* Contact Dave Fynn: 01202-474599.
24 **Chingford DMEC.** *Alan Rose: 'Far Saltare' – An Update.* Contact Ron Manning: 020-8360-6144.
25 **Worthing DSME.** *Claire Hicks: Keep your pecker up.* Contact Bob Phillips: 01903-243018.
26 **Brighton & Hove SMLE.** *Maureen Dillon: The History of Lighting.* Contact Mick Funnell: 01323-892042.
26 **Newton Abbot & District MES.** *Dinner/Dance.* Contact Graham Day: 01626 772739.
29 **Canterbury DMES (UK).** *Ernie Millard & Granville Askham: Boiler Making & Tolerances.* Contact Mrs P. Barker: 01227-273357.
30 **Chelmsford SME.** *Club Members' Videos.* Contact D. Blake: 01376-324205.
31 **Chingford DMEC.** *Brian Upson of Colchester SME: Top shed engineman.* Contact Ron Manning: 020-8360-6144.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