MODEL ENGINEER

Vol. 197 No. 4288

8-19 December 2006

THIS SUMMER'S STEAM RALLIES

MYFORD VISIT

NEW SERIES: RATCHET DRILL

UK £2.50 | Canada $8.25 | Australia $8.60 | New Zealand $10.70


Chronos
Engineering Supplies
Online Catalogue - www.chronos.ltd.uk
SEE US AT THE LONDON MODEL ENGINEERING SHOW - ALLY PALLY - JAN 19-21 2007
NEW PROFESSIONAL PARTING SYSTEM!!
Ideal for owners of Boxford, Student and any other 4 1/2 centre height lathes!
This set up is very well made and very rigid - just what you need when parting off!
The shank that you clamp in your toolpost is only 1/2 wide thus allowing this excellent tool to be used in smaller lathes than usual. It xan even be adapted to Myford etc. It is supplied with a HSS blade whick is 4mm thick x 24mm wide and 150mm long - Spare blades are readily available.
CODE PRICE
PT2005 £22.00 INC VAT!
ELECTRONIC DIGITAL MICROMETER
GUARANTEED FOR TWO YEARS!
CODE RANGE PRICE
XC234 0-1"/0-25MM ~~£39.95~~ £35.00
CLARKE CLM300 VARIABLE SPEED LATHE
HUGE SAVING PLUS FREE STEADY INCLUDED!!!!!
CODE PRICE
XC22 ~~£682.00~~ £425.00
ACCESSORIES FOR VARIABLE SPEED LATHES
SUCH AS CLARKE, WARCO, CHESTER, ARC ETC
CODE ITEM PRICE
XC23 QC TOOLPOST SET £35.00
XC24 FIXED STEADY £18.00
XC25 TRAVELLING STEADY £18.00
XC26 FACEPLATE £16.00
ER25 COLLET CHUCK FOR CLARKE 300
Top quality brand new British product - This collet chuck allows you to use the very flexible ER 25 split collets on your Clarke CL300 or other brand variable speed mini lathe. ER collets are available seperatly and cover the range from 1mm - 16mm
CODE PRICE
CSC1 £129.95
BRITISH MADE
ER25 COLLET CHUCK FOR BOXFORD
Top quality brand new British product - This collet chuck allows you to use the very flexible ER 25 split collets on your Boxford lathe. ER collets are available seperatly and cover the range from 1mm - 16mm
CODE PRICE
BFC1 £125.00
BRITISH MADE
ER25 COLLET SYSTEM TO SUIT MYFORD ML7 ETC
CODE ITEM PRICE
XC152 CHUCK & SPANNER £87.00
XC153 SET 15 COLLETS 1 - 16MM £85.00
SOBA 3" ROTARY TABLE
EXCLUSIVE TO CHRONOS
OVERALL HEIGHT 1 ½"
CENTRE HEIGHT 1 ½"
CODE PRICE
XC154 ~~£79.95~~ £69.00
SET OF 5 INDEXABLE LATHE TOOLS 10MM INCLUDING A BORING BAR (8MM)
CODE
XC68
PRICE
£24.95
SET OF FIVE INDEXABLE LATHE TOOLS
CODE SHANK PRICE
XC72 1/4 £19.95
XC73 5/16 £19.95
XC74 3/8 £19.95
XC75 1/2 £26.95
XC76 5 X SPARE INSERTS 1/4 £10.00
XC77 5 X SPARE INSERTS 5/16 £10.00
XC78 5 X SPARE INSERTS 3/8 £10.00
XC79 5 X SPARE INSERTS 1/2 £10.00
SET OF 4 INDEXABLE BORING TOOLS SHANK SIZES 8, 10, 12 & 16MM
CODE
XC69
PRICE
£24.95
HSS BORING & THREADING SETS
INC BORING TOOL & MET/IMP INT THREADING TOOLS
CODE SIZE PRICE
XC70 6MM DIA/9MM SQ HOLDER £17.50
XC71 12MM DIA/16MM SQ HOLDER £26.95
PARTING TOOL WITH HSS BLADE
CODE SHANK PRICE
XC80 5/8 HIGH 5/16 BLADE ~~£16.95~~ £12.00
XC81 3/4 HIGH 1/2 BLADE ~~£19.95~~ £15.00
SET OF 3 8MM TOOLHOLDERS WITH HSS BITS
STRAIGHT LH & RH
CODE
XC82
PRICE
~~£19.95~~ £14.00
SETS OF 7 INDEXABLE LATHE TOOLS
COMPLETE WITH 5 DIFFERENT TURNING TOOLS, A PARTING TOOL & THREADING TOOL
CODE SHANK PRICE
XC91 6MM HIGH ~~£32.00~~ £29.00
XC92 8MM HIGH ~~£35.00~~ £31.00
XC93 10MM HIGH ~~£39.95~~ £37.00
XC94 SET 7 INSERTS 6MM ~~£14.00~~ £12.00
XC95 SET 7 INSERT 8MM ~~£14.00~~ £12.00
XC96 SET 7 INSERTS 10MM ~~£14.00~~ £12.00
GLANZE TURNING, MILLING & BORING SET
NEW - PROFESSIONAL QUALITY SET. INCLUDING 3 TURNING TOOLS LH - RH & STRAIGHT, 1 X BORING BAR - PLUS 3 INDEXABLE ENDMILLS
CODE
XC88
PRICE
~~£89.95~~ £79.00
INDEXABLE PARTING TOOL WITH 6MM SHANK
CODE PRICE
XC89 ~~£11.95~~ £10.00
XC90 SPARE INSERT ~~£3.50~~ £2.50
SET OF 7 INDEXABLE LATHE TOOLS WITH 12MM HIGH SHANK
COMPLETE WITH 6 DIFFERENT TURNING TOOLS & A THREADING TOOL
CODE PRICE
XC97 ~~£42.00~~ £38.00
XC98 SET 7 INSERTS ~~£14.00~~ £12.00
VISA
ALL PRICES INCLUDE VAT & CARRIAGE (UK MAINLAND)
(Prices are correct at time of going to press and are only available while stocks last)
Maestro
CHRONOS LTD UNIT 14, DUKEMINSTER TRADING ESTATE, CHURCH ST, DUNSTABLE, BEDS, LU5 4HU
TEL: (01582) 471900 - 5 LINES FAX: (01582) 471920 WEB: www.chronos.ltd.uk EMAIL: sales@chronos.ltd.uk

Model Engineer is published by
Encanta Media Ltd.
Berwick House, 8-10 Knoll Rise, Orpington, Kent BR6 0EL
Telephone (+44) 01689 899200
Fax (+44) 01689 899266

SUBSCRIPTIONS

26 issues (annual) **UK** £65.00,
Europe £80.00,
US Airmail $130.00
RoW Airmail £86.00
Make cheques payable to
Encanta Media Ltd.

UK ONLY

NEW, RENEWAL & QUERIES

Tel: 01689 899200
Email:
modelengineer@subscription.co.uk

REST OF WORLD

NEW, RENEWAL & QUERIES

Tel: (+44) 1858 438798

USA & CANADA

Tel: (760) 603 9768
Email: info@wiseowlmagazines.com

BACK ISSUES, BINDERS, PLANS

Tel: (+44) 01689 899228
Email:
customer.services@encanta.co.uk

EDITORIAL:
Editor David Carpenter (01689-899255)
Technical Editor Neil Read (01604-833670)
Production Editor Kelvin Barber
Associate Editor Malcolm Stride
PRODUCTION:
Designer Carol Philpott
Commercial Designer Ben Wright
Creative Services Assistant Michelle Briers
Production Assistant David Jewiss
Printed by William Gibbons & Sons Ltd.
SALES & MARKETING:
Marketing & Subscriptions Manager Nicola Simpson (01689 899209)
Advertising Manager Paul Baldwin (01689 899217)
Advertising Sales Executive Jenni Collins (01689 899215)
MANAGEMENT:
Creative Director Nikki Parker
Acting Creative Director Carol Rogerson
Managing Director Owen Davies

ISSN 0026-7325

IN THIS ISSUE

● Vol. 197 No. 4288 8-21 Dec 2006 ●

SMOKE RINGS
Editorial news, views and comment.
PAGE 669

POST BAG
Letters to the editor.
PAGE 670

NEW SERIES:
A COMPACT RATCHET BRACE
Bill Steer constructs a precision version of a simple tool that once formed an essential part of the fitter's tool kit.
PAGE 673

A FREELANCE RADIAL AERO ENGINE
Dr. Michael Ackerman continues the account of his latest engine project and describes the teething troubles that accompanied its first trial run.
PAGE 676

A VISIT TO MYFORD LTD.
Neil Read travelled to Nottinghamshire to visit the famous machine tool maker and reports on their manufacturing process.
PAGE 679

OVERHEAD VALVE ENGINES
Colin Pape continues his description of the Step 3 type engine and provides notes on the reverser and self-starting.
PAGE 681

WYKE HALL
After a long break Neville Evans returns to this Modified Hall 7929 design with a look at the bogie arrangements.
PAGE 685

ROAD STEAM
OUT AND ABOUT
Martin Wallis presents highlights of the year's steam rallies including the Whissendine and Bressingham Model Rallies plus The Great Dorset Steam Fair.
PAGE 689

HIPP CLOCK DEVELOPMENTS
Frank Taylor relates how he modified a clock design to give as a present.
PAGE 694

On the cover ...

This splendid Wilder ploughing engine was seen at Bedfordshire's Old Warden Rally and is believed to be unique. It was built in 1927 using parts from at least three Fowler single-cylinder engines of considerable vintage, plus other parts to Wilder's own design with even a few new ones from Fowlers - a true hybrid indeed!
For other interesting steam vehicles seen on this summer's show circuit see Road Steam's *annual* Out and About *feature commencing on page 689.*

(Photograph by Martin Wallis)

MACHINE TOOLS FOR MODEL ENGINEERS - BOXFORD LATHES
Tony Griffiths looks at the development of the Boxford range of lathes and provides advice for today's owners.
PAGE 697

PETE'S PAGE
Peter Spenlove-Spenlove takes a look at the subject of T-slot extensions.
PAGE 703

CLUB CHAT
A review of what clubs and societies around the UK and world are up to.
PAGE 704

CLUB DIARY
Forthcoming events .
PAGE 705

TURN TO PAGE 708 FOR SUPER SUBSCRIPTION OFFERS

magicalia media

IMPORTANT NOTICE

Due to circumstances beyond our control The Model Engineer Exhibition, due in December 2006 at Olympia 2 is being rescheduled into the New Year, 2007.

Revised event details will be published shortly.

Please note competition entry forms may be carried forward, as well as tickets already purchased.

The organisers apologise for any inconvenience this change causes, and look forward to bringing you an outstanding event in 2007 – our 100th year!

THE MODEL ENGINEER EXHIBITION

SMOKE RINGS

With the Editors

Straight from the horse's mouth

Fred having recently retired decided to take his locomotive for a quiet midweek run. On arriving at the track Fred proceeded to raise steam. However, the process took considerably longer than normal, eventually full pressure was reached and Fred set off on his first lap round the track.

He had only covered half a lap when the little locomotive had run out of puff and Fred was forced to stop for a blowup. While contemplating a pressure gauge that seemed determined not to rise, Fred pondered on the problem, his locomotive normally being a free and easy steamer.

Just then Fred heard a voice behind him, thinking another member must have quietly entered the ground Fred turned around to see who it was.

"*It's your smoke box door that's the problem*" the voice said. Fred, having turned around could not see anyone, the only sentient living creatures close by were two horses, a black one and a white one with their heads over the fence looking in Fred's direction.

"*Did you say something*?" asked Fred. "*Yes*", said the white horse. "*It's your smoke box door that's the problem, go and have a look.*"

More out of surprise than anything else, Fred got off his driving truck and went round to the front of his loco. Sure enough, though the smoke box door was not loose, it had some small obstruction under it preventing it from closing properly. Fred removed the offending debris, after which he had no further steaming problems, enjoying a pleasant two hours on the track. Having packed everything away Fred decided he needed a drink to calm his nerves and stopped by the inn local to the track. Nursing his half pint and pondering what had recently happened, Fred was very quiet. The innkeeper, noticing, came over to Fred and said "*What's up Fred*?"

Fred said: "*You won't believe this*" and proceeded to relate the story to the innkeeper. Fred finished his story and the innkeeper, holding up a beer glass to the light that he had been polishing for the last five minutes said to Fred.

"*The white spoke to you, you say*?"

"*Yes*" said Fred.

"*Then you were very lucky*" said the innkeeper, "*as the black horse doesn't know b****r all about locos*".

(Thanks to our Cambodian correspondent, Harold Pearson, for that one)

Looking for a better future?

The number of people working in manufacturing industry has slumped to its lowest levels since records began in 1841, according to recent government figures.

Employment in manufacturing had fallen to a shade over 3 million by September, as another 77,000 jobs were lost over the previous year.

We're here!

As you may know, Model Engineer, has changed hands a number of times in recent years. Mail, and email, with defunct company addresses is no longer delivered. For some weeks now our postbag has shrunk, which is a relief in some ways. In others we are sure we are missing out on a lot from readers and, especially, clubs still using an old address. We do like to hear from you, so do please check your address list, and amend it to:

Model Engineer
Berwick House
8-10 Knoll Rise
Orpington
Kent BR6 0EL

If you have any business with the new owners of the magazine, please address it to Magicalia Publishing Ltd. at the same address.

Unemployment increased to a seven-year high of 1.7 million and figures from the Office for National Statistics showed 141,000 people were made redundant. But the number of people in work increased by 56,000 to 28.9 million, the second highest figure on record. Economists said the increase reflected the country's increased population.

If any readers have been affected, remember that we have a couple of vacancies here, and there may just be time to apply. But be quick. We are looking for an editor for Model Engineers' Workshop and an Assistant Editor for Model Engineer. You'll be glad to know that our magazine and advertising sales are going very well indeed.

The young Duchess

Since we featured the rare Duchess of Swindon, in issue 4284, in the Curly Bowl competition report, we have heard a bit more of the history of the model, designed by LBSC. Ron Price, a member of the North London Society of Model Engineers, read the article, and his part in the history of this locomotive starts way back on 9 April 1961. The photograph shows him driving the locomotive at the Hatfield Society of Model Engineers, of which his father was a founding member (before the NLSME). The tender in the photo is borrowed from Ron's own locomotive, Princess Marina. The tender Roy Boulcott built is based on the Hielan Lassie design. Ron is at present building a $3^1/2$in. gauge Peppercorn A1, and has previously built Mallard (A4) and the fascinating Gresley high pressure experimental locomotive 10,000. We still have yet to hear if another Duchess exists

POST BAG

More on Wimpeys and their engines

SIRS, - I would apologise for continuing the non-model engineering correspondence but Mr. Cannell has made further incorrect statements and questioned the background of Mr. Bourne and myself.

I cannot speak for Mr. Bourne but in my own case my aviation enthusiasm, possibly as strong as many of your reader's enthusiasm for all things steam-driven, goes back to my first flight, 70 years ago. From that day I only wanted to fly myself and be around aircraft. I passed the entrance examination and became a RAF Aircraft Apprentice - known as *'Trenchard Brats'*, Sir Frank Whittle himself having been one of the more illustrious past members of this band.

I spent time with BOAC overhauling Rolls-Royce *Merlins* and Pratt & Whitney *Double Wasps* for their then fleet of Lancastrians, Yorks and Dakotas.

While in the RAF I was grounded on suffering a perforated ear drum but gained a Private Pilot Licence later while in Canada and spent many happy hours bush flying in various aircraft so I feel that I have had a fair spread of aviation experience.

My memory of those days is still good but whenever quoting facts I always double check in the extensive library that I have accumulated over the years. I find that memory alone can be misleading.

To return to Mr. Cannell's letter. Tiger Force was being formed with Avro Lancasters fitted with saddle tanks to increase range for the Pacific. The Avro Lincoln was a Lancaster development, designed for Pacific operations but the first service trials were not started until a month after the Japanese surrender. Only two Mk. V High Altitude Wellingtons with a pressurised cabin were built, designed to operate at 35,000ft. with a maximum ceiling of 40,000 feet. The first with *Hercules* III engines struggled to 30,000ft. and the second with *Hercules* VIII engines only gave a slight improvement so the Mk. VI Wellington was built with *Merlin* 60 engines, the first *Merlins*, with two-speed two-stage superchargers. Performance was still disappointing, Service Ceiling (where rate of climb falls below 100ft. per minute) was established as 38,500 feet.

The Service Ceiling of other marks of Wellington varied between Mk. XIII with *Hercules* XVII at 16,000ft. and 23,500ft. for the Mk. II with *Merlin* X engines. Incidentally, the Mk. I Wellington had a wingspan of 86ft., increased to 86ft. 2in. from Mk. Ic onwards. The Warwick, also of geodetic construction, had much in common with the Wellington but was larger with a wingspan of 96ft. 8½in. and powered by Bristol *Centaurus* or Pratt & Whitney *Double Wasps*. No pressurised versions were built. Outclassed as a bomber by the four engine types in service ahead of it, it was mainly used by Coastal and Transport Commands.

The Westland Whirlwind was designed from the beginning with Rolls-Royce *Peregrine* engines. The *Peregrine* was developed from the *Kestrel* but was plagued with problems causing late deliveries which along with Westland's delays meant that it was late into service and soon outclassed by the Mosquito. The *Peregrine* problems together with those of that other *Kestrel* development, the *Vulture* (put simply as two V *Kestrels* built in X configuration) led to R-R stopping production of both in favour of the much better later models of *Merlin*.

There never was a 12-cylinder in-line *Kestrel*! The *Kestrel* was a 12-cylinder, upright 60deg. Vee as were most R-R aircraft engines from the *Eagle* through *Falcon, Condor, Kestrel, Merlin* and *Griffon*. The length of a *Kestrel*, depending on accessories fitted, went from 66.72in. for unsupercharged versions to 69.82in. for supercharged models. The thought of an in-line 12-cylinder aircraft engine around 11ft. long beggars belief.

The experimental *Goshawk*, based on the *Kestrel* IV, was built to investigate evaporative cooling (often mistakenly referred to as 'steam-cooling') in an effort to reduce the size of radiator required. Twenty engines were built in six versions and mainly tested on prototype aircraft. Output varied between 600 and 660hp.

The *Merlin* C was an early experimental version rated at 890hp and development continued through to F which went into production as the *Merlin* 1 in 1937 rated at 1,030hp.

The Italian jet aircraft referred to, built by Caproni, was not a jet but what is today called a ducted fan. The first true jet to fly was German in 1939.

I will admit that my aviation interests are of the 1930s and 40s and flying, sitting on a stove pipe does not appeal. I suppose a similarity would be a steam buff's interest in a magnetic levitation train.

H. J. 'Bob' Shilling, West Midlands.

Philip Collins working model of Brunel's vacuum powered train.

Vacuum railways

SIRS, - I am indebted to Derek Skinner, an avid reader of *Model Engineer,* who has suggested I wrote to you regarding our model Vacuum Train (which he helped to build) as it apparently has had one line mentions in a couple of your editions over recent months.

The reason I built it was because my entire business is concerned with barometers which measure air pressure and for some years I have had a passion for public demonstrations to try and explain the force of air pressure. We arranged the full-scale re-enactment of 'The Magdeburg Hemisphere' experiment in March 2000 on Great Torrington Commons complete with 16 horses - the first time ever this has been done in the UK.

We built a 12 metre wine barometer for the 'North Devon Agricultural Show' to demonstrate Louise Pascal's experiment - again in costume.

Brunel's Vacuum Train was a natural progression for a public experiment of air pressure - one which has worked exceptionally well and has been enjoyed by all the spectators that have visited during those special occasions here at Barometer World in Merton, Devon.

We also have had other public experiments which make understanding science fun such as our vacuum gun, and weighing the atmosphere. In May 2006 we were invited for the first time to take the 'show' down to the garden of Old Forde House, Newton Abbott where hundreds of spectators over a weekend enjoyed a combination of celebration and understanding of Brunell's vacuum train and his bi-centenary. The original train ran from Newton Abbott to Exeter some 20 miles and was for a short while very successful, except when the pressure was low and *"third class passengers may be asked to get out and push the train!"*

On good days the 24-ton train travelled at speeds up to 70mph and in 1844 that was some feat. After only a year the greased leather seals along the track leaked. This was due mainly to rats nibbling away at them overnight and consequently the seals needed replacing along the 20 miles and at a cost of £20,000 so conventional steam trains took over instead.

Some pipes were used to discharge sewage out to sea and a few sections have been recovered and preserved in recent decades. Our totally unique *'Vacuum Experiments Experience - The Power of Nothing'* have proved very successful both at our own establishment in Merton and also at Newton Abbott.

Bookings are possible for the right event although transport and costs would need to be met.

Although we are considering selling it to the right establishment, it could make an interesting addition to a themed attraction (our own is rather small to run it regularly) We have a website at **www.barometerworld.co.uk**

Philip R. Collins, Barometer World Ltd, Merton, Devon.

Response on global warming

SIRS, - It is now sometime since my letter on Global Warming (*M.E.* 4271, 13 April 2006); however, I feel I must reply to Mr. Robinson's letter (*M.E.* 4279, 4 August 2006), he does not appear to have grasped the basic science to which I drew attention. For the benefit of Mr. Robinson and other readers, I will attempt to clarify the situation.

Solar radiation, in this context, is electro-magnetic radiation or EMR. That part of it which constitutes the visible spectrum has been investigated by scientists from Sir Isaac Newton onwards. Newton viewed light as a stream of minute particles or corpuscles and was able to explain many of the properties of light comparatively easily using this model. However, a different view was taken by other scientists, notably Huygens, who saw light as having a wave character. The wave theory came to be dominant in the 19th century; it was seen as providing the better explanation for the various properties of light.

Early in the 20th century enormous developments in physical science took place, it is a fascinating period in the history of science. The first major piece of work by Albert Einstein (1905), more generally known for his work on theories of relativity, was an explanation of the photo-electric effect which had hitherto defied explanation. Einstein proposed that light had a dual wave particle character, that in effect neither model alone described the behaviour of light.

The particle is the photon, a particular photon is associated with a wave of specific wavelength and therefore specific frequency (all EMR travels at the same speed, the speed of light).

In a separate, slightly earlier, development, Max Planck (1900) in attempting to explain the phenomenon of black body radiation which had defied classical physics (neither the thermodynamics nor the mechanics of the day could account for the experimentally observed results), proposed his now famous Quantum Theory which did provide an explanation.

A basic tenet of the philosophy of science is that the test of a theory is that it should not only explain existing observations but that it should generate new knowledge.

One result of Planck's Quantum Theory was that it provided a corner-stone for the development of the modern understanding that we have of the structure of atoms and molecules. Essentially, the Quantum Theory states that energy is not continuous but exists in discrete packets or quanta (singular: quantum). These are so small that in our everyday life we are unaware of this but at the atomic - molecular level things are very different. Each quantum is associated with a precise frequency, the larger the frequency then the more energy the quantum represents.

The work of Einstein, Planck and others provided a sound theoretical understanding for the very large body of experimental spectroscopic data that had been accumulating for over a century. At last an explanation became available for line and band spectra.

This brings us finally to the case in point. Carbon dioxide consists of three atoms; although the nuclei define essentially the mass of the molecule, it is the electrons that define the volume and shape of the molecule. The electrons can only exist in precisely defined energy levels, to transfer from one to another an exact amount of energy must be gained or lost; thus for a photon to be absorbed or released it must have this exact amount of energy, it follows that this photon is associated with a precisely defined frequency.

This phenomenon has nothing to do with the situation in which the molecule exists, it matters not that the molecule is in laboratory apparatus or wandering around the atmosphere. The only relevant factors are the frequency of the photon and the electronic energy levels of the molecule. In the case of carbon dioxide, short wavelength solar radiation tends to pass through without interaction.

However, longer wavelength radiation can be absorbed; the energy of these photons does correspond to the differences in energy levels within the carbon dioxide molecule. These energy levels involve deformation of the molecule (such as vibrational and rotational modes) and may be seen as kinetic energy changes. Thus absorption of a photon of longer wavelength increases the kinetic energy of the carbon dioxide molecule. In this context readers should appreciate that what we commonly refer to as temperature is actually the mean kinetic energy of the particles with which we are involved (basic kinetic theory), in effect the temperature of the carbon dioxide has increased. However, this will be short lived. Further reference to kinetic theory discloses that the binary collision rate for common gases at ordinary temperatures and pressures is of the order of ten to the power thirty five per cubic metre per second - an unimaginably large number (ten raised to the power three is a thousand, to power six is a million, to power nine a thousand million and so on).

Energy rich molecules quickly pass on energy to neighbouring molecules via collisions, they will not wander off with it through the atmosphere.

Reference to the dynamics of heat transfer within the atmosphere as a whole is all very well but it fails to address the central problem; increasing the carbon dioxide content of the atmosphere increases the insulating ability of the atmosphere and tends to trap heat energy at the earths surface.

As an analogy, consider a locomotive boiler, if we replace the existing lagging with a layer of the same thickness but which is a better insulator, is it not reasonable to suppose that a new temperature gradient will be established with an increase in the temperature immediately adjacent to the boiler?

Increasing the carbon dioxide content of the atmosphere does little or nothing to reduce incoming short wavelength solar radiation but it does make it more difficult for the longer wavelength radiation (heat energy) generated by that radiation at the earth's surface to escape back into space. Of course there is a dynamic equilibrium between energy in and energy out, if there was not then the earth would continuously heat up and life would never have been possible! But adding carbon dioxide to the air will change the equilibrium - and not in our favour.

There are many points in Mr. Robinson's letter, other than the basic science, with which I would take issue. What exactly is a 'convector of a gas'?

Of what relevance are the latent heats of water to it being a greenhouse gas? For this we need the spectra (U.V., visible, I.R.) not the latent heats.

Again, his reference to glacial events is at variance with current views. The last 800,000 years have witnessed eight glaciations and there is much detailed knowledge available. The last glaciation, the Devensian, ended some 10 to 11,000 years ago in Western Europe. The climate warmed until it reached a climatic optimum approximately seven thousand years ago and for the last five thousand years it has been cooling. The warming has not continued to the present day as Mr. Robinson appears to suggest.

The complex pattern of temperature variation for the earth established for the last half million years or so does have a satisfactory explanation in terms of natural phenomena - until we arrive at the last century when it no longer fits the established pattern. To make it fit, it is necessary to add in the effect of the additional carbon dioxide generated by burning fossil fuels.

The reference to an Antarctic ice core producing an anomalous result for atmospheric carbon dioxide is puzzling, no date or other details are given; I have a diagram for the Vostok ice core (Antarctic) which details the carbon dioxide content of the trapped air for the last 160,000 years and it shows no such anomaly, the values being from somewhat less than 200 to a maximum of 300 parts per million by volume. The current value is approaching 400, historically it used to be 300.

In this letter I have tried to confine myself to the basic science and avoid political aspects, rumour and innuendo; however, since Mr. Robinson accuses me of *"snide remarks"* I must point out that he feels able to impugn the honesty and integrity of scientists working in climate change (*"well, they would wouldn't they"*) and also accuses others of a deliberate lie.

Climate change is not a new study and, additionally, knowledge is accumulating at a considerable rate. That is the nature of science. If readers of the *Model Engineer* are serious in their desire to know more of climate change and its likely effects I suggest that they go to their local library, obtain a copy of *The Holocene, an Environmental History* by Neil Roberts, published by Blackwell, second edition 1998, which I found to be an excellent and balanced review of the subject. At the end of the book they will find a bibliography listing approximately 850 references including many to papers in the original research literature in such journals as *Nature* which will supply a wealth of further information, again via the library. Such material will have been scrutinised by a knowledgeable editorial committee or peer reviewed. Please do not rely on newspapers, magazines or the Internet. The study of climate change is a complex study and not one suited to either *Post Bag* or

articles in the body of the magazine, let's keep these pages for the wealth of material for which the magazine is eminently suited.
Roy Froom, Berkshire.

More dezincification

SIRS, - The ongoing correspondence about dezincification prompts me to write about some of the practicalities. The serious consequences of the effect were first examined at the close of WW1 when the Admiralty ordered an investigation into the high incidence of brass condenser tube failure in the British Grand Fleet when compared to the lower failure rate in the German High Seas Fleet. Compositional analyses of the brasses revealed that the German brass contained traces of arsenic which were absent from the British brass. Trial and error experiments showed that as little as 0.03% of arsenic effectively reduced dezincification. To this day, all drawn brass tube for use as condenser tube has this small amount of arsenic added to it and is designated CZ105. Admiralty brass CZ111 (which in reality should be designated a gunmetal since it contains tin) also contains arsenic although Naval brass CZ112 is devoid of arsenic and, whilst still containing tin, has a higher content of zinc.

Whilst it is generally recognised that higher levels of zinc in brass encourage dezincification, no definitive relationship has been established due to variations introduced by local environmental conditions, the complex nature of brass alloys themselves and the effects of the adventitious occurrence of other trace elements in them. The manufacture of brass is far from straightforward due to several physical constraints. The melting point of copper exceeds that of the boiling point of zinc and even when this complication is controlled, the solubility of zinc in copper i.e. the molten brass, does not exceed about 30% depending on temperature. Further additions of zinc give rise to the separation of a zinc rich phase which is, in reality, a solution of copper in an excess of zinc. The two phases are described as alpha and beta respectively. When stirred together these two phases can be mixed (but not dissolved) to yield duplex brasses. The nature of the mixing is difficult to control and as with any binary mixing of fluids there is the option for one phase or the other to be the continuous phase. In addition, the presence of small amounts of other elements such as tin or silicon not only increases the proportion of the beta phase but can make dramatic changes in the physical distributions of the phases. Thus it is possible to have an alpha in beta duplex as well as a beta in alpha duplex, both with the same bulk analyses. On this basis the second option will be more resistant to dezincification than the first since the copper rich, alpha alloy is the continuous phase. Advantage of this is taken in the production of the duplex alloy CZ132 used for forging and hot stampings where heat treatment in the range 450-550deg. C ensures resistance to dezincification. This condition will be lost if the alloy is reheated as happens in brazing. One final complication arises in the manufacture of brass in that the rate of cooling from molten to solid affects the grain boundary conditions which can have a marked effect on the properties of the alloy.

In view of the complexities outlined above it is hardly surprising that a definitive prediction for the occurrence of dezincification is elusive. However, it is less likely to occur with lower contents of zinc or with copper/zinc alloys containing tin, nickel or silver. Furthermore, the local environmental conditions can also play a major and unpredictable role.

To come to the specific question of brazed boiler barrels, it is a nonsense to consider the composition of the brazing rod when the braze fillet on the copper plates will have a totally different composition. This is due mainly to the dissolution of copper from the plates into the molten fillet and to the loss of zinc by volatilisation due to the heating. Both effects will reduce the level of zinc in the fillet and both effects will be more pronounced with higher temperatures and longer heating times. What a pity that Mr. Counsell (*M.E.* 4278, 21 July 2006) did not appreciate this before designing his tests to include a Sifbronzed copper joint which might then have been more meaningful. In the specific case of Sifbronze (presumably No. 1) this is a 60/40 duplex alloy with an additional 0.3% of silicon to sharpen the melting range, which is 875-895deg. C, and to increase the fluidity and wetting properties of the molten braze. The presence of silicon will increase the ratio of beta phase to alpha phase and the increased fluidity will ensure a better mixing of the phases. The inevitably rapid cooling of the molten fillet will ensure a fine grain structure. Also available is Sifbronze No. 2 which contains 9-10% of nickel and 42% of zinc plus 0.3% of silicon. Whilst this has a wider and higher melting range (920-980deg. C), the nickel content should ensure a significantly greater resistance to dezincification.
Martin Humphrey, Hertfordshire.

Stoichiometry corrections

SIRS, - Just a couple of points if I may...

First, the letter by Tim Coles More on Stoichiometry (*M.E.* 4282, 15 September 2006), very good, but, line 33, Carbon does not have 14 times the mass of a Hydrogen atom, it has 12 times the mass of a Hydrogen atom (i.e. atomic weight of 12(ish). Also, in the same issue on page 333, Stoichiometric Ratio by Keith Roper, Line 16, 12 is not the Molecular weight of Carbon, it is the Atomic weight. Furthermore, on page 334, Graham Astbury writes: centre column, second paragraph, line 12, I assure you there are not *"hundreds of isomers of Octane"!* There will be many compounds represented by the formulae C_8H_{18} but they will not be *"isomers of Octane"*. Rather, they will be regarded as substituted Heptane (eg 3-Methylheptane), substituted Hexane (e.g. 2,5-Dimethylhexane) or Pentane (e.g. the 2,2,4-Trimethyl pentane mentioned).

Sorry to be pedantic, but Chemistry is a precise subject.
John Johnson, North Yorks.

Obsolete materials

SIRS, - I like the way in which subjects reappear in articles in *Model Engineer* often answering questions posed by their first appearance. I am often in the dark when reference is made to products or materials which are obsolete in general use, where does one get them? I was recently surprised to find a pot of Traditional Soft Soap made by Chempak, on the shelf at the local gardening centre. Next time I am following Tubal Cain's instructions for hardening and tempering, I shall be fully equipped. Similarly he recommends resin as an ingredient for turner's cement. I was looking through the H. S. Walsh website (*Smoke Rings, M.E.* 4282, 15 September 2006) and found that they supply it, very useful.

A while back there was some correspondence on how to remove the brown varnish like stains which tend to build up on lathes etc. as the old oil oxidises. I have found that the gun cleaner spray used for cleaning gun barrels and supplied in small spray cans in shooting shops dissolves it quickly and efficiently, though I doubt that it is safe to use on the painted surfaces.

I hope other readers will find these tips useful.
Malcolm Phillips, by e-mail.

History of cutting tool steels

SIRS, - I should be grateful if any of your readers could help me find published (and available) literature on the history of the development of steels used for cutting tools.

Today, model engineers need only consult the many advertisers in your excellent publication to obtain, by return of post, all types of lathe tools or milling cutters. But how have we arrived at such a situation?

We all know the tribulations caused by machining cast iron for example but how did Brunel's contractors cope?

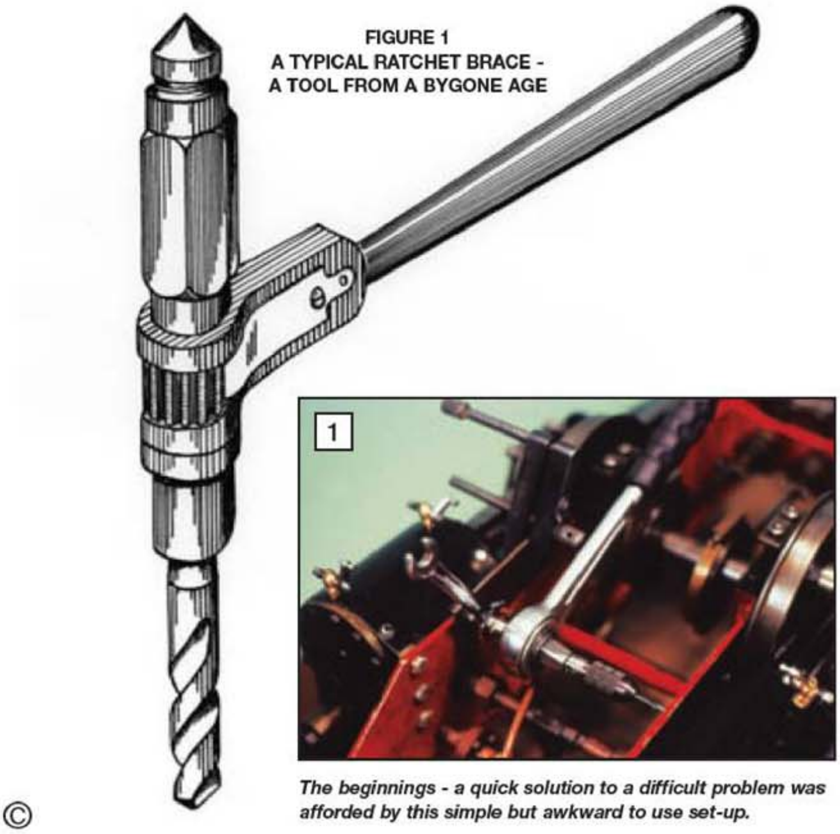
Who supplied them with their cuttings tools and who developed the steels used?

I would greatly appreciate any help on this topic. My e-mail address is:
Roland@harries.demon.co.uk
Roland Harries, Cumbria.

Bill Steer
describes the construction of a precision version of this simple tool, that once formed an essential part of every fitter's tool kit.
● *Part I*

A COMPACT RATCHET BRACE

FIGURE 1
A TYPICAL RATCHET BRACE - A TOOL FROM A BYGONE AGE



©

The beginnings - a quick solution to a difficult problem was afforded by this simple but awkward to use set-up.

A ratchet brace may seem to be a strange sort of tool to be describing in these pages. These implements tend to be regarded as something from a bygone age, more akin to the historical development of heavy engineering than the light, precision work that most of us are concerned with. It was perhaps for this reason that I had never really considered their potential value. That was, until I was faced with drilling and tapping a number of very awkwardly located 6BA holes in the chassis of a near completed 5in. gauge locomotive.

For those unfamiliar with ratchet braces, they consist essentially of a means of holding a drill bit, which is then rotated by a lever operating through a ratchet. The cutting force is provided by means of an axially-mounted jacking screw, which works against a suitable abutment. Such braces were normally quite large, often crudely constructed and required a lot of skill and muscle power to operate. **Figure 1** depicts a ratchet brace of a type available some 60–70 years ago. It is similar to one illustrated in an old Tyzack catalogue I have by me, which indicates that they could be bought in a variety of sizes, with lever arms ranging from 10 to 24in. length. Because of the erratic side thrusts involved and the high torque that could be applied they were often used in conjunction with stubby, taper shank drill bits.

One of the main functions of the ratchet brace, being portable, was to drill the holes needed during the installation or assembly of a system. This was a particularly important role, since much of our early mechanical heritage was never fully designed, or drawn out in detail, before construction began. Even where an established design did exist, variations were often called for by the prospective buyer. Consequently, there would be plenty of holes to be drilled as work progressed. Apart from a few well organised areas of heavy engineering, including some of the larger locomotive works, this type of construction was fairly widespread even up to the time of World War Two. Hostilities, however, brought about a real need for standardisation and this in turn dictated that from then on, every hole should be pre-planned — the ratchet brace and the versatility it offered was heading for redundancy!

Despite this, once the war was over, ratchet braces could still be found in the tool kits of a few remaining specialist fitters, and until recent times gangers could occasionally be seen using them on the national rail network, fixing a length of broken track. However, with an ever-increasing range of portable power tools, their use even here has fallen into demise. Probably the only chance of seeing one now is in a museum or at an industrial preservation site. I did watch one being used at the Corris Railway (mid Wales) two-or-three years ago and read somewhere that the Talyllyn has restocked its own collection following recent disposal by Railtrack!

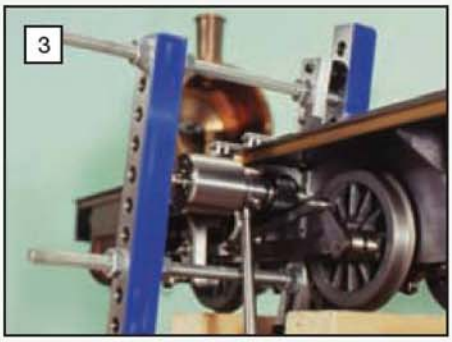
As briefly mentioned above, the idea for this tool came about when adding the last few fittings to a near-finished locomotive, the construction of which had been spread over many years. I was at the point of installing the drain cocks and although the cylinders had been drilled and tapped for these a long time ago, no provision had been made, within the chassis, to accommodate the various linkages needed. On studying the situation it became apparent that the most appropriate position for the rocker bar (extending from one side of the chassis to the other, and providing final motion to operate the four drain cocks) was midway along, but just below, the two externally mounted cylinders. The bar would need to be supported in bearings slung from each of the two inner sides of the frame. This was fine, as there would be room, but it left the problem of how to drill and tap the necessary fixing holes. Their position was totally obscured from the outside by the cylinders, and I certainly didn't want to have to remove them and the accompanying motion, at this late stage of assembly!

Further inspection revealed that there was a fair amount of clearance between the frames at this point — a trained mouse with a miniature power drill could possibly have tackled it from within! It occurred to me that if I made up some sort of contrivance that enabled a drill bit to be squeezed between the frames, rotated and given additional longitudinal thrust the problem might be solved — indeed, a small ratchet drill! After further consideration a simple prototype was constructed. This consisted of a short piece of 3/8in. square steel bar, drilled throughout its length with a 1/4in. dia. hole. An Eclipse pin chuck was fitted into one end of this hole and the threaded portion of a 1/4in. BSF bolt, carrying a nut, into the other. The bar was rotated by means of a ratchet driver borrowed from the set of socket spanners that normally live in the boot of my car. In use, the whole assembly, fitted with the drill bit, was wedged between the locomotive frames. With the head of the bolt constrained, thrust was applied by turning the nut with a small spanner (**photo 1**).

Waggling the ratchet driver and juggling with the spanner at the same time, was not the easiest of tasks. Too little end thrust and the device would fall out of alignment, too much and it would jam up. This latter situation was a frequent occurrence, since the feed nut tended to rotate with the drill itself. All-in-all, its action was very reminiscent of that I had seen when watching full-sized ratchet braces being used in the past! With a little perseverance, however, this simple device did enable me to solve the immediate problem with a reasonable degree of success.

Having completed this particular job, my thoughts began to wander to those other occasions when it had been necessary to drill holes in the chassis of near completed locos or other assemblies — always a messy operation and never very satisfying! Anyone who has made up an LBSC design will be familiar with this situation. The Maestro's style was primarily one of encouragement. As such, he ▶

The outcome - a precision ratchet brace.



The ratchet brace, with its support structure, set up to drill a hole for a brake hanger in the chassis of a near completed locomotive.

Using the brace to drill holes for track circuit connections in the author's ground level railway.

was well aware that the enthusiasm and excitement of his followers would grow more rapidly, the sooner an engine could be brought to the running stage — stopping it was a totally different matter and could come later! Consequently, brake gear, and its method of attachment to the chassis (involving the drilling of new holes), was often one of the last items to be considered in a serial. (For the benefit of new readers, LBSC was the pseudonym of Lillian 'Curly' Lawrence, who, for over 40 years, until the time of his death in 1967, contributed regularly to *Model Engineer.* It was through both his pioneering work and the inimitable way in which he presented his constructional articles that the popularity of building small, coal fired, passenger hauling locomotives has often been attributed.)

Another area of hole drilling in which I have struggled has been in partially laid rail, e.g. for fish plates, tie-rods and track circuiting connections etc. It was with all these applications in mind, that the design for this particular ratchet brace evolved.

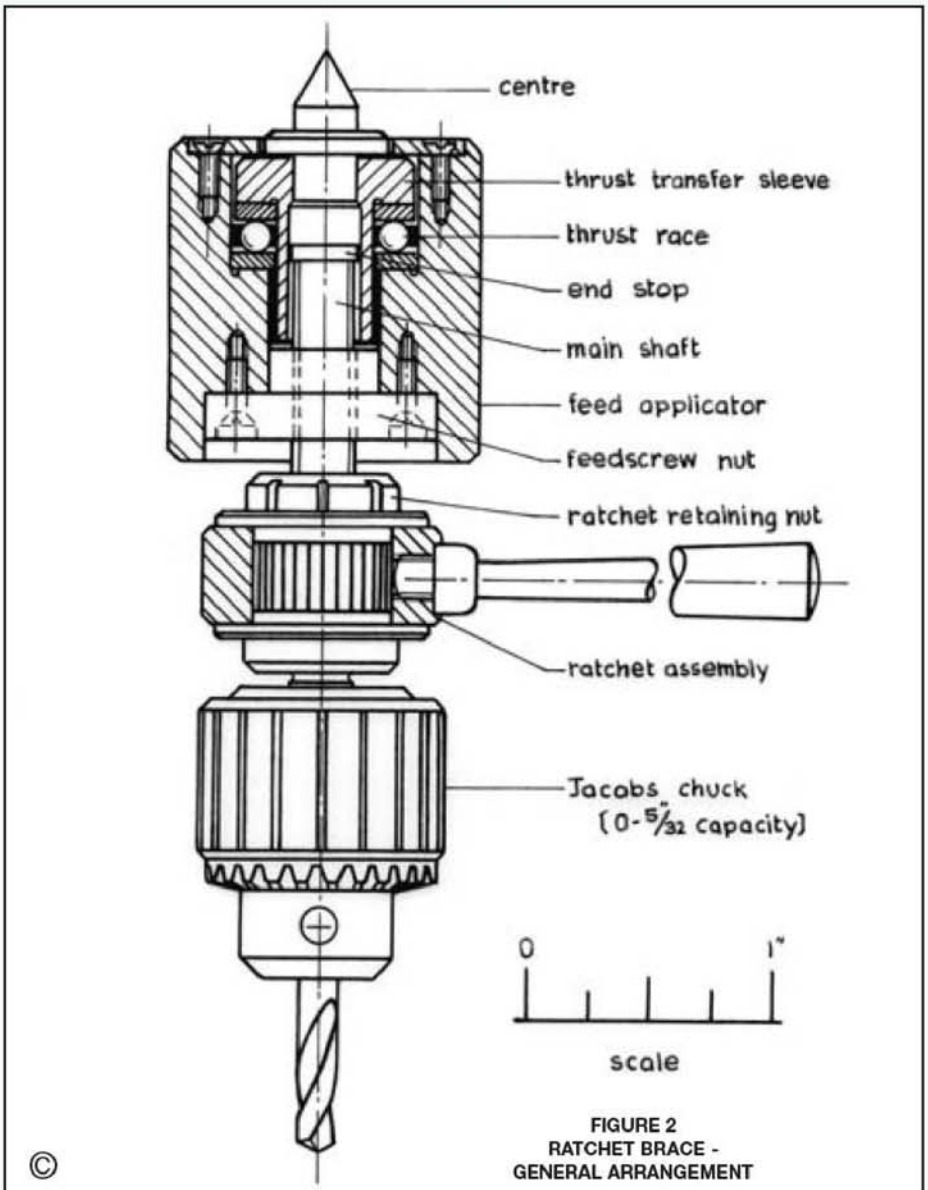


FIGURE 2
RATCHET BRACE -
GENERAL ARRANGEMENT

Design details

In the light of my experience with the drain cocks, one of my main considerations for this brace was that it should be small enough to be usable within the confined spaces of the frames of a 5in. gauge loco. At the same time, I was also concerned that its small outline should not restrict its usefulness, intending that it should be able to cope with drill bits of up to at least 2BA tapping size (No. 22). Of equal importance, I wanted something that would be easy to set up and use (none of the juggling so often associated with these devices).

The outcome is a very compact tool (**photo 2**) that enables awkwardly positioned and 'afterthought' holes to be drilled cleanly and easily with precision. **Photograph 3** shows the brace set up to drill a hole, for a brake hanger, in the chassis of a near completed locomotive and in **photo 4** holes for track circuit connections are being made in the author's ground level railway. In both cases, note the use of a simple, general purpose, support and reaction assembly for the brace to thrust against.

Figure 2 is a general arrangement of the ratchet brace itself, details of the additional support structure will be given later. Starting at the bottom, the drill bit is held in a Jacobs type chuck. This is the smallest size available (No. 0) and has a capacity from 0 to 5/32in. Unfortunately, it presents the first compromise to my original specification in that a No. 22 drill is 0.0008in. larger than 5/32 inch. In practice this difference is slight and unlikely to concern us. (The tolerance on my own chuck, believed to be of Far-Eastern manufacture, is such that it will in fact grip a No. 22 drill, quite easily.) The chuck is attached to the end of the mainshaft by means of the usual taper.

The diameter of the mainshaft increases just above this tapered section to form a flange on which the ratchet assembly rides. The drive from the ratchet is transferred to the mainshaft via a length of square section taken on in this region. Above this square section, the mainshaft is reduced in diameter and carries a 1/4in. x 40tpi thread which engages with the feedscrew nut. To prevent this nut from becoming disengaged during use (something that could put an unacceptable loading on the threads) the mainshaft terminates in a small end stop. The ratchet assembly is held in place by means of a retaining nut.

The feedscrew nut is held within the body of the feed applicator which also houses the thrust race. The latter acts, via the thrust transfer sleeve and a hardened centre, on the external thrust reaction assembly (not shown in this drawing). The thrust transfer sleeve is located within the feed applicator by means of a bronze bush. The feed applicator, itself, has a smooth outer surface, and the design is such that once the brace is set up for use it will rotate freely with the mainshaft. In this mode no cutting will take place, however by applying a gentle braking force to the applicator (using the thumb and first finger), the nut will ride slightly along the threaded portion of the mainshaft supplying a longitudinal thrust. Cutting will now commence. By controlling the grip on this part, a steady cutting rate can be easily maintained. The diameter of the feed applicator is governed by the pitch of the mainshaft thread, and is such that a moderate grip has to be applied before excess cutting forces cause the larger drill bits, within the specified range, to slip in the chuck (smaller drills will require a lighter touch). Just before slipping occurs a sharp drill can be removing metal at a rate of 0.002 – 0.003in. per revolution. The ratchet handle is 3in. long and provides a 'sensitive feel' to the drilling operation; its length is sufficient to provide enough torque for efficient cutting without undue risk of the drill slipping.

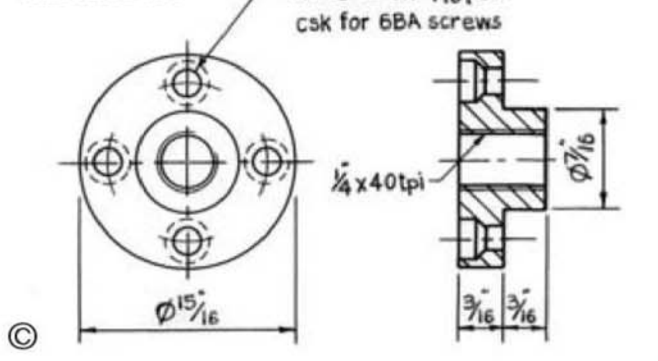
With the mainshaft fully retracted within the body of the feed applicator, the total length of the ratchet brace is about 3 3/4in. This is a little tight for use between the frames of a 5in. gauge locomotive (typical spacing 4–4 1/2in.) and would entail the use of a very short drill bit. However, under these circumstances, it is often possible to substitute the interchangeable male centre for one of the opposite gender and thus gain an increase in space.

Choice of drill chuck

Before starting to cut metal, it is advisable to procure the drill chuck; we shall need this item quite early in proceedings in order to produce the fitted taper on the end of the mainshaft. If you take pleasure from quality tools, go for a genuine Jacobs item (No. 0), these are beautifully made and have a lovely silky feel when being tightened; they also hold drills to within a high degree of concentricity. On the other hand, if you just want something to do a reasonable job of work, similar items now made by some Far-Eastern companies, form acceptable substitutes. These are often available at exhibitions or through our advertisers at relatively low prices. My own chuck was of this ilk and came from a local tool shop. It was covered in anti-rust compound and on getting it home, I decided that it would be worth giving it a proper cleaning. Paraffin was used, and in doing this, quite a lot of extraneous metal chippings were released. After drying, the chuck was given a coating of oil and on testing, I was pleasantly surprised at its performance.

At this point I must pass on a word of caution. All the parameters for this ratchet brace have been carefully optimised for use with the specified size of chuck. Should you decide to increase capacity simply by using a larger one you will almost certainty become frustrated with the way in which the tool handles. There is of course, no reason as to why the given dimensions should not be scaled up to match a larger chuck, if greater capacity is required. Even so, as touched upon previously, it is important to consider the diameter of the feed applicator, in terms of the pitch of the mainshaft screw thread, in order to optimise the braking force and hence the amount of feed that can be applied.

FIGURE 3
FEEDSCREW NUT



Making a start on construction

The logical place to begin is with the mainshaft, since everything else hangs on this. Part of it though, is threaded, and needs to work nicely with the feedscrew nut — not too tight and yet certainly not sloppy. Since the exact dimensions of the thread in the nut are dictated by the tap used in its manufacture, and hence cannot be adjusted, it is better to make the nut first and then use it as a gauge when putting the thread on the mainshaft. This way the ideal fit can be readily obtained. We shall therefore, in practice, begin with this item.

Feedscrew nut

Details for this are given in **fig 3**. As well as providing the cutting force which acts along the main axis of the brace, the feedscrew nut also serves as a bearing to carry part of the radial thrust generated by the action of the ratchet. Despite the relatively high axial loading that could be transferred by the nut under extreme conditions (up to 100lbf), its speed of rotation, with respect to the mainshaft, is very low. Similarly, the total number of revolutions made by it (again with respect to the mainshaft) during the drilling of a hole of typical depth, will also be few, hence wear should not be a serious problem. Because of this the nut could be made of mild steel and as such it would probably have a reasonable service life. However, it is never good practice to have similar metals (other than cast iron) in sliding contact with one another and so for smoothness of action and also ensured longevity I decided to make this part from drawn phosphor bronze. (Note that the cast form of this material, which actually has better bearing properties, does not have the toughness and strength required for this particular application and hence should not be used.)

Having decided that we would start with the feedscrew nut, there is still a slight problem. This is due to the fact that the 7/16in. dia. shoulder on the nut itself, forms a register with a corresponding hole in the feed applicator (to be described later) and hence needs to be a nice fit in this component. The feed applicator, in turn, needs to fit other parts — just where does one start? Since the hole in the applicator will be reamed to size, we can overcome our dilemma by spending a couple of minutes by first making up a simple gauge containing a similarly formed hole. This doesn't have to be anything fancy — I made mine from a small off-cut of 3/4in. dia. mild steel. This was faced to a length of about 5/16in. and provided with a 7/16in. dia. reamed hole running through its middle. All edges were lightly chamfered. Once you have made gauge like this, we really can begin!

First operations

Take a piece of 1in. dia. drawn phosphor bronze rod long enough to be held securely in the 3-jaw chuck and leaving about 5/8in. protruding. Since drawn phosphor bronze is a tough material it is best cut at a moderately slow speed using a sharp tool and plenty of cutting fluid.

Face the end, centre and drill a suitable sized tapping hole (see below), to a depth of 5/8in. Due to the relatively high loading of the nut it is important that a reasonable thread engagement is obtained. A No. 1 drill is normally specified when tapping 1/4in. x 40tpi threads and this will give a satisfactory 65% engagement, providing the drill has not cut oversize. To minimise this risk, it is worth making the hole in at least two stages; I suggest first using a No. 6 or 7 drill and then opening up with a brand new No. 1; this worked fine for me. I don't recommend, in this particular case, incrementing drills one size at a time, as is sometimes suggested, since the springy nature of drawn phosphor bronze will almost certainly cause the follow-up drills to jam and possibly break in the workpiece.

With the workpiece still in the lathe, the thread can now be cut with a tap. Ideally, this should be held in a proper tailstock tap holder which will provide a little float. Failing this it can be gripped in a drill chuck, guided by means of the tailstock barrel. (If you use this method, the tapered arbor of the chuck should be well oiled and loosely positioned in the barrel so that it is free to turn, rather than being jammed in.) In either case, tapping should be by hand, using the normal backwards and forwards motion. Withdraw the tap frequently to clear the flutes and use plenty of Trefolex or other cutting compound. Once the full thread has been cut along the required length (just over 3/8in.), inspect it for form. This is best done with an eyeglass, but, since we still need to preserve concentricity don't yet remove the work from the chuck. The threads should ideally have a textbook appearance, with near fully rounded tops (due partially to extrusion). If the crests terminate in large flat areas, part off and begin again, using a slightly smaller tapping drill.

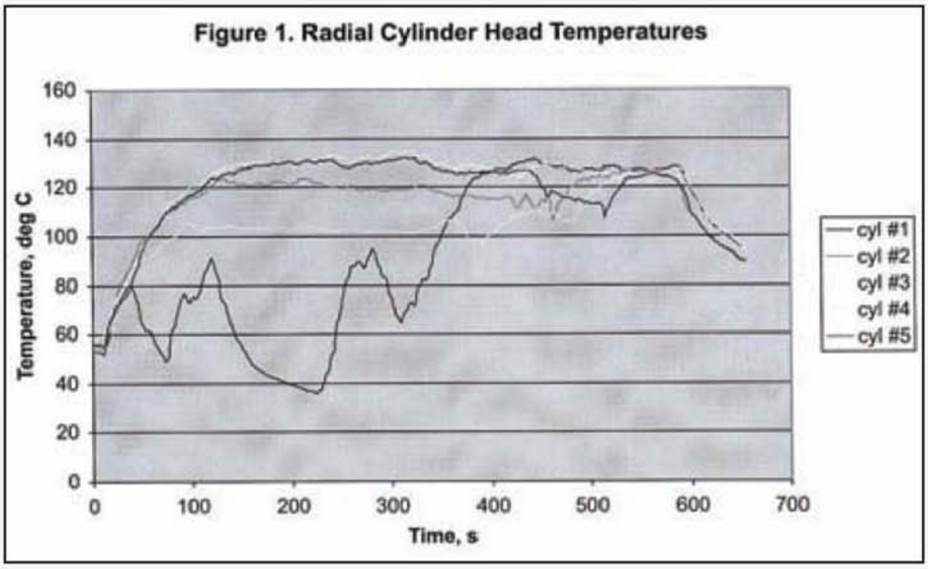
Once all is well turn down the 7/16in. dia. shoulder. This should be 3/16in. long and end up as a fairly tight, push-fit in your hole gauge. Following beyond the shoulder, the next 1/4in.-or-so should be turned to a diameter of 15/16in. Very lightly chamfer the edges, just sufficient to break the sharpness, and part off to a little over 3/8in. total length. Reverse the workpiece in the 3-jaw chuck, lightly gripping it by the small diameter portion and with the flange hard against the jaws. Face the parted surface, bringing the flange to its final thickness of 3/16in., again lightly touch the sharp edge with a tool set at 45deg. to produce just the barest glint of light.

●*To be continued.*

A FREELANCE RADIAL AERO ENGINE

Dr. Michael Ackerman
continues the story of his engine starting with the teething troubles associated with its first trial.

●*Part II continued from page 575 (M.E. 4286, 10 November 2006)*



The first build of the engine used an inlet manifold of the ring type, with a single carburettor feeding in at the bottom of the ring. The carburettor was a small Zenith model taken from a 4-stroke lawn-mower engine, having a choke size of about 9.5 millimetres. This was clearly on the large side but had the attraction of being complete, working and close to hand. The oil pressure was set to a nominal 15psi to give all the bearings a good supply for running in. Initially no starter motor was fitted because the engine was quite free and easy to flick over by hand. In this way a few pops and bangs were produced, and with a little twiddling of the mixture screws, some short and faltering runs at a few hundred rpm ensued.

There was clearly something not right in the sparks department. From the occasional flashover at the plug caps it seemed that the distributor was not working properly. A little investigation showed that tracking inside the Tufnol unit was sending sparks to a somewhat random sample of cylinders, rather than in the customary order of 1-3-5-2-4. All the surfaces were thoroughly cleaned and then sprayed with a proprietary HT sealant lacquer. With the benefit of hindsight it is obvious that those smooth surfaces inside distributors are not merely for show.

After allowing the lacquer plenty of drying time the engine was tried again. Now it would start readily and run beautifully smoothly at about 2,000 to 2,500rpm, and some other things started to become apparent. The engine was running very cool; this was to be expected. The cooling air flow, and hence the heat transfer (to the first order), is proportional to the speed. The heat to be dissipated (again to first order) is proportional to the power developed, which for an air screw scales as the cube of the speed. So the temperature rise at steady state should be proportional to the square of the speed. The engine was designed to run with a cylinder head temperature of about 150deg. C at 6,000rpm, so 2,500rpm should give about 40deg. Celsius.

The undesirable side-effect of the low running temperature was that astonishingly large amounts of oil were finding their way past the piston rings. This was disappointing, since quite a few trials of different piston ring schemes had been tried on the single cylinder development engine before the radial scheme was detailed. However, operation at such low temperatures is not really a fair test.

Running at larger throttle openings, speeds in excess of 3,000 rpm could be achieved but accompanied by increasingly rough running. The oil pressure was reduced in the hope that over-oiling might be contributing to the roughness, but with no noticeable effect. In fact, having faith that circulation rather than pressure was the important issue, the oil pressure was reduced in stages to a mere 2-3 pounds per square inch. This did reduce the amount of oil being sprayed out of the exhaust stubs somewhat but without improvement in the running. Much tweaking of the carburettor failed to make any systematic improvement to the rough running, though once or twice the engine would come on song and run briefly and smoothly at little over 4000 rpm, at which times the exhaust note was very pleasing to the ear. A set of speed and torque measurements were made at this stage; it was necessary to fit a damper to the torque indicator so that readings could be made under conditions of rough running.

Engine trials 2 - toward design speed

Knowing that mixture distribution problems were a known aspect of radial engine operation, a new manifold was constructed with a single carburettor feeding into a 1:5 splitter, having the connections to each inlet stub roughly the same length. A smaller carburettor was used on this set-up, on the grounds that a higher velocity in the venturi should promote atomisation of the fuel and better mixture distribution. The choke diameter was 4mm, the same as had successfully been used on the single cylinder development engine.

Although, of course, the average airflow through the radial should be about five times that of the single, the peak airflow should be very similar since the cylinder swept volumes are the same. At the same time the test rig was also modified so that the engine was supported from the front, making it easier to try different manifold and carburettor arrangements, though this set-up did not allow of torque measurement. The drastic change of the inlet manifold hardly had any discernible affect on performance however, no better running was forthcoming at larger throttle openings.

With the benefit of hindsight this would have been a good point at which to consider other possible reasons for rough running, but the opportunity was missed. Instead, after some deliberation, it was decided to construct a five-choke carburettor with individual mixture adjustments, so that the mixture distribution issue could be settled once and for all. To shed further light on the situation, five thermocouples were attached to the cylinder heads. At small throttle settings the individual mixture adjustments worked well, allowing very smooth running, but still no amount of tweaking could produce satisfactory results above about 3,500rpm.

Despair was beginning to set in at this point, when fortunately the penny dropped; the problem was ignition not mixture. The points assembly on the radial was a near copy of that which had worked well on the development engine, but the fact that on the radial the points were operating at five times the frequency had been overlooked. On the next test run a little pressure on the contact breaker arm brought an immediate improvement and confirmed that contact breaker bounce was the problem. The contact breaker spring, of the blade type, was quickly reworked to approximately double the closing pressure, and the engine then sang up to a record 5,000 rpm. Careful adjustment of the mixture screws allowed the speed to be finessed up to a peak of about 5,500 rpm, where contact breaker bounce again became evident. A final tweak was administered to the troublesome spring and at last the design speed was realised; in fact about 6,200 rpm was the best speed registered with this set-up.

A graph of cylinder head temperature versus time for that test run is shown in **fig 1**, and has some points of interest. At the very beginning of the test the engine was running smoothly on part throttle at about 3,000rpm with very similar temperatures on all cylinders. As the throttle was opened, mixture variations began to cause misfiring and power loss on individual cylinders, indicated by diverging temperatures. As the test proceeded, the individual mixture screws were being adjusted to achieve the best engine speed, and as all cylinders were coaxed into full song, the temperatures converged again. The final conditions show surprisingly similar temperatures on all cylinders.

This indicates that the five cylinders must be quite closely matched in valve timings, compression ratio, ignition timing and so on. This was an interesting result in itself, since the inevitable minor differences between components could conspire to give significant overall performance differences between cylinders. Having said that, the engine has not been run at full power for long enough to actually establish the individual cylinder powers by, for example, a Morse test. When a large investment of time and tender loving care has been put into an engine, it can be difficult to cheerfully hold the throttle against the stop and gather data as the engine noise rises to that *"terrible chattering whine"* (as the late Hunter S. Thompson once eloquently described it).

Engine trials 3 - full power testing

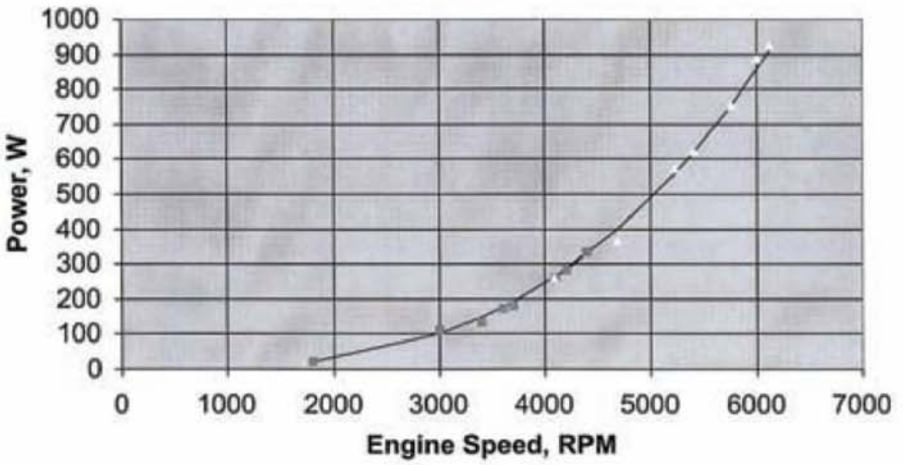
Now that the major design flaw had been corrected, the next question to be investigated was whether design speed could be attained with a single choke carburettor arrangement. The 1:5 manifold with 4mm carburettor would allow smooth running up to about 4,500 rpm and increasingly rough running up to about 5,000 revolutions per minute. The ring manifold was tried next in conjunction with the small carburettor, and gave very similar performance. These results called into question the idea that a small choke size was desirable, so the Zenith carburettor was refitted to the ring manifold. Design speed could just be obtained with this set-up, but not at wide open throttle settings. This seemed to indicate that there was, after all, something to be said for high air speeds at the carburettor venturi. At this point it was decided to return the test rig to the original set-up, allowing torque measurement so that performance measurements up to design speed could be completed. The engine was now running so smoothly that no damping was needed on the torque indicator. **Figure 2** shows the power-speed graph comprising the two data sets; the first low speed (up to 4,400rpm) before the contact breaker problem had been identified, and the second up to design speed. The fact that the two data sets are consistent is a good indication that there are no gross errors in the measurements. This is perhaps a little lucky for one needs to be wary of interpreting measurements where heavy damping or smoothing is used to extract the mean values of strongly varying signals.

The single line fitted to the data points represents a power-speed relation very close to the expected cubic function. It can be seen that the power developed at the design speed is somewhat above the hoped-for 1hp (746W). Notice that the cubic law means that small increases in speed require significant increments of power.

The fact that very similar engine speeds could be realised with the single carburettor is actually somewhat misleading, because of the characteristics of the air screw as a load. The difference between 6,200rpm with the 5-choke carburettor, and 6,100rpm with the Zenith, actually represent a drop in engine power of about 5%, or a torque drop of about 3 percent. That performance loss could be accounted for by a single cylinder running weak or rich enough to have dropped 15% from its nominal torque.

Full size radial engines also developed powers rather less than would have been expected, based on the performances of individual cylinders, because of mixture variations between cylinders. Graphs of measured engine torque versus time for instance often show surprisingly large differences between cylinders (ref. 2). It was found in full size that the mixture distribution could be strongly affected, often in unpredictable ways, by quite small details of carburettor and manifold design. Some engines, such as the Bristol *Jupiter IV*, incorporated complex intake arrangements. This engine was a 9-cylinder design with three carburettors feeding three groups of three equi-spaced cylinders by means of a cunning helical baffle within the manifold. The general stirring and mixing effects of superchargers tended to help with mixture distribution of course. Some engines, for instance the Armstrong-Siddeley *Jaguar*, used quite simple fans driven at engine speed, more for stirring than for the supercharging effect (ref. 3).

Figure 2. Radial Performance Data

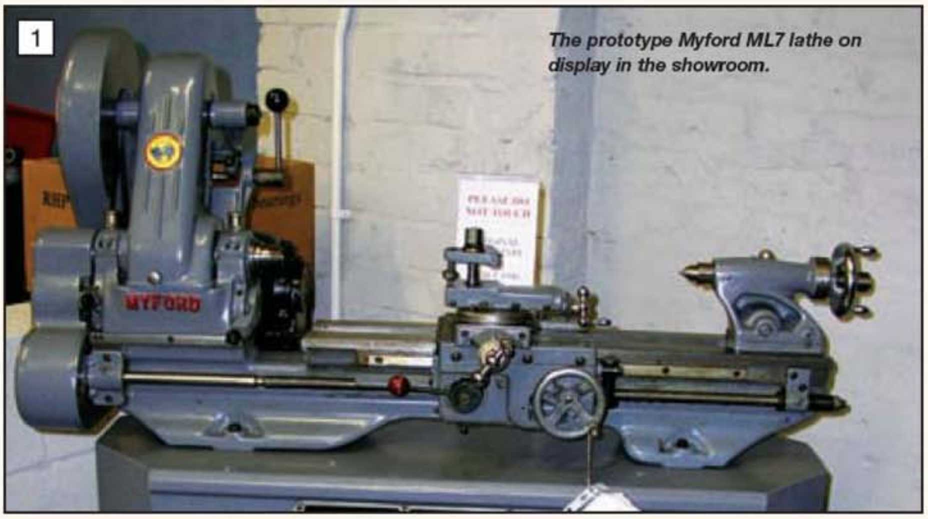


Although design performance could now be obtained with the Zenith carburettor, it was judged to be undesirably large and heavy and two other carburettors borrowed from commercial model aero engines were also tried. The choke sizes were 5mm and 8mm. The interesting outcome of these tests was that the design speed could be realised with the large choke carburettor partly open, but not with the smaller carburettor. at fully open. The smaller carburettor set-up apparently fails to develop full power because of mixture variation betrayed by rough running, not because of generally restricted breathing.

All kinds of things may be going on in the manifold involving the deposition of fuel droplets, transport of fuel as a film on the walls of the pipes, and re-entrainment into the airflow. This may favour some subtlety of the plume of mixture delivered by the larger carburettors, though this is highly speculative. The search continues for a carburettor that can reliably allow clean running from tickover to design speed. It has to be admitted that although the ring manifold proved to be the best arrangement so far tried with a single choke carburettor, it is cumbersome. A number of people have observed, more or less kindly, that it is a wonder the engine runs at all. Certainly there is a lot of pipework for the mixture to navigate, as can be seen in the detail view in **photo 4**. The carburettor is out of sight right at the bottom of the ring manifold. Of course, by the time I put much thought into the manifolding I was running out of places to put things.

It has turned out to be quite difficult to achieve the magic 6,000rpm on a routine basis; everything has to be spot on in order to get all the cylinders on song. The mixture has to be very delicately adjusted to find the point at which neither the weakest nor the richest cylinder misfires. The last few percent of power depends, amongst other things, upon the ignition delivering a strong enough spark to reliably ignite those rich and weak mixtures. A typical coil ignition system delivers a spark energy typically 30-50 times greater than that needed to ignite the optimum mixture. However, the ignition energy increases dramatically away from the optimum mixture, particularly for weak and flowing mixtures (ref. 4). This was discovered by observing that sometimes a misfiring cylinder could be brought on song by pulling the spark plug cap a few mm away from the spark plug; an old trick to introduce an extra gap so that there is a higher spark energy. At this marginal kind of operation, it is worth trying all the old ignition coils that are lying around in case one of them turns out to be better for some reason or another.

Some interesting snippets of information have been gleaned from problems experienced with the ignition system. Before the contact breaker spring was strengthened, when contact bounce would have been causing sparks to occur at odd timings, flashover was sometimes seen across the spark plug insulators. This implies that the breakdown voltage across the 0.5mm (0.020in.) plug gap was greater than that across 9mm of air, and illustrates the profound influence of cylinder pressure and charge density. Incidentally, the material used for the plug caps was Nylon 66 and no tracking problems occurred. Breakdown of the Tufnol distributor disc did occur twice; this was a failure of insulation through a thickness of one to two millimetres of the material, not surface tracking. It may also be that Tufnol has planes of electrical weakness because of the lay



1 The prototype Myford ML7 lathe on display in the showroom.

A VISIT TO MYFORD LTD.

Neil Read reports on his visit to this famous machine tool maker.

What do Technical Editors with a few hours to spare do with their time? Well, they could do far worse than pay a visit to Myford during their annual 'Open House' event held during October. I had been planning a trip to the Myford spares counter for some time to get one or two parts for my own Series 7 lathe so was able to 'kill two birds with one stone'. In the event the day proved to be most interesting and worthwhile and I stayed far longer than anticipated. Not least of the attractions for an engineer was the factory tour and I include a few photographs of some of the production processes used at the Myford works. I cannot remember seeing these reproduced in *M.E.* before so I hope they will be of as much interest to readers as they were to me.

Myford have an enviable reputation for producing machine tools that accurately do the job for which they are designed. Apart from sound design, the key to this is carefully controlled machining and fitting practices. We were shown a Myford MG12 cylindrical grinder undergoing fitting of the feed slide in the assembly area (**photo 2**). This is located on the bed of the machine with a normal V-flat slide-way arrangement. The fitter was undertaking the final scraping procedure to fit the slide to the bed whilst ensuring that the wheel spindle was in accurate alignment with the machine's table. Readers will appreciate that the fitter has to vary the amount of stock removed from the surfaces depending on whether he is scraping the V or the flat. It is all too easy to upset a fit that is in correct alignment but not properly seated or vice-versa. Fortunately, like many of Myford's employees the fitter concerned had many years experience to draw on.

The work head spindle of the grinding machine was also undergoing fitting. This is


2 Scraping the feed-slide V-flat slide-ways on a Myford MG12 cylindrical grinding machine.

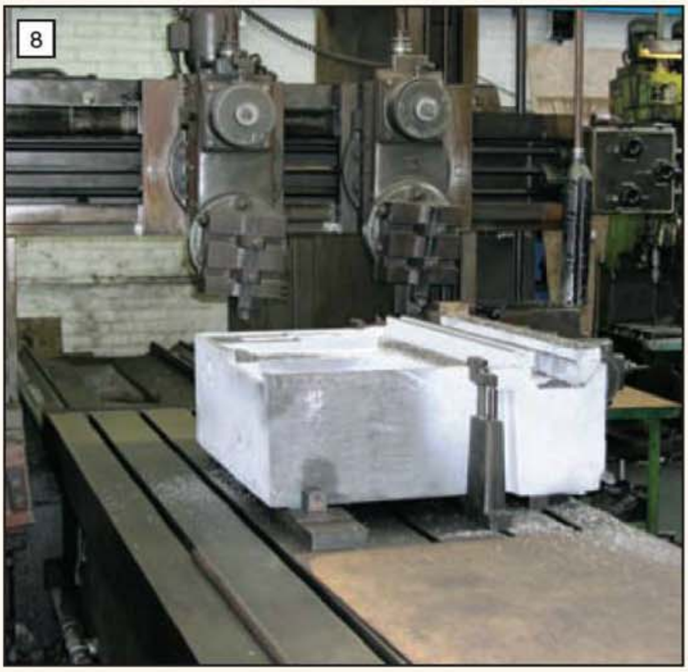

3 The front spindle bearing in the work head is also carefully scraped to a perfect fit on the spindle.


4 Setting up a lathe bed for grinding on the Snow grinding machine. The operator is turning the clamp screw to deflect the bed.


5 Parting off in style with a rear tool post and an Iscar tungsten carbide, throw away tip tool.

Rolling the thread on a leadscrew on a BSA thread rolling machine, a fast and accurate process.

Shaping two gears simultaneously on a Drummond Maxicut machine. The 'gear' on the left is the cutting tool.



Planing a MG12 grinding machine base on the Butler. Note that two tools are in use at the same time.

A Hitachi Seiki CNC machining centre was busy throughout the visit making lathe parts.

similar in design to that used on the Series 7 lathes and a plain, tapered bearing supports the front of the spindle. This is scraped to ensure a good fit (**photo 3**) and the finished machine undergoes a test grinding procedure to verify the truth of the assembly. We were shown a Talyrond roundness trace, which showed that the roundness achievable with this set up could be measured in millionths of an inch.

The care and attention lavished on the grinders tends to feed down to the Myford lathes. One feature of the lathes I was not aware of is that the beds are ground slightly crowned. This is done to compensate for cutting loads, the weight of the bed and the weight of the saddle assembly. Before grinding in undertaken the bed is lightly clamped in its centre to depress it 0.0005in. (**photo 4**). After grinding is complete the bed is released and takes on the slightly crowned form.

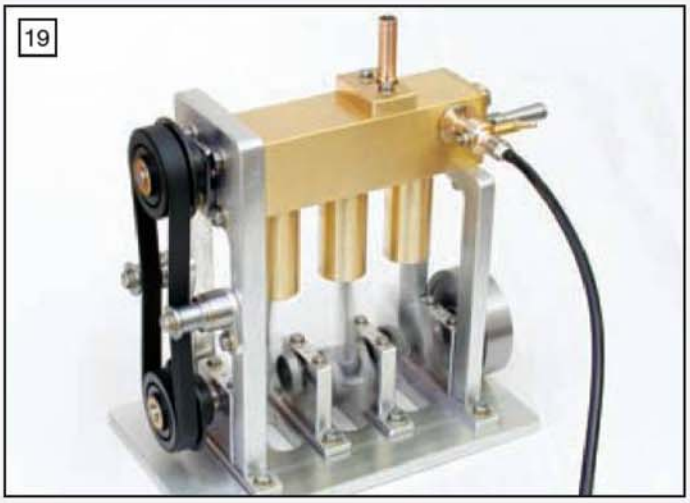
Whilst in the assembly area it was mentioned that one of the things that seems to worry Myford owners is dismantling the spindle for routine maintenance tasks like belt changing. If that applied to them, visitors were invited to attend a special training session later in the day where an experienced fitter would go through the task on one of the work's lathes.

Moving on into the main machine shop area we were shown further aspects of Myford's manufacturing procedures. However, first we were treated to a demonstration of parting off (**photo 5**). With a rigid set up, a good tool and plenty of coolant the process was shown to be trouble free.

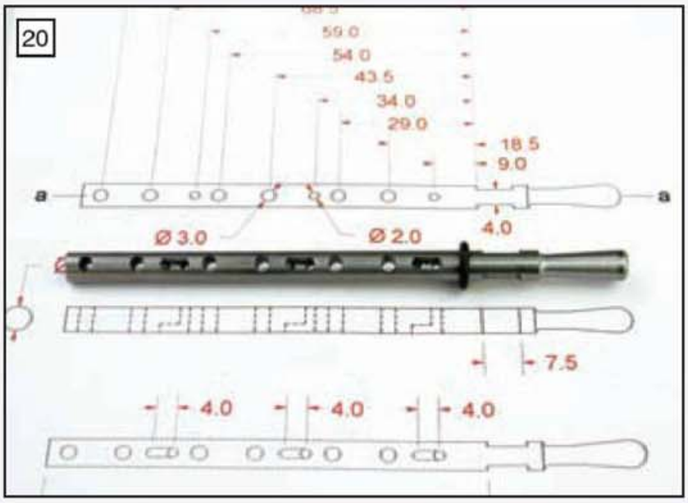
Myford try to make as much of their machines as possible and so have equipment for cold rolling their leadscrews (**photo 6**), machining racks and gear cutting (**photo 7**). For anyone who has spent the time necessary to screw cut a long thread, the thread rolling process was a revelation. Suitable bar was fed into the machine and the process set under way. Within what seemed like seconds a beautiful thread had formed and the finished item could be unloaded by the operator. It should be noted that the process displaces material to the top of the thread so, to achieve a $^{3}/4$in. dia. leadscrew, the material fed into the machine is undersize on diameter.

The Myford factory proved to be a delightful mixture of old and new machine tools working alongside one another. For example grinding machine beds were seen being machined on a large, venerable Butler planer (**photo 8**) whilst nearby, lathe parts were being machined on a CNC machining centre (**photo 9**). One interesting point was that the machine operators were seen to move around the works undertaking different operations according to production need. Myford managing director, Chris Moore, confirmed that this was the case and that most employees were multi-skilled. He added that it was becoming more difficult to recruit good quality staff and the youngsters he had taken on usually didn't last long. Apparently they object to taking a turn at the more mundane, but very necessary, tasks like de-burring. A sad reflection on our times, I suppose.

My thanks go to Chris Moore and his team for a most interesting and enjoyable day. Keep an eye open for Myford's next Open House event. You do not have to own a Myford to attend but you may come away with one if you do. I even remembered to pick up the parts I originally went for so, all in all, it proved to be a very good use of my time.



The Step 3 engine shown running, fed with air form the author's compressor through the tube shown.



The reverser plug for the Step 3 engine shown superimposed on the part drawing.

OVERHEAD VALVE ENGINES

Colin Pape

of France continues the description of his Step 3 and 3b engines starting with more on the reverser.

●*Part V continued from page 580 (M.E. 4286, 10 November 2006)*

There is an input slot and an exhaust slot for each cylinder and for each rotation direction on the rotor for this engine. These slots are cut symmetrically around the rotor shaft. I designed the system so that both input slots for each cylinder are pressurised at the same time. Since they are opposite each other this avoids the need for balance slots. The design of the rotor is shown in **fig 22** and a few words are necessary to explain how the slots are arranged for reversing.

First of all the cylinders and the crankshaft offsets are numbered 1, 2 and 3 starting at the drive belt end. When the engine turns clockwise, seen from the drive belt end, the 'firing' order is 1, 2 then 3. When the engine turns anti-clockwise the 'firing' order is 1, 3 then 2. The inlet and exhaust slots are cut to take this change into account automatically. For any given cylinder the slots are arranged symmetrically about the centre of the shaft. This does not seem to be the case if you look at the inlet slots for cylinders 2 and 3 but if you rotate slots g and h, 120deg. clockwise you will see that they look just like slots c and d and if you rotate slots k and l, 240deg. clockwise, they also look just like slots c and d.

The reversing switch is a shaft that can be set in two positions. In the shaft are passageways that control which rotor slots connect to the cylinders. I call this shaft the reverser plug.

The reverser plug extends through the rear frame and has a handle. Because of the space limitations inside the cylinder head this shaft is only 6mm in diameter but it works without problems. The engine can be made to change direction on the fly and at any speed by simply pulling or pushing on the reverser plug handle. The reverser plug is shown in **photo 20**.

There has to be a path from each slot to each cylinder but there is not enough space in the cylinder head to have four ports. There is just space for three so the reverser shaft was designed

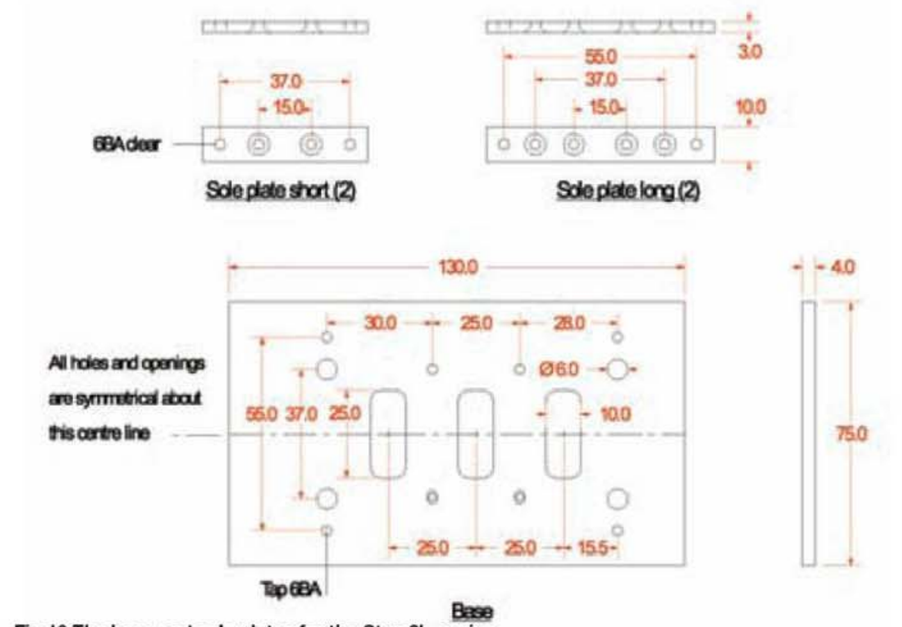


Fig 16 The base and sole plates for the Step 3b engine.

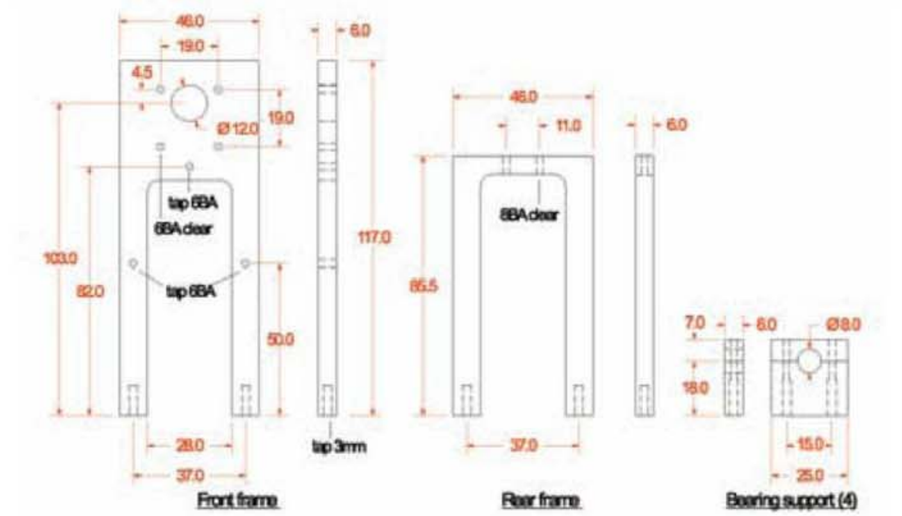


Fig 17 The frame parts for the Step 3b engine.

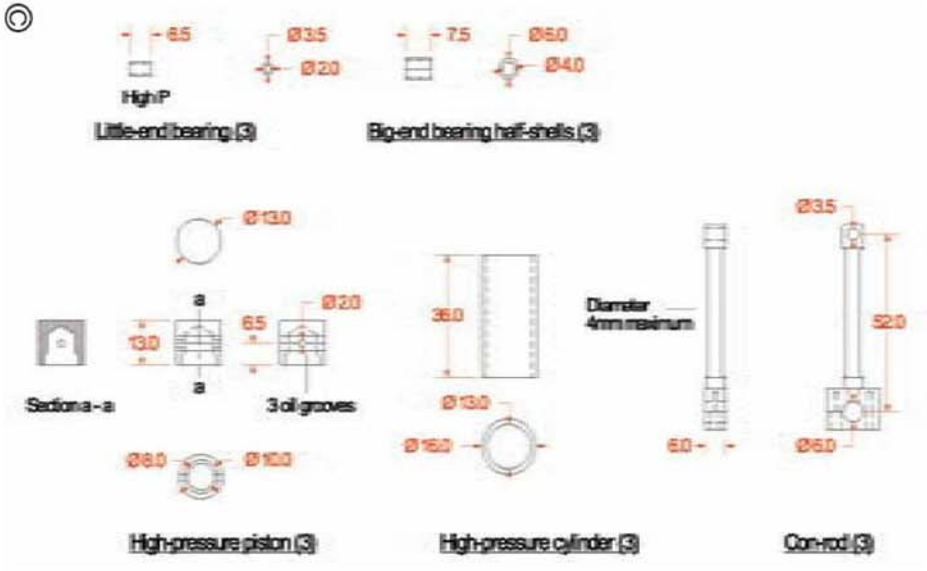


Fig 18 The cylinder and piston parts for the Step 3b engine.

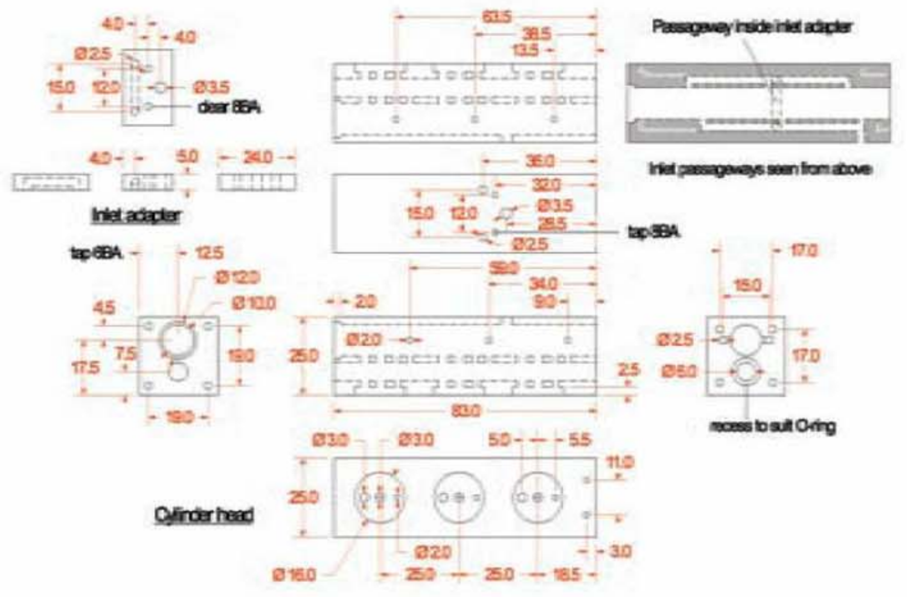


Fig 19 The cylinder head for the Step 3b engine.

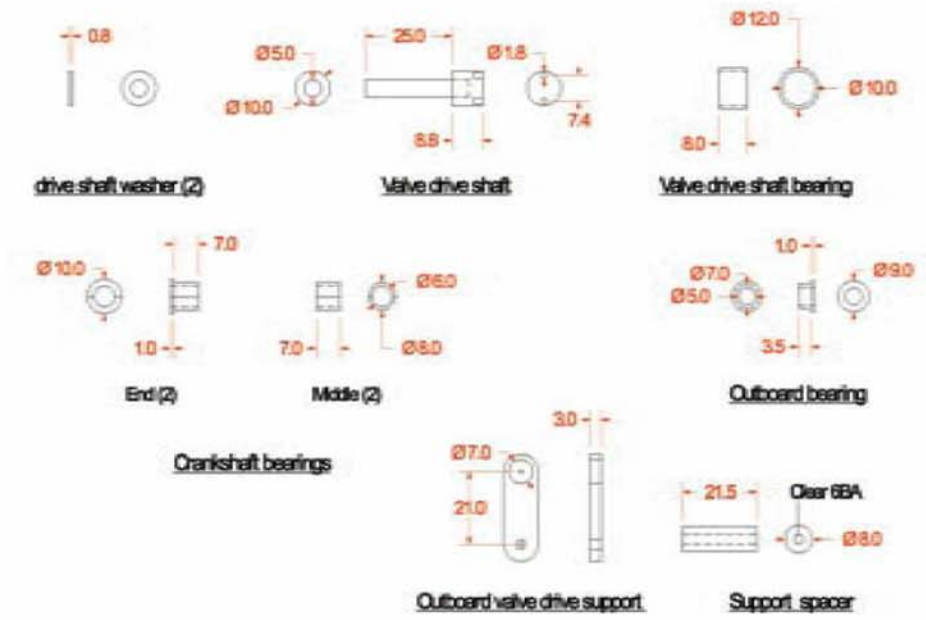


Fig 20 The shaft parts for the Step 3b engine.

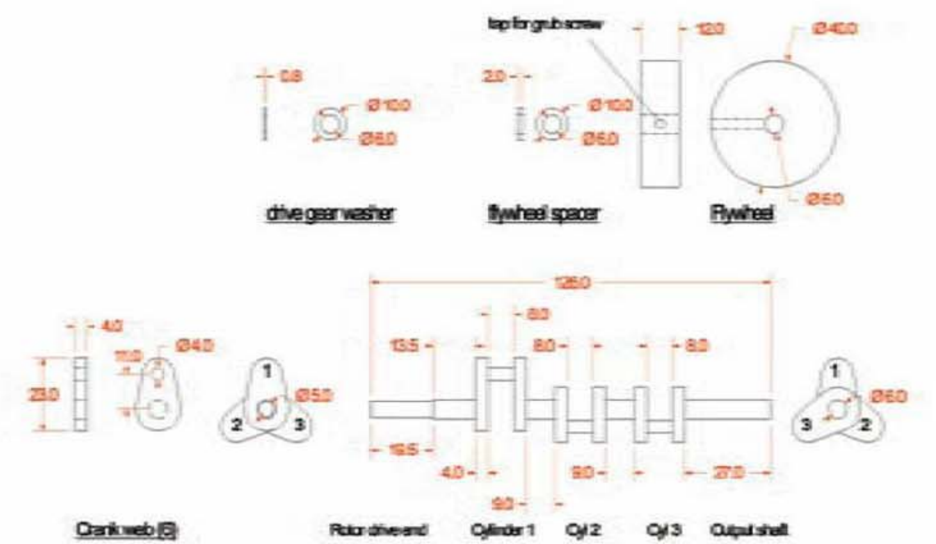


Fig 21 The crankshaft parts for the Step 3b engine.

to switch four slots into three ports. The design of the reverser plug is shown in **fig 23**.

Self-starting

I did not achieve reliable self-starting initially and I think a few words about that are worthwhile. First of all what we need for an engine to self-start is for a force to be available to turn the crankshaft at whatever point the engine happens to be at when it stopped after a previous run. If we only talk about single-acting cylinders for the moment, this requirement means that a minimum of three cylinders is required. I have made several self-starting engines without any problems and they have been very reliable. However, this time the situation was a bit complicated by having the notion of inlet cut-off.

In the Step 1 and 2 engines there is a fixed inlet cut-off and it is 50%. I am mainly interested in simple engines and they need to operate if necessary by remote control. So, although I thought that I could have some degree of cut-off in the three-cylinder engine it would still have to be fixed. Nobody might be around to change the cut-off for starting reasons or to inject steam directly into a low-pressure cylinder either.

It is clear that a cut-off, which is fixed at 50%, will result in a three-cylinder engine that will not start a lot of the time. The reason is that instead of having always one, and mostly two pistons, able to exert force on the crankshaft there will be many times when there is no cylinder under pressure. With 50% cut-off and three cylinders there is no overlap between cylinder inlet ports and the combined opening duration of all the inlet ports is only 270 degrees.

With no cut-off, the port openings total 540deg. and self-starting is virtually guaranteed.

Nothing less than 360deg. can possibly work and a good margin has to be added because of difficult starting when the pistons are near top dead center and bottom dead centre. So for many stopping positions a self-start is not possible with a cut-off fixed at 50%.

I made a first attempt with a cut-off of 75%. This value gives inlet ports that are open for a total of 405 degrees. It was fairly reliable but not good enough. I went to 80% cut-off, which gives a total of 432deg. and this was a lot better but still not completely reliable. Increasing the cut-off value was not at all interesting. **Figure 25** shows why this is so. At 80% cut-off I was already filling the cylinder to 92%. I decided to design this engine with no cut-off because of the simplicity requirement. It would not be an efficient engine but after all it was a step towards the compound engine, which would be much more efficient anyway.

Considerations for smooth running

One of the characteristics of reciprocating engines is that they spend a lot of time trying to destroy themselves. This was the despair of early engine builders. The problem is due to the fact that the maximum pressure is applied to the pistons when the connecting rods are perpendicular or nearly perpendicular to the crankshaft. The result of all the pressure is a force trying to push the crankshaft out of the engine. There is absolutely no force trying to turn the crankshaft at TDC. A similar situation occurs at BDC but the pressure is generally lower at this time.

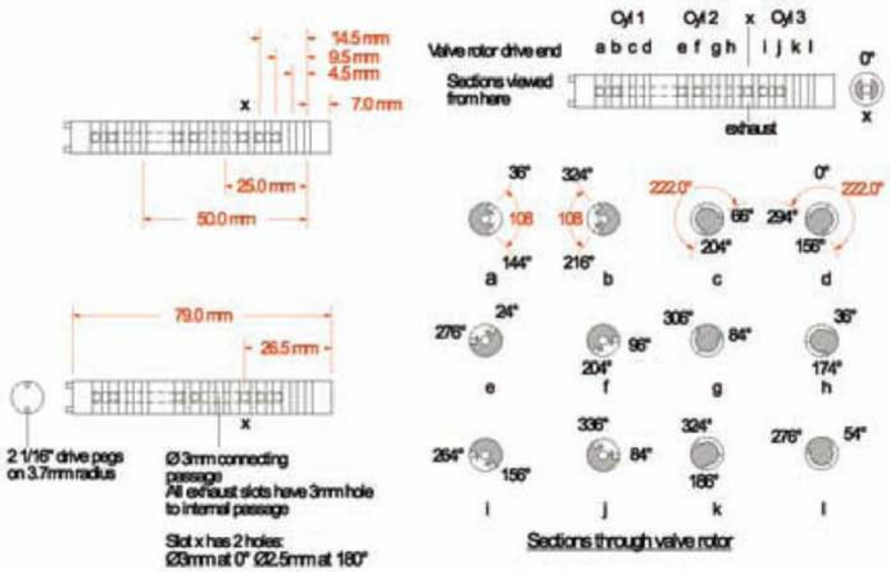


Fig 22 The rotor with zero cut-off for the Step 3b engine.

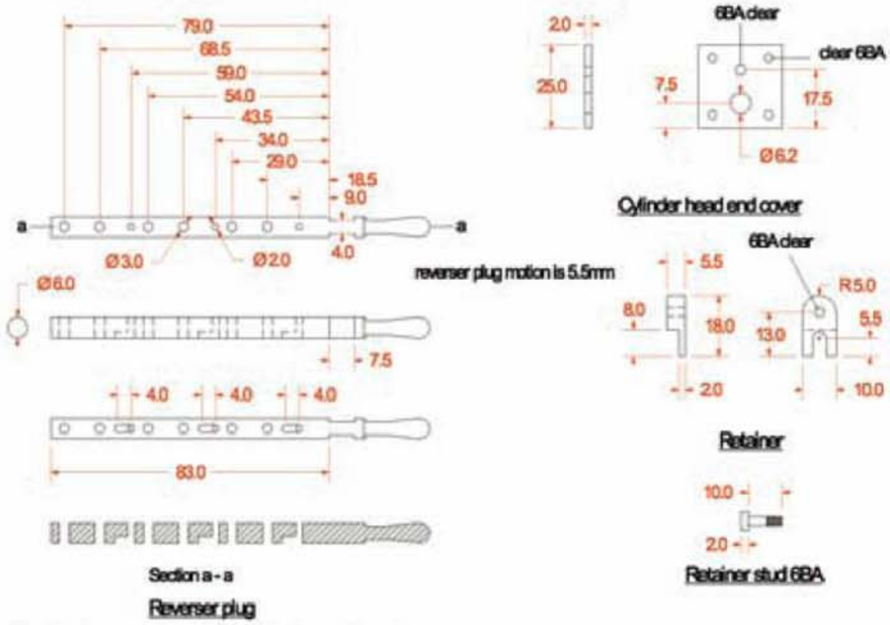


**Fig 23 The reverser stud for the Step 3b engine.
The retainer stud doubles as a backstop for the rotor.**

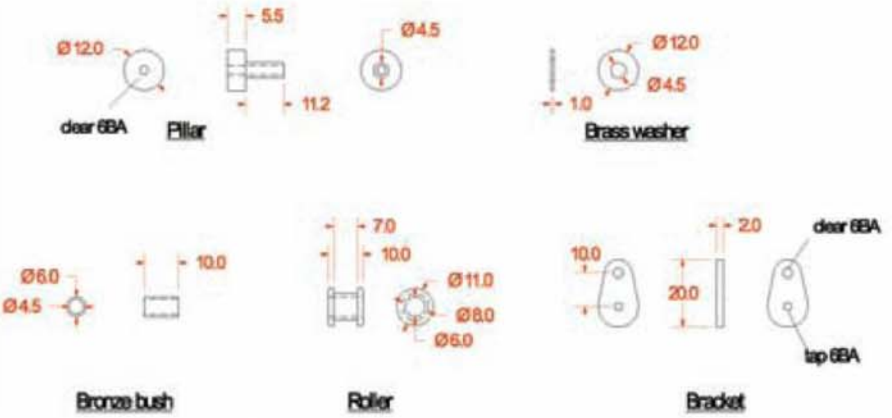
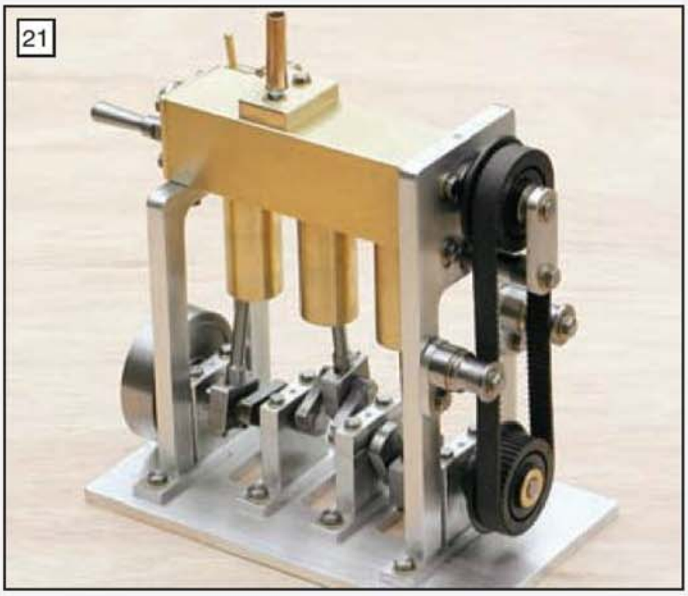


Fig 24 The belt guide parts for the three-cylinder reversible engine.

One way to address this problem is to modify the inlet timing so that the high-pressure gas is not let into the cylinder until a few degrees after top dead centre. It is not a cure of course but this approach also makes it easier to set up the engines that are designed to be reversible. Overall, the inlet duration is reduced to less than 100% but I do not count the difference as 'cut-off' because the saving in input gas or steam is really quite low.



The Step 3b engine, presented to show the timing belt supported by two tensioner pulleys.

The shaft holes being drilled in the webs while they are still mounted on the bar of material.

Keeping the belt in place

The previous engines had been uni-directional and this meant that the application of a belt tensioner/guide was quite straightforward. The ideal place for a tensioner is on the feed side of the belt. Motor car engines always have the tensioner on this side and, of course, they only turn in one direction. If the tensioner is placed on the pulling side of the belt the pulling force will load it. This will result in extra wear.

With a reversing engine the situation changes. The feed side of the belt goes from one side of the engine to the other. One approach to the positioning problem would be to make a tensioner that automatically changes sides when the engine changes direction. I did not have a simple solution to this. I had at one time thought about not having any tensioners at all but the belt run-off characteristic put an end to that idea so I decided to work with two tensioners. Since I knew what the centre-to-centre distance should be for ideal tension I only needed the tensioners to keep the belt nicely centred on the pulleys. Only a small deflection of the belt was necessary. This resulted in very little tension increase. I thought that the load on the engine would be acceptable and so far this seems to be true. It would probably be more accurate to call these devices belt guides.

In the original Step 3 engine, the belt run-off situation without the guides was more pronounced than with the previous engines. I concluded that this was due to the longer valve rotor presenting a higher load to the belt and consequently the belt pulled a bit more on the valve drive shaft. This resulted in a slight downward movement of the valve drive shaft and a slight out-of-parallel situation with respect to the crankshaft.

I decided to re-build this engine to incorporate an outboard bearing for the valve drive shaft and incidentally to install a no cut-off valve rotor. Having an outboard bearing meant that the inner retainer flange on the drive shaft was no longer required. I had abandoned this retaining flange already in the first Step 3 engine where I fitted an external retaining clip but this bearing avoided the need for that as well. The drive shaft bearing did not need to be so long so I reduced the front frame thickness. This engine I called Step 3b and it is shown in **photo 21**.

The fourth web being faced on one side prior to parting off.

This engine is a very smooth runner. It has an excellent speed range. It can turn slowly and evenly and its top speed is only limited by my air supply system. It will reverse instantly at any speed except very slow when it may need extra air to re-start. The engine direction can be cycled continuously without problems.

Notes on building this engine

I have included the drawings of the Step 3b engine components in **fig 16** to **24** and some photos showing the important parts. Some parts have to be made three times so it is worth tackling these parts in batches and organising the machining so that a minimum of set up changes is required. The belt and pulleys have the same part numbers as in Steps 1 and 2.

The crankshaft

I fabricated the crankshaft. It is very important for alignment reasons to have all the webs with the same basic dimensions. With previous engines I have found that it is a good idea to make the webs as a batch on a single piece of round bar. **Photograph 22** shows the webs defined on a length of round bar and the holes are being drilled for the main shaft and the cranks. **Photograph 23** shows the webs in process of being faced on one side and separated one by one.

●*To be continued.*

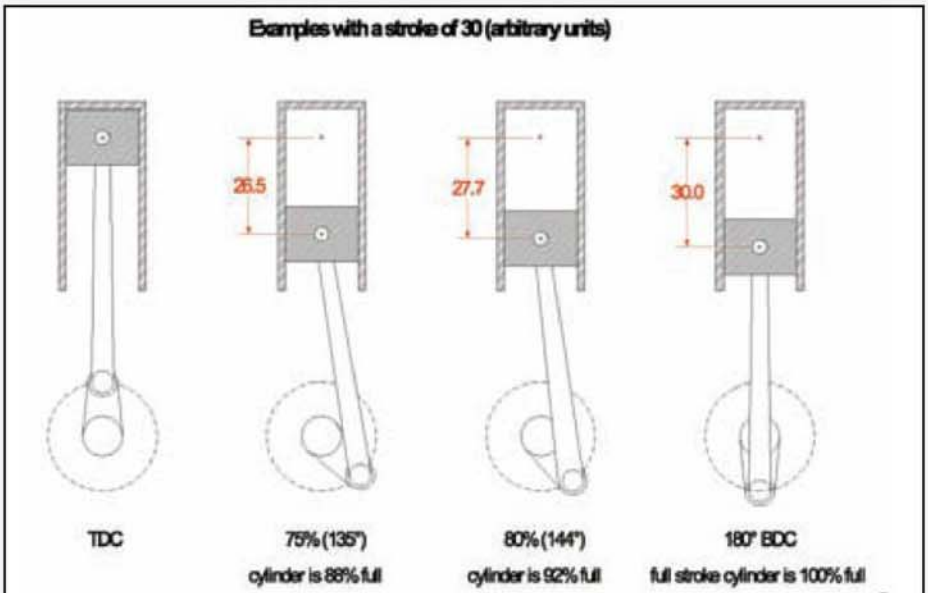
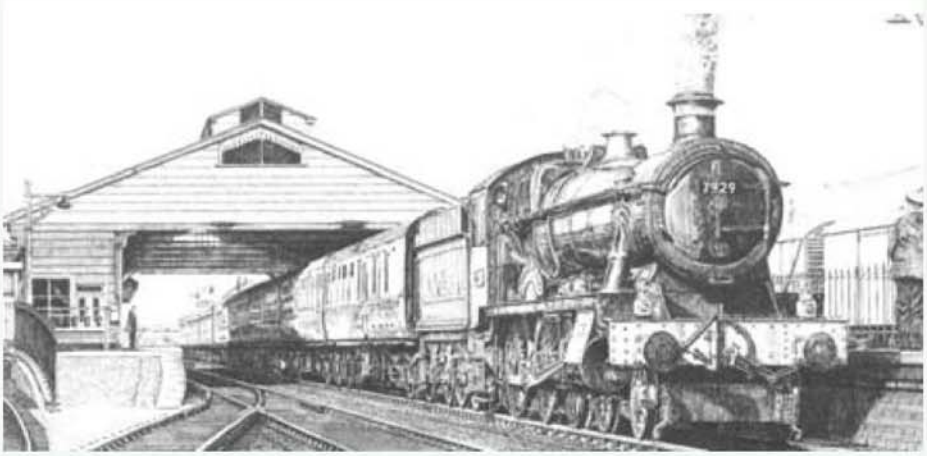


Fig 25 Increasing the cut-off value does not achieve much! ©

Neville Evans
picks up the story of the Modified Hall 7929 *Wyke Hall* and, in particular, describes the bogie arrangements.

●*Part II continued from page 749 (M.E. 4276, 23 June 2006)*



WYKE HALL

I was talking to Pete Thomas the other day and he mentioned that quite a few people who were building the 'Modified Hall' had expressed a little concern as to when the next instalment was forthcoming. The answer is right now. I have been doing some work on both *Wyke Hall* and *County of Glamorgan*, (which sounds a bit better than 'County of Neath and Port Talbot' as we would call it today) and think that the bogie in particular, which is one of the few parts of these locomotives that at least looks different to the older ones, should be described in detail before we go any further. I have taken the opportunity to draw the 6ft. 3in. wheel that is used by the 'County' at the same time, so that builders of both locomotives will be happy.

The frames and running gear, in general, are more or less common to both engines. There are however slight exceptions to this rule in that the platforms are different, the valances or hanging plates as the GWR was wont to call them, are much deeper on the 'Mod Halls', and the frames have to be modified very slightly to accommodate the extra one and a half inches or so in height of the centre of the larger wheel. And of course we have the spectacle of that long ungainly splasher. I should point out that this is purely a personal view, as some friends of mine prefer them (not very close friends of course).

A further point is that we have slightly over-stretched ourselves on the 'Schools' in that we are a bit behind on the pattern making and castings front. Not Pete's fault, more a question of the undoubted popularity of these designs. Ta-ra on the trumpet. Incidentally I am rather amused by the comments of some of the letter writers. If it were possible to obtain cheap, clean castings, in a reasonable time scale, do you honestly think that we would be happy with the service that we are sometimes faced with. Please don't think for a second that the trade as a whole aren't trying to do something about it. I mentioned this very point to Reeves about 25 years ago, when they were under the previous management. I suggested that, as they had plenty of room in their Marston Green establishment, they considered starting a small forge in the corner, where the stores was, to cater to their needs and possibly those of the rest of the trade, I was pooh-poohed at the time, I bet they wished that they had listened, it would have saved them a lot of problems later on.

Plate frame bogie

I have, in the last six months or so, talked at length about the development of the bogie, and the rudiments of good bogie design, so I'm sure that I needn't risk boring the pants off people by going over it all again. Suffice it to say then that this offering from the GWR is rather different from those of the Southern and North Eastern, in that no castings have been used either in large or small versions. A slight advantage is that the 'County' uses an identical bogie, which saves me a lot of work, if nobody else.

An important point which I must mention immediately, is that the bogie is set forward from the centre line of the cylinders by 1in. full size and 0.089in. at our scale. I had thought of including this in the bogie centre, but in the end I've moved the pivot point in the bogie stretcher instead. That way you can't put the bogie on back to front (Murphy's law). Just be careful to put the stretcher in the right way round (Evans' law). One further thought is that this bogie, unlike the rest of the Churchward and Collet 2 cylinder 4.6.0s, is unequalised. This means that we need slightly softer springing, otherwise the bogie will rock about the central pads. As luck would have it, with the new set up, we have both coil and plate springs so we can set them any way we please.

The bogie centre is built up from $^1/_8$in. bright mild steel strip and plate and, compared to the 'Schools', the side springing is pretty rudimentary and probably none the worse for that. Another difference is that the new bogie has plate springs which, as it happens, use two coil damping springs per unit. This is ideal for our purpose, as we can use a prototypical set up, which will give us good spring characteristics. As a matter of fact, I have just finished some plate springs for the 'Jeannie Deans' bogie. They were made exactly as I have described many times, brought up to red heat and quenched in water. The 'Royal Scot' bogie has quite a short wheelbase and so the springs themselves are not really very long, despite this I found that when loaded with a 40lb weight they flexed in a most satisfactory manner, and as they have some measure of compensation I think that they will do the required job in the approved way.

The plate side frames and front horncheeks are quite orthodox. Only in the rear cross member and axlebox guides do we depart slightly from normal practice. It is all pretty straightforward however and should prove pretty obvious from the artwork. I need hardly add that all the cut out bits are available as laser cut items from Practical Scale.

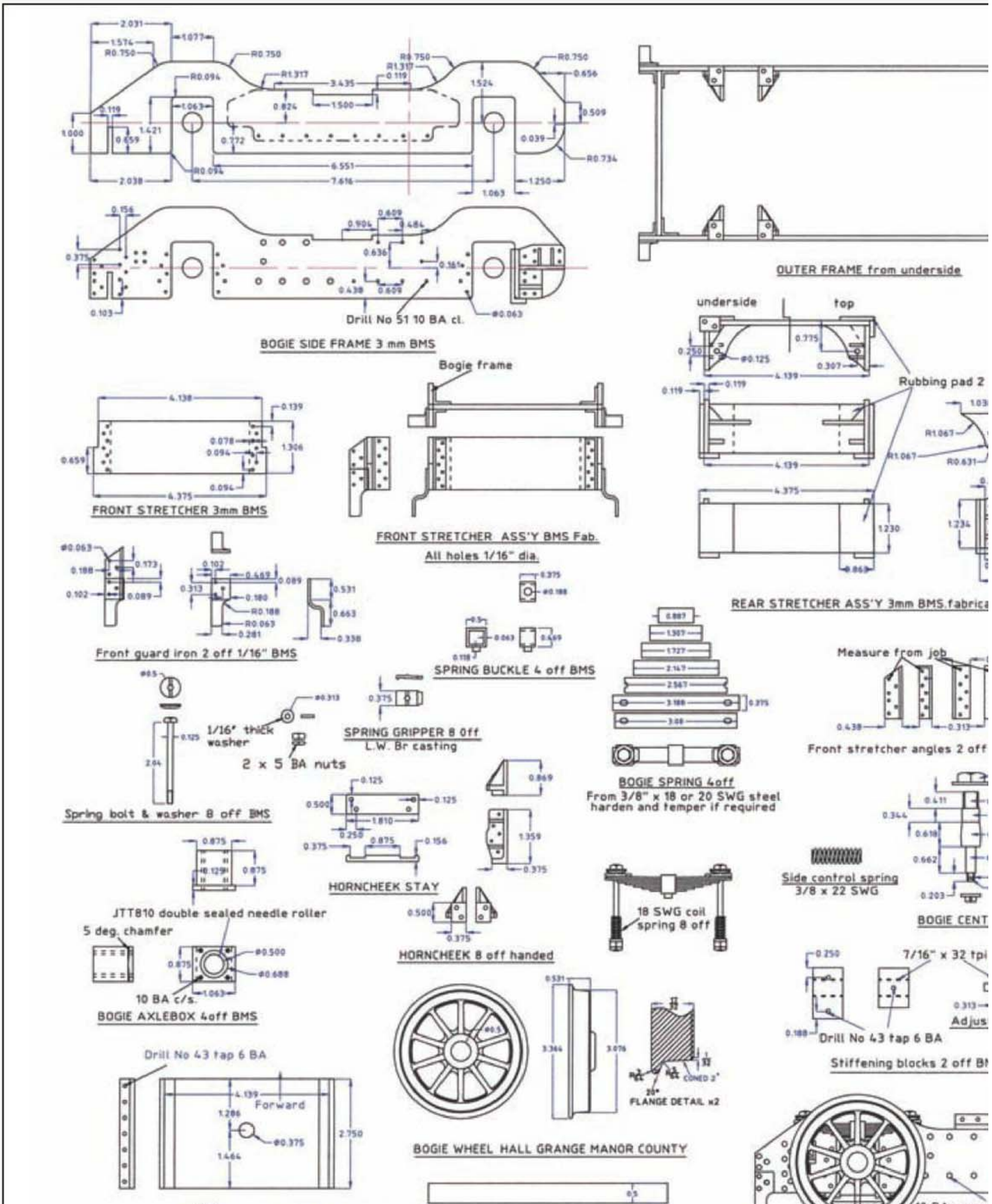
The centre is also built up from plate, as a separate unit to which are bolted and screwed the side frames and stretchers. If anyone thinks that the profusion of small diameter bolts is not adequate for the purpose of holding on the side frames, then they can be augmented with a few 5BA countersunk screws into the central steel blocks. Be sure to flush off the countersunk heads of these screws or, failing that, to fill the screwdriver slots with one of the proprietary fillers.

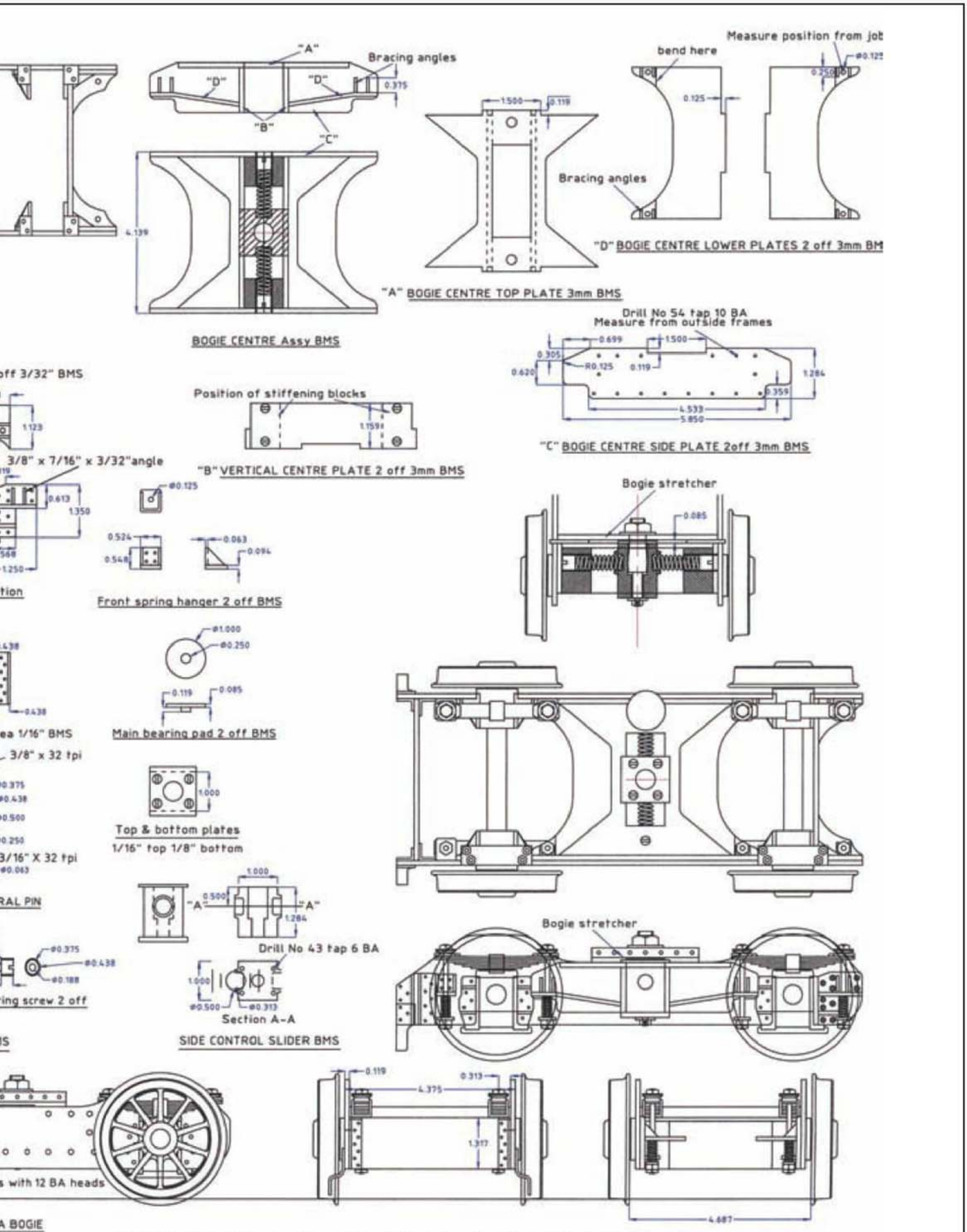
I can't foresee any snags and with the slotted up method of assembly; it shouldn't tax anyone too much, (Pete calls it a jigsaw, without I hope the puzzle). The two mild steel blocks that form the outer receptacles for the side springs add a lot of rigidity, and the top and centre cross members are screwed onto them as is the top member, with the side members helping to form a box structure. The two sloping bottom members and the top member are then silver soldered into the side frames of the centre assembly to form a braced unit.

Jeannie Deans

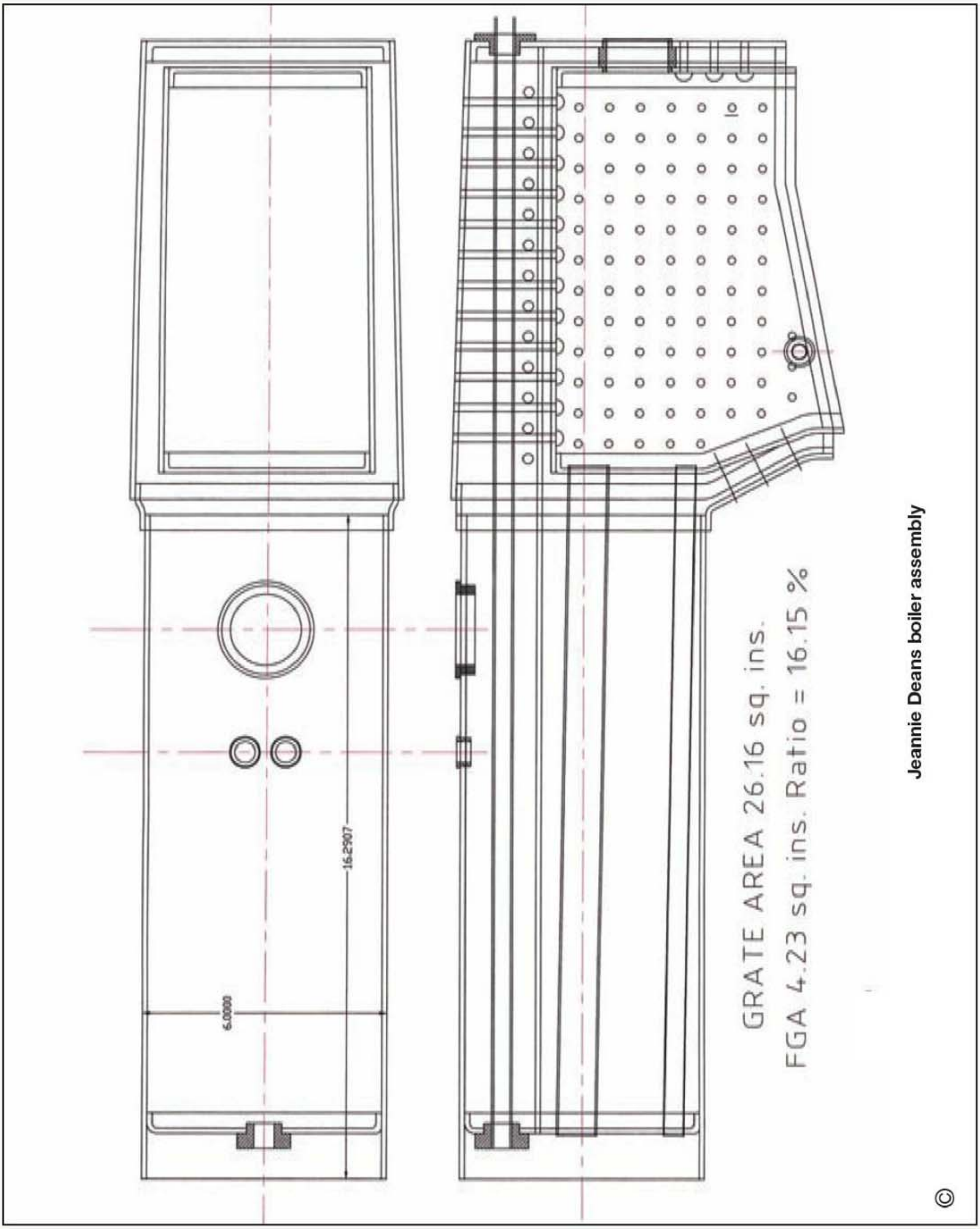
As promised, I'm keeping you up to date on my 'Magnum 'opeless' the 3 cylinder compound based on the projected LMS compound 'Scot', which was replaced by the ill considered 'Fury' project, with which I am sure everyone is familiar. The new locomotive would have been based, as was the 'Midland Compound', on the work of M. Sauvage in France and Switzerland, and that of Walter M. Smith of the North Eastern. The basics are that I am using a high pressure cylinder bore of 1.375in. together with two low pressure bores of 1.50in., this gives a ratio of 2.38:1 which is almost exactly what I require.

Received wisdom says that the lower the boiler pressure of a compound, the smaller should be the ratio of low to high pressure cylinders. Whether this is true or not I can't say, but my logic tells me that if the low pressure engine is working at a lower pressure, then it needs larger not smaller cylinders. My resolve was strengthened by Deryck Goodall who used to look after some Bellis & Morecome compounds that, as with most of the products of this illustrious firm, worked with great efficiency and power on pressures of about 125psi, which is exactly what I have in mind. Mr. Carl Keiller who produced excellent model compounds, used these ratios with a boiler that he designed for 150psi but worked at about 130psi because it developed too much power. Simon Bowditch and I have been discussing valve gear and boiler proportions for the last year or so, and I'm hoping, if not for great things, at least a huge amount of interesting experimentation in the near future.


BOGIE SIDE FRAME 3 mm BMS
Drill No 51 10 BA cl.
OUTER FRAME from underside
underside
top
Rubbing pad 2
REAR STRETCHER ASS'Y 3mm BMS.fabrica
FRONT STRETCHER 3mm BMS
Bogie frame
FRONT STRETCHER ASS'Y BMS Fab.
All holes 1/16" dia.
Front guard iron 2 off 1/16" BMS
SPRING BUCKLE 4 off BMS
Measure from job
Front stretcher angles 2 off
1/16" thick washer
2 x 5 BA nuts
SPRING GRIPPER 8 Off
L.W. Br casting
Spring bolt & washer 8 off BMS
BOGIE SPRING 4off
From 3/8" x 18 or 20 SWG steel
harden and temper if required
HORNCHEEK STAY
Side control spring
3/8 x 22 SWG
BOGIE CENT
JTT810 double sealed needle roller
5 deg. chamfer
10 BA c/s.
BOGIE AXLEBOX 4off BMS
18 SWG coil
spring 8 off
HORNCHEEK 8 off handed
7/16" x 32 tpi
Drill No 43 tap 6 BA
Adjus
Stiffening blocks 2 off BM
FLANGE DETAIL x2
Drill No 43 tap 6 BA
Forward
BOGIE WHEEL HALL GRANGE MANOR COUNTY
10 BA screw
BOGIE AXLE 2off Sil. St.
Set wheels 4.685" back to back
BOGIE
STRETCHER
©



BOGIE MODIFED HALL & COUNTY



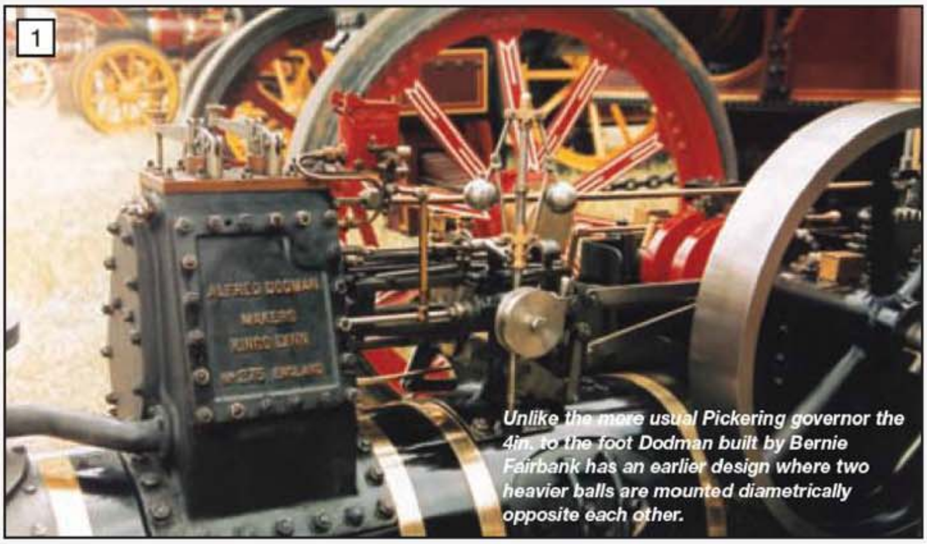
Jeannie Deans boiler assembly

I enclose a few sketches of the boiler, the order for which I shall be shortly placing with Paul Tompkin, a young friend of mine who makes a lovely boiler down Farnborough way. It will not have escaped the notice of the more observant of our readers, that apart from the parallel barrel, the boiler is very like the LMS type apparatus that was used on the 'Counties' which of course made use of Stanier 8F flanging plates. This is jolly handy as our own 'County' will sport a very similar boiler, tried and tested on Colin Burrows' locomotive. Incidentally, I am using two steam pumps one on each side of the smokebox, *a la* 'Fury', and hope that the right hand one with a big steam piston and a small ram will work from receiver pressure, if not actually from exhaust pressure. Deryck and I have been trying out a small proprietary pump and are very impressed with its capabilities in the field of water shifting into high pressures.

●*To be continued.*

ROAD STEAM

Martin Wallis
invites you to join him for his annual tour of the steam rally scene.



Unlike the more usual Pickering governor the 4in. to the foot Dodman built by Bernie Fairbank has an earlier design where two heavier balls are mounted diametrically opposite each other.

OUT AND ABOUT 2006

This year was an excellent year for steam rally enthusiasts, although it is probably fair to say the weather was rather mixed. There was certainly no shortage of interesting models to pick from for these notes. This year I also have almost as many pictures of unusual full size engines, which made choosing the selection for this article even more problematical. I am rather hoping our editor might allow a photo or two to spill over in next month's *Road Steam (we will see what we can do - Ed.)*.

The year began very pleasantly with the Burrell Museum models gathering followed by the Hollowell Rally. Unlike most events the Hollowell organisers lay the show out differently each year, which can be dis-orientating, but does give the exhibitors plenty of variety. Amongst the models at Hollowell was Bernie Fairbank's 4in. to the foot Dodman (**photo 1**), a fine model which was built in just 14 months. The engine is a single crank compound design, not too unlike that used by Burrell.

Also at Hollowell was Aveling DCC registration number D2608, a full size engine I had not seen for many years (**photo 2**). The engine is a type XAC and is rated at 4nhp. The compound motion has slide valves, which in your author's opinion is a much prettier cylinder casting than their later piston valve designs. The engine is called *Dougal*, weighs 5 tons and was built in 1906. It is fitted with Aveling cast wheels together with a rain guard over the motion and a rather different, possibly unique, 'windscreen' affair with two round glass windows.

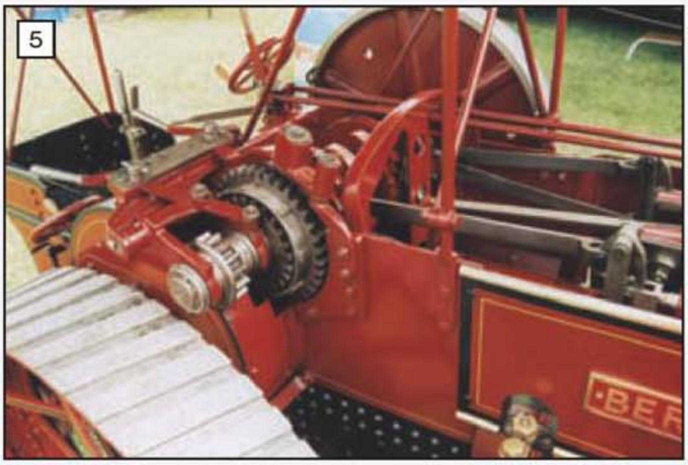
Half size Burrell Gold Medal tractor

The ever popular Whissendine model rally in June usually manages to turn up at least one fresh model and this year was no exception. The engine was a beautifully constructed half size Burrell

A beautifully built half size Burrell Gold Medal tractor, built in just 2 years by David Bennion.

Aveling and Porter tractor No 6021 of 1906. The wheel design is that adopted by Maxitrack on their model Aveling.

Detail of the motion on the half size Burrell Gold Medal tractor. It ran as well as it looked.



The Burrell three speed gearing. Note the middle speed gear slides inside the fast speed gear.

This 1:3 scale Sentinel seen at Bressingham is a very powerful and speedy engine. The full size was designed for timber cartage.

The powerful winch fitted to the rear of the Sentinel. It is sign written W.E. Cuttem, Union Saw Mills, Axminster on Sea.

One of the Modelworks 4in. to the foot Burrell traction engines now making an appearance on the rally scene.

Gold Medal tractor, built over a two year period by David Bennion. David used the ever-popular 2in. to the foot scale MJ Engineering drawings together with further details taken from full size engines and numerous works drawings to supplement the already comprehensive detailing from MJ. The result was quite stunning. Certainly worth pausing for a description.

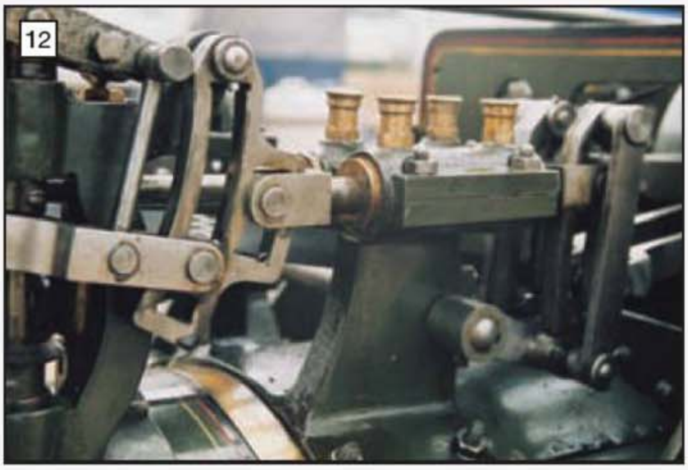
David made all his own patterns. In the vast majority of cases these are not only of the correct diameters (as one would expect) but are also of the correct cross section (usually made a little over scale to add rigidity). The result is that items such as the gear spiders, or gear centres, look exactly right and are not over engineered as tends to be routine in published designs. Likewise boiler plate and tender plate thicknesses are much thinner than are normal on models. The net result is an engine that looks superb and is not too far from scale weight. The prototype is allegedly 5 tons, so a 6in. to the foot model ought to be 1/8th of that weight or 12.5 hundredweight. In reality the model is 15cwt, which is quite an achievement bearing in mind that my own 6in. to the foot Fowler is twice the weight it ought to be - not far short of 3 tons where the scale weight ought to be about 1.5 tons, and a 4in. to the foot Foster (a much smaller model) David reckons to be about 9 hundredweight.

The attention to detail does not stop there, the final drive gears have been cut with extra deep gear teeth, machined with a special hob designed for the purpose. The suspension is fully working as per the prototype; the suspension movement on the full size is 3/8in. so on the model it is 3/16 inch. It does not sound a great deal but I am advised it

The 2006 GDSF models' section hosted a meeting of all five half size replicas of the 1904 Burrell Devonshire design to mark the 30th anniversary of South Dorset Engineering.

Paul Wills spent six years rebuilding his half size Devonshire engine to 'Royal Show' condition.

A fine 4in. to the foot scale Wallis and Steevens expansion engine built by Graham Hunt.



Detail of the unusual Wallis and Steevens expansion gear fitted to Graham Hunts model.

A fine Clayton roller hard at work road making at the 2006 Great Dorset Steam Fair.

This Ruston and Hornsby direct ploughing engine is a powerful monster of an engine.

certainly softens the ride. Rubber tyres are not fitted. The model works at 180psi and is named *Bert* after David's dad.

Bressingham

The Bressingham model rally was sadly not blessed with fine weather, particularly on the Saturday night which was both wet and windy. This was a shame as there was an excellent selection of models to see. Considerable credit must go to the organiser, Norman Atkin, for making the exhibitors feel so welcome. The train rides for exhibitors' families and the fish and chip van on the Saturday evening all added to the atmosphere. There is always plenty to do at Bressingham, in addition to the road steam there are numerous full size railway engines and a very comprehensive garden centre.

Cheque book engineering

The model rally community has been awaiting the arrivals of the Modelworks 4in. to the foot Burrells for some time now. The batch of 84 kits were sold quite quickly, and I understand a new batch of a further 50 kits is being considered for January/ February 2007. This year the first few have emerged into the daylight and matches struck. There is no doubt that it is a fine engine, an example winning the 'best model in show' at the Thurlow rally in Cambridgeshire.

I have now chatted to three Modelworks model owners, all delighted with their models, and while just three builders cannot constitute a meaningful survey, they all said the same things so I feel I can pass on their wisdom in these pages.

The quality of the parts was perceived to be very good, and the help line service was excellent. If anything was not as expected it was replaced immediately without fuss or quibbling. However, the notion of 'all you need is a spanner' was considered to be optimistic, potential builders should remember Modelworks' literature ▶

The width of the Ruston and Hornsby was quite staggering. Anybody fancy buying a full size engine?

This 5in. to the foot scale chain drive Foster rope haulage engine was built by Brian Baker.

An overhead view of the unusual Foster rope haulage engine.

The Wilder ploughing engine is believed to be unique. Just why this old fashioned design was built is not fully understood.

suggesting 'hand tools only'. The 'best in show' model had had all the parts carefully draw filed and polished to remove the machining marks and a few fittings, for example the oilers, were replaced with more prototypical ones from other commercial sources.

All three builders underestimated the amount of time required to assemble and paint their models; in consequence high praise was readily given to those individuals who manufacture the components themselves before even starting on the assembling and painting! All three builders found a friend with steam experience to attend their first steaming and were grateful for their presence. Minor teething problems occurred, the odd leak of steam, but no more than on any other freshly built model.

Cheque book engineering? Well why not. We have a wonderful hobby and there is room enough for us all. Modelworks presently have a $4^1/2$in. to the foot scale Foden wagon in production, a report on these models perhaps next year.

30th anniversary celebrated at Dorset

The star turn of the 2006 GDSF (Great Dorset Steam Fair) models' section was a reunion of all five half size models marking the 30th anniversary of South Dorset Engineering Company's venture into model road steam. The models are 'true scale' representations of the 1904 Burrell Devonshire. For the chimney counters **(photo 9)** there were actually six engines present, as the designer Chris Lord built a further engine in 1997.

Back in the seventies it was hoped that a batch of large models would prove be an appropriate engineering venture for South Dorset Engineering; at the time there were very few half sized models around, and even fewer with the high standard of construction that they had in mind. Every care was taken in making the replicas faithful to prototype but, unfortunately, the costs involved in producing such true scale models made them rather more expensive than prospective purchasers would fund.

Sadly the project was abandoned. Of the five engines started by South Dorset Engineering only one was completed by them, being first steamed in July 1978, the other models were sold on and the remaining machining and assembly undertaken in private ownership.

One of the Devonshires was outstanding, probably the best finished half size model your author has ever seen. The model was completed by John Foreshaw who rallied it in East Anglia for many years before selling it to William Lobb of Sticker near St. Austell, Cornwall. On the passing of Mr. Lobb the model was purchased by Paul and Anne Wills of the same county. Paul subsequently spent six years rebuilding and repainting the engine.

Wallis and Steevens

Two further engines are worth a mention, the first a superb 4in. to the foot scale Wallis and Steevens Expansion engine built by Graham Hunt, the build taking $2^1/2$ years and included all the pattern making (**photos 11** and **12**). The engine is modelled on Wallis and Steevens No. 7248. Graham's completion of the model coincided with the restoration of *Pedler* by Ricky Kenway, the engine having laid in the open for some 20 years prior to purchase by Ricky. Number 7248 was originally built for export for direct ploughing and had extra wide rear wheels and an additional strengthened towing gear on the tender. The engine was never exported and was sold on the UK market after having standard rear wheels fitted. Unusually for a Wallis it was painted black from new. Graham's model is also called *Pedler* and also has the additional towing gear on the tender

The front view of the Wilder single cylinder ploughing engine.

Wallis and Steevens are well known for their 'expansion engines' where two slide valves, one on top of the other, work against the ports. On a normal engine as the motion is 'notched up' the stroke of the slide valve is decreased, thus limiting the period the ports are open to steam and so allowing for greater expansion. Unfortunately the decreased stroke does nothing for the exhaust arrangements. The Wallis arrangement allows the exhaust arrangements to remain unchanged, while the governor 'notches up' the steam admission. Two sets of Stephenson's valve gear are provided, one for the exhaust and one the admission.

The second engine worthy of comment was a beautiful 4in. to the foot scale Clayton & Shuttleworth roller, making its first appearance at the GDSF. Each day the engine was manfully employed on road making duties. The model was completed by Sam Scutter and daughter.

Ruston and Hornsby direct ploughing engine

I have included Ruston and Hornsby Class SCLA No. 128138 simply on grounds of its size (**photos 14** and **15**). It is enormous. The engine left Lincoln on 30th August 1925 bound for Buenos Aires dealer Agar, Cross & Cia Company Ltd who were Ruston's sole agents in Argentina. The engine was designed for direct ploughing, hence the great width of the rear wheels, the engine in all being 10 foot 6 inches wide. The total weight is 15 tons. There is only one other engine of this class known which is in preservation in Argentina. It was returned to the UK by Michael List-Brain of Preston's Services of Kent in 2002 and sold to the present owner in 2003.

Fowler A8 No. 12754 built in 1928. Note the two brackets on the side of the smokebox, which may have carried the actuation mechanism for the elevation gear.

A mystery. Just why would the Fowler have a lifting front end?

Foster chain drive engine

This beautifully presented 5in. to the foot scale, chain drive Foster rope haulage engine was built by Brian Baker over an eight-year period to Pete Filby's drawings (**photos 16** and **17**). The model was awarded a Very Highly Commended Certificate at the Model Engineer Exhibition in 2004.

The full size engine was, I understand, described as a 'self moving portable'. Like a portable the cylinder is over the firebox and the crankshaft is supported in brackets attached to the boiler barrel.

The drive to the wheels is via a single chain and no differential is fitted, the drive being normally to one wheel only. By inserting a second drive pin both wheels may be driven if preferred, on the model both pins are only needed if the ground is very wet.

The model weighs $18^{3}/4$cwt and the boiler capacity is 57 litres (completely filled) which at a working pressure of 100psi I understand falls within the bar/litre maximum that enables the boiler testing to be undertaken by a model engineering club. The boiler was built by Terry Statham (TRS engineering).

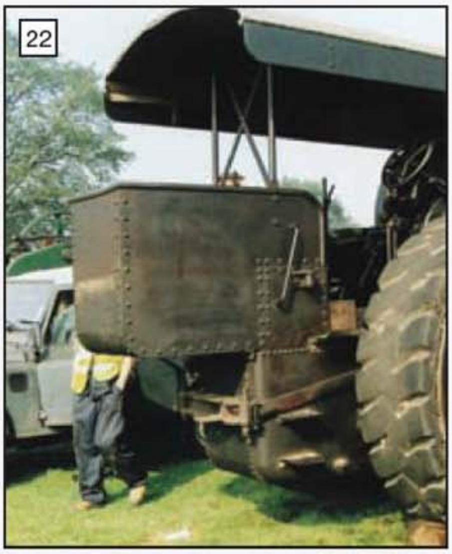
The model is presently fitted with two injectors but Brian is in the process of designing and fitting a mechanical boiler feed pump mounted on the barrel under the crankshaft. A slight disadvantage is that if the motion stops on dead centre it is quite a stretch to reach forward to nudge the flywheel. The outer wrapper is a dummy plate with the correct rivet pattern on it. Brian has added Stephenson's link reversing gear which makes the model a whole lot easier to manage, the original was non reversing,

The full size engine was believed to have been used for hauling timber out of forests, but just how successful it was is unknown and no examples have survived.

Wilder ploughing engine

One of the last events of the year was the Old Warden Rally in Bedfordshire. Of great interest was the Wilder ploughing engine, a truly fascinating machine. By 1926, the year Wilder manufactured the engine; single cylinder ploughing engines had been long replaced by larger and much more powerful compound versions. However Wilders, using the parts of at least three Fowler single cylinder ploughing engines of 1868/1869 vintage, decided to build a new single cylinder ploughing engine, completing it in 1927 (**photos 18** and **19**). Existing Fowler single cylinder engine parts were extensively used, two of the three donor engines having already been considered obsolete and withdrawn from use, presumably in the process of being scrapped. Sadly the third donor engine had blown up killing the driver. The engine that blew up was either 1054, 1109 or 1281 of 1868/1869. The driver was Walter Henry Woodward and the accident happened on Wargrave Hill when the rivetted seam between the firebox backhead and wrapper failed.

Reclaimed parts included the wheels, the flywheel, some of the gears, and the winding drum; the balance of the rest, including the boiler and piston valve cylinder, were to their own designs although a few new parts were ordered from Fowlers. The Wilder engine was given registration number BL 4150 and a works number 001.



Fowler fitted an oversized bunker - routine on colonial engines.

The owner, James Hodgson, explained that, even with the piston valve cylinder, that the engine was certainly 'old' technology when new. It is believed that the reason Wilders built the engine was due to the great rivalry between themselves and the Oxford Steam Plough Co, later known as Allens of Oxford, who had been building their own engines based on Fowler designs. It is also said that representatives of Oxford Steam Ploughing Company stopped the engine on the road to examine it as they thought that Wilders had copied their design of piston valve. In fact the designs were quite different as the Oxford Plough Co. representative confirmed. The engine worked from 1927 until 1933, a very short working life. Wilders did build a second engine but it was never completed and was included in their closing down sale.

Mystery extra

I should like to conclude this year's *Out and About* with a mysterious 'extra' fitted to Fowler A8 No. 12754 (**photos 20, 21** and **22**). The engine was imported from Australia in 2001 and, apart from the generous bunker extension, looks to be a fairly routine colonial engine. However, closer inspection reveals an arrangement where, hydraulically, the front of the engine may be lifted 12in. or more. Figure 22 shows the hydraulic cylinder and the two flanges for the associated pipe work. Since there is no evidence for the boiler feed pump being adapted or plumbed for delivering the required water pressure it is believed some sort of pump may have been fitted on the side of the smokebox; two substantial brackets for such a potential device are fitted.

The reason for the lifting smokebox is unknown. Perhaps it was to keep water over the firebox when going down hills, or maybe it was to help it steam on inferior fuels. An answer was thought to have been found as the Fowler drawings were located in Reading but the sheet title was "*Elevating gear for Class A*", which shed no light as to the purpose of the assembly. If any reader has the answer the engine owner would like to know.

The set of spares supplied with each clock even included lamps and lubricating oil.

HIPP CLOCK DEVELOPMENTS

Frank Taylor

continues the story of how he modified the traditional Hipp clock design to provide two worthy presents for each of his sons.

●*Part II continued from page 557 (M.E. 4286, 10 November 2006)*

The contents of the spares draw are laid out in **photo 9**. On the top row are four spare lamps. Second row is a small container of polish for the case; the little book; oiling sticks and a bottle of synthetic oil which I hope will never go gummy. Third row is a plastic packet of 0.2 Amp panel fuses; the pendulum clamp; plastic packet of mains plug fuses. Lastly, at the bottom is a plastic packet of spare pendulum suspension springs.

Pendulum clamp detail

The dimensions of my clamp are shown in **fig.2** but there is scope for wild variation in this item, to suit materials available. The clamp screws go into tapped metal inserts in the backboard.

Investigation into the trigger/ trigger blade malfunction

The clocks had been completed to the point where both pendulums were running on a large backboard (pendulums do not need the clock mechanism to run). Within a couple of days running it was evident that both clocks had the problem described in the introduction. For the benefit of readers who are not familiar with this type of clock it is proposed to describe the normal action followed by the malfunction. **Figure 3** shows the parts of the clock that we are concerned with.

In normal operation the pendulum trigger support block and trigger blade swing back and forth over the notched blade. With sufficient swing in the leftward direction the trigger blade goes right over the top of the blade and swings clear. As the pendulum swing slowly gets less the trigger blade is arrested by the highest point of the notched blade and when the pendulum moves to the right the blade descends the notch operating the contacts as it passes to the right. The contacts operate the electromagnets, which increases the pendulum swing. The malfunction can now be described.

When the pendulum moves to the left and the trigger blade is arrested it digs in to the tip or left hand slope of the notch in the blade and does not descend to the bottom of the notch. On the rightward swing there is excessive downward movement of the contacts and prolonged energising of the magnets. This produces an annoying scraping sound at the very least and, in extreme cases, it can stop the clock.

I could see that over a long period of time there would be cumulative damage to the trigger blade and notched blade which would result in failure of the parts. It was decided that if the problem could not be solved I would not proceed with the project

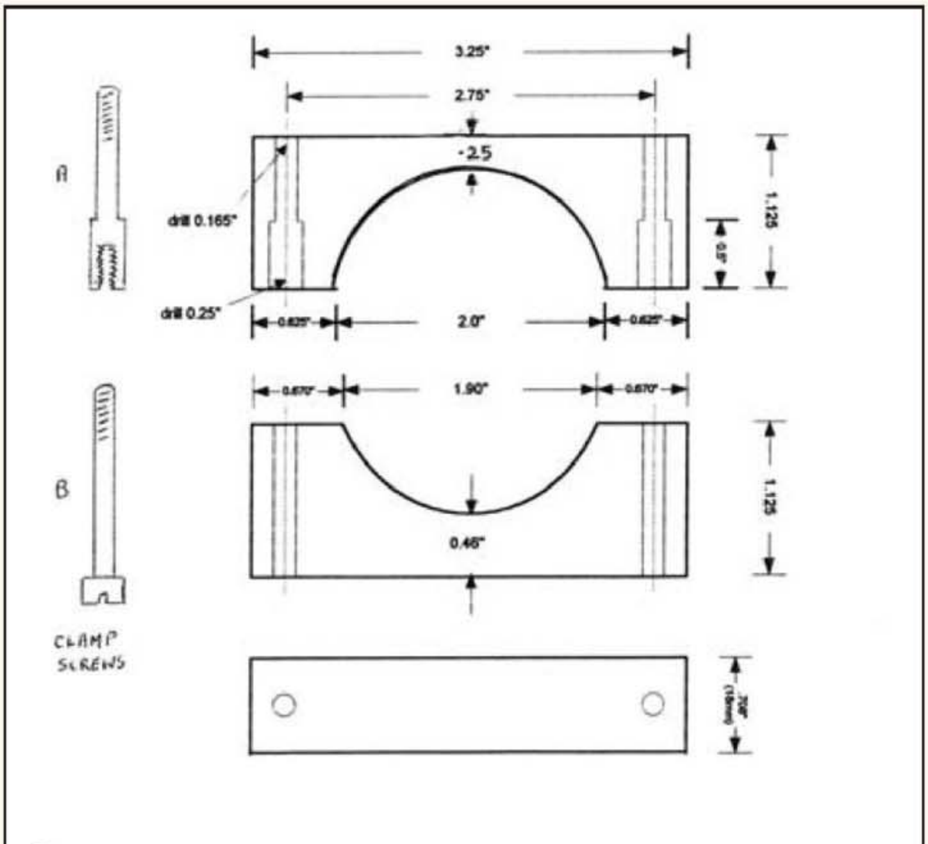


Fig. 2

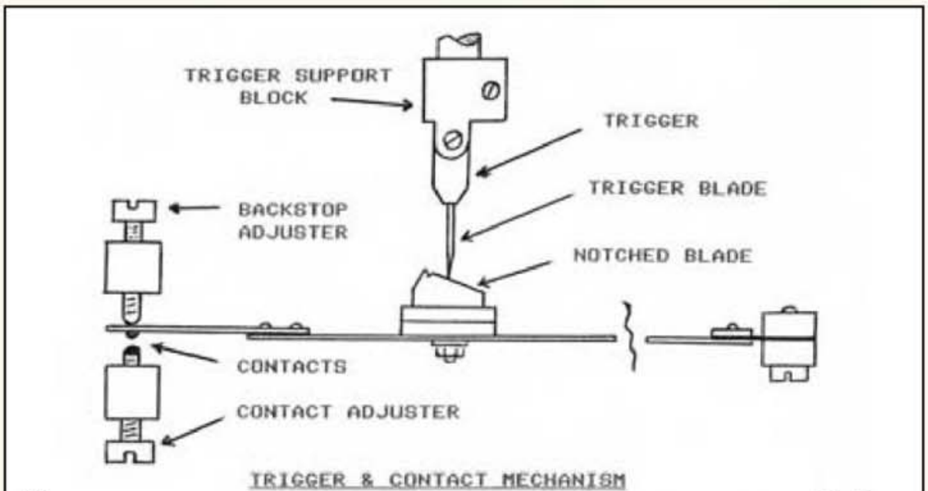
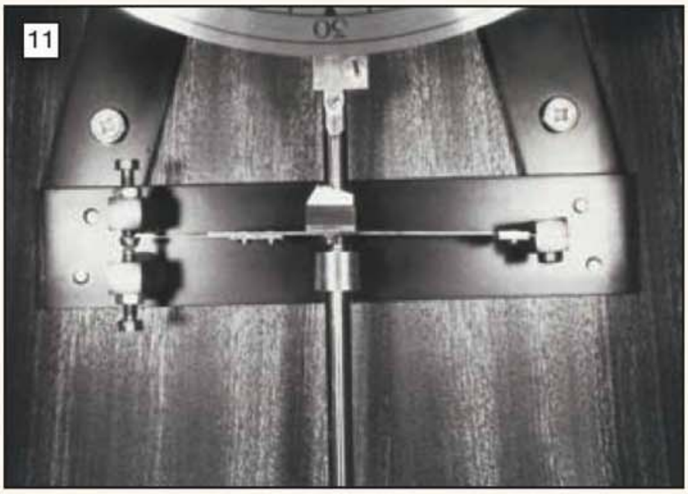


Fig. 3

The listening device used by the author to help in fine tuning the performance of the clocks.



The experimental blades were accurately placed in a slot for testing in each of the clocks.

Investigation

I have a listening device (**photo 10**) which was made many years ago. The device picks up sound by conduction to which it is very sensitive and it does not respond to airborne sound.

Essentially it consists of an electret microphone mounted inside a 1/4in. thick steel container. The microphone plugs into an amplifier with speaker or headphone facilities. The microphone was clamped to the backboard and the shocking sounds of the malfunction could be heard. Although the sound was of short duration it was plain that this was the squeals of a mechanism in sore distress and, to an engineer, it was painful listening to it. Simply then all we had to do was to find the source of this horrible sound. The first thing needed was means of seeing clearly what was going on.

A spot light was fixed to shine on the offending parts together with x12 watchmaker's eyeglass fixed at its correct focal length. A piece of string was attached to the lower part of the pendulum and the other end tied to a T-nut in the table of my milling machine. This enabled micro movements of the pendulum to be made by turning the table handle. Finally a chair was fixed to the bench so that when I sat on it my eye was level with the eyeglass (I do enjoy comfort).

A glimpse in the glass revealed the bottom of the notch was slightly rounded. By turning the milling machine handle I was able to get a trigger arrest and a decent of the notch in very slow motion stopping at any point I fancied. This revealed the source of the terrible sound. The sharp point of the trigger blade scraped and tried to dig into the left hand side of the notch and, in very slow motion, descended in a series of jerks. When it got to the bottom of the notch it scraped its way around the rounded bottom before finally moving off to the right. All that needed doing was to arrange things so that this did not happen.

Figure 4 represents an enlarged notch showing the original angles together with a trigger blade at the moment of arrest. It is quite clear from this that the blade will scrape down the left hand slope of the notch as it moves to the right. it will do this if the blade is anywhere in area 'B' which is on the right hand side of the dotted line.

If the trigger could be arrested when it is in area 'A' then the scraping would not occur. I think that the drawing shows that the angles of this notch are unsuitable to achieve this. It now became a search for the best angles.

Finding the best angles

Many enlarged drawings were done and attempts were made at calculation but with the state of my mathematics they were doomed from the start. However, the outcome of this indicated the direction in which to move and so a long series of experiments were carried out.

A 10in. hacksaw blade was cut up to provide for a large number of notched blades. It was decided that the blades would be cut with a fly cutter in the lathe. The fly cutter had an absolute point on the end to get a perfect 'V' at the bottom of the notch. The point was asking for trouble and I got plenty, but with the correct temper (mine and the metal) plus good support for the work I got it to do the job. The last thing to be made was the little fitting shown in **photo 11** where the experimental blades could be accurately placed in a slot for testing (see detail in **fig.5**). After nearly using up the whole of the material from the hacksaw blade the angles were found. The original angles are presented at 'A' in **fig 6** and the new angles at 'B'. The final action achieved is shown and described in **fig 7**.

A little sting in the tail

The new notched blade was fitted to one clock and an electronic monitor made up to watch it night and day. Over a period of about a week it did not fail once. The sound produced by the triggering was now very little more than the

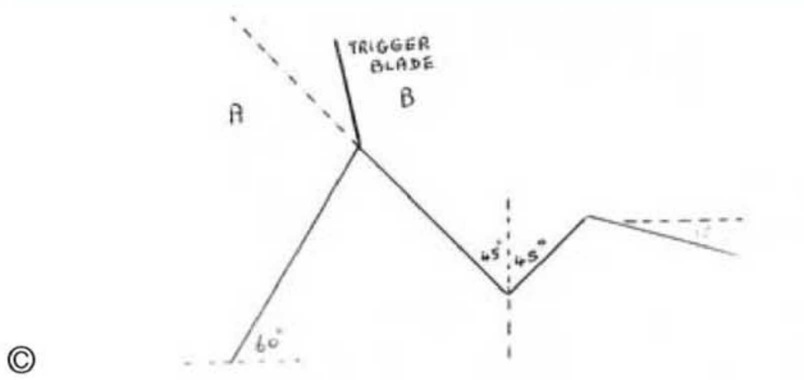
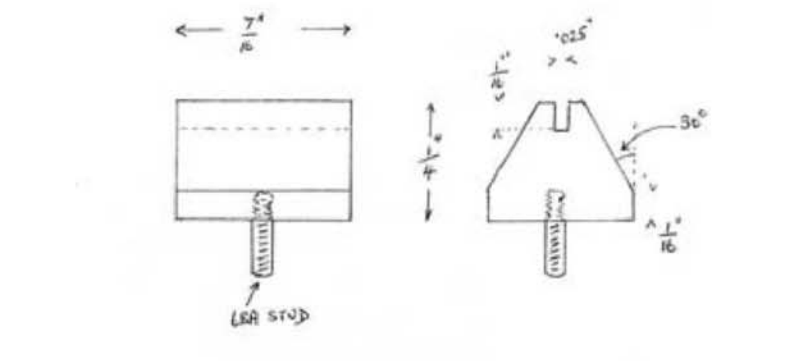


Fig. 4



Notched blade support block

Fig. 5

tick of the clock and just a light click. I revelled in the lovely feeling that the sound gave me. Another identical blade was made for the other clock and fitted as before. I had no need for the electronic monitor this time because it failed within two hours. I was devastated. However, the sound of the failure was different to the original problem. The trigger pin was polished to no avail and then I noticed that the trigger blade was free on its pin when off the clock but seemed to be sticky when fitted to the clock. I could find no reason for this. I stood there in a kind of stupor not knowing what to do next. When I finally became focused my eyes were looking at my demagnetiser, which is fixed on the wall. Within ten minutes the parts had been in the demagnetiser and were back on the clock and that was the end of the trouble.

Trigger and Contact Mechanism Adjustment

Figure 7 explains the way the trigger blade now descends into the notch when the mechanism is in correct adjustment. It also may be necessary to refer to fig 3 for names of parts. An eyeglass (x12) clamped at the focal point; a good light and a small piece of white paper placed behind the notched blade helps considerably in checking and making adjustments.

1: Set the backstop so that the contact strip is horizontal or a little above this at the backstop end.

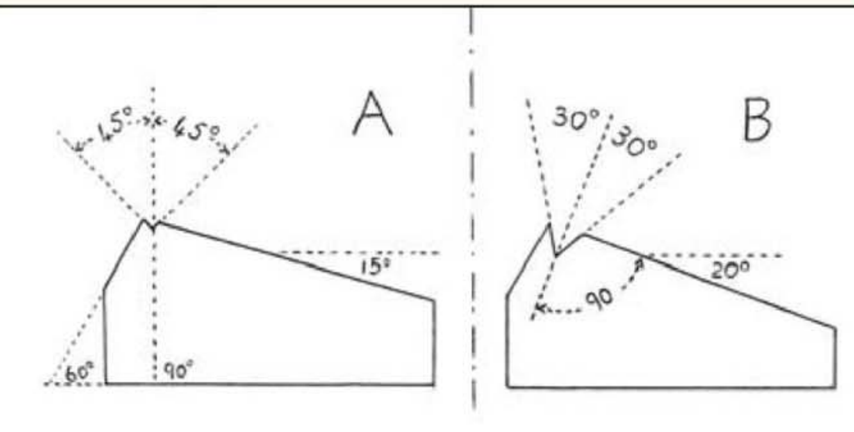
2: The notched blade assembly runs in a slot in the contact strip. Unscrew the nut; stand square to the clock and adjust, by eye, until the notch lines up with the left hand edge of the pendulum shaft. This adjustment controls the amount the pendulum swings. Moving the notch to the left increases the swing. When tightening the nut ensure that the assembly is in line with the contact strip.

3: Now the difficult bit. The trigger support block is fixed to a stub on the pendulum by means of a clamp screw. After first making sure the trigger is perfectly free, set the support block such that the trigger blade is almost touching the notched blade when the clock is at rest. The trigger blade must be at right angles to the notched blade. This can be checked with a suitable square piece of card placed against the backboard and the left band face of the support block.

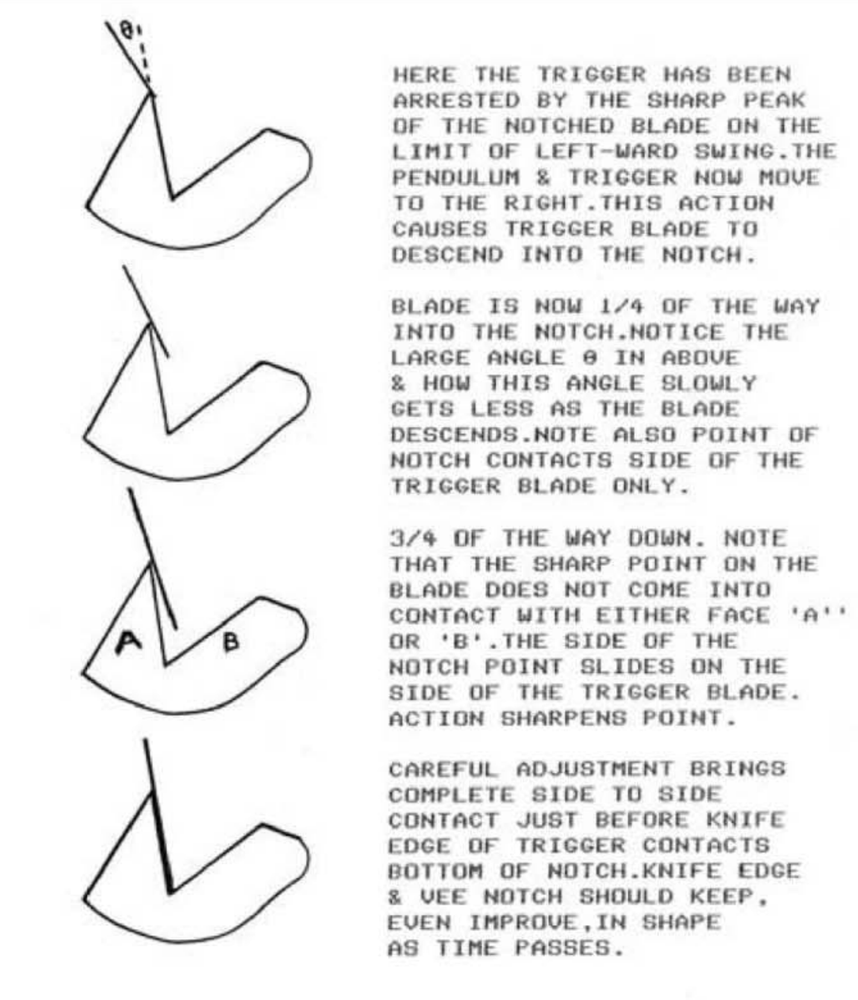
4: For the next part slowly move the pendulum to the left (keeping approximately the same distance from the backboard) until the trigger blade drops into the notch. Move the pendulum back and forth tiny amounts and watch how the blade descends into the notch. Compare with fig 6. Correct action can now be achieved with the backstop adjuster (refer to fig 3). If the trigger blade contacts face 'A' during its descent of the notch then unlock and unscrew the backstop say 1/8th turn and observe. Continue until conditions are as fig 6.

If the backstop is unscrewed too far the trigger blade point will touch face 'B' as it descends and thus the backstop will need to be screwed inwards. The range between these two extremes is about half to three-quarters of a turn of the screw. The contact screw should now be adjusted to give a suitable gap. Check contact action by turning power 'on'; moving the pendulum to get the trigger into the notch; hold the pendulum and move it slowly towards the magnets. You will feel the magnets pull the pendulum. Correct action of the contacts is when this pull ceases just before the pendulum is centrally over the magnets. Adjust the contact screw accordingly. When all is okay tighten the lock nuts.

In conclusion I would like to thank John Wilding for his articles and helpful correspondence together with all I learned about filing and the magic of burnishing. To all those who build clocks may all your pendulums keep swinging.



© Fig. 6

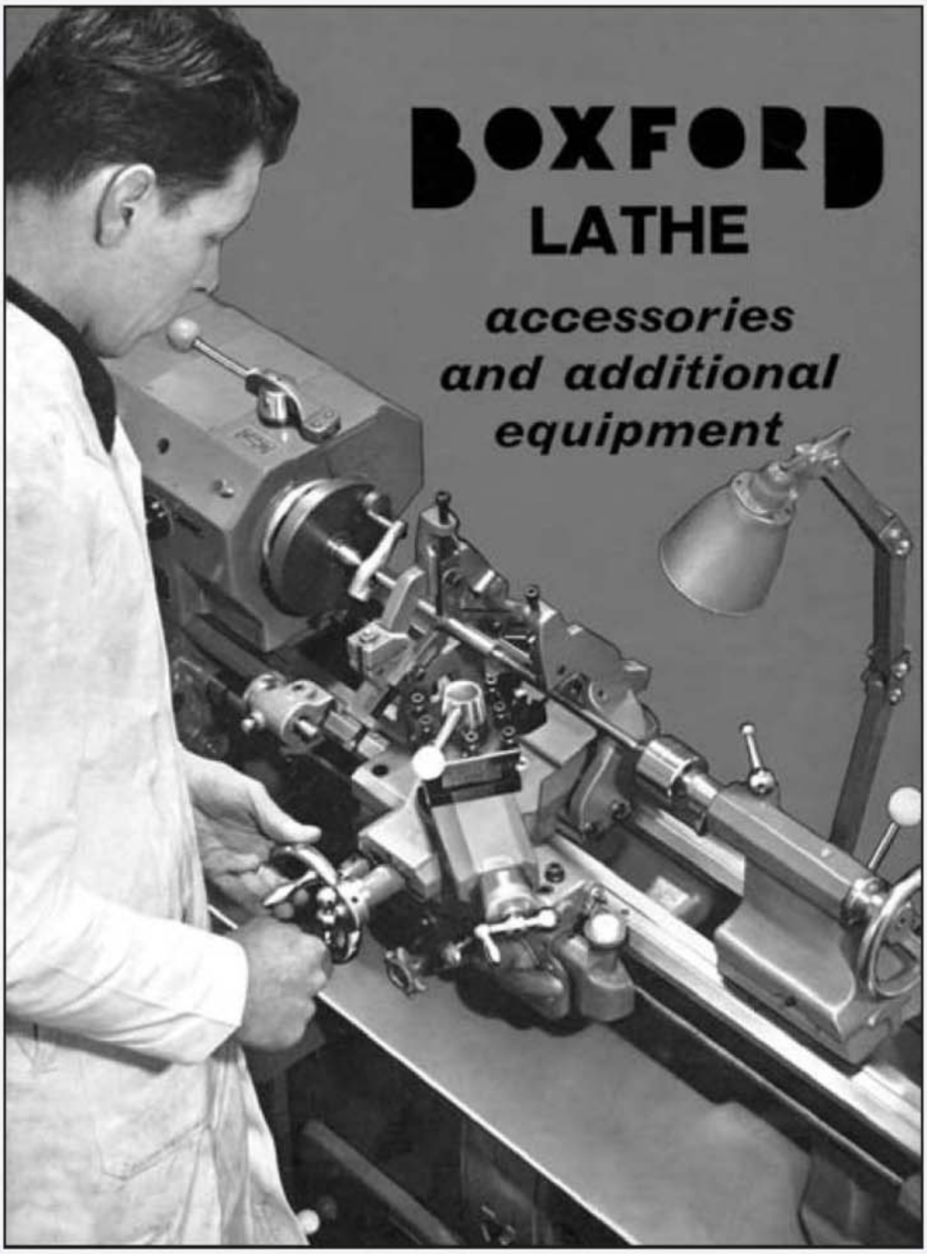


© Fig. 7

BOXFORD LATHES

MACHINE TOOLS

Tony Griffiths looks at the development of the Boxford range of lathes and gives advice for owners today.



Some tricky turning shown on this early Boxford catalogue.

Well made, strongly built and capable of sustained hard work, the original belt-drive Boxford lathe has long been a favourite with not only amateur and professional engineers but also schools and colleges where many thousands were installed during the 1950s and 1960s. The lathe had its origins in the Denford Small Tools Company D.S.T.), founded in Brighouse by (so far as is known) Horace Denford in the years before World War Two. Original products included a range of small precision tools and, no doubt, sub-contract work for the many local general-engineering and machine-tool companies who once inhabited the area. It is believed that Denford moved at least part of its operation to a former spinning factory, Box Tree Mills, in Wheatley.

Having set up in Wheatley a new company, Denford Machine Tools, was created and in 1946 production began of small engineering tools. A variety of products was made including the well-known comparator together with its various types of holding stand, precision parallels, straight edges, sine centres, sine tables and, most important of all, two small precision plain-turning bench lathes. All the products were branded "Box-Ford", including the lathes, one of which was a conventional centre lathe while the other, of a similar size but almost completely different construction, was a miniature capstan. Both these machines, for which one would have thought the market somewhat limited at the suggested price of £175 (when a backgeared and screwcutting ML7 was around £60), nevertheless had a production run that the factory hinted might have exceed 400 units.

Even today a small but regular supply of these well made little machines still turns up on the second-hand market. As a point of interest these were not the only Boxford precision lathes ever made for another example, a considerably larger 4.5in. x 17in. machine, was built in the early 1950s. Unfortunately - apart from knowing that it was fitted to an under-drive stand with an Allspeeds Kop swash-plate variable-speed drive unit and a headstock spindle with a bore of 1.125in. running on taper-roller bearings - no details of this version have survived.

After the two original precision lathes the company's next model, introduced in 1948 and again branded a Box-Ford was an improved copy of the American South Bend backgeared and screwcutting 9in. workshop model. For details see: http://www.lathes.co.uk.southbend

Denford was not the only company to copy the South Bend, the simplicity and ruggedness of the design also appealing to Blomqvist and Storebro in Sweden; Hercus, Purcell and Sheraton in Australia; Sanches Blanes in Brazil; Smart and Brown in England and Moody in Canada. However, apart from Hercus, none of the companies enjoyed as great a success with the machine as Boxford and the new lathe was, in its various forms, to be the foundation of the firm's success.

With the exception of the headstock, its fittings and location on the bed the new Box-Ford was almost an exact copy of the South Bend original and available from launch in the same three versions: a top-of-the-range Model A with screw cutting gearbox and power cross feed, a Model B that retained the power cross feed but with screwcutting by changewheels and a basic Model C with change wheels and hand-operated cross feed. Even though the South Bend headstock, together with its spindle and plain bearings, had proved to be reliable and rugged (a South Bend bed nearly always wears out before the headstock) Boxford introduced a much more rigid, box-like headstock casting open only at the rear to accommodate the drive belt and carrying a spindle running in easily-changed taper roller bearings. Instead of locating the headstock on a front V and rear flat as South Bend had done Boxford choose to use a V-way at both locations.

However, in later years the development of under-driven lathes (with a belt running down the front face of a now wider headstock) forced a return to the original design. Even so, on these machines, to keep things looking 'right' from the front, a deep dummy V was cut into the underside of the casting. The main dimensions of the original South Bend spindle, with its 1.5in. x 8 tpi nose, were unchanged, and indeed stayed the same on the ordinary V-belt drive models until the end of production. Behind the bearing change would have been a desire to not only improve the lathe but also to gain economies of production where the spindle, instead of being hardened and 'micro-finished' to run in the cast-iron of the headstock, could be made to lower tolerances in a less-expensive material. A further advantage was that the bearings could be replaced easily and, if required, much higher spindle speeds reached with safety.

In 1952 Mr. Denford sold out the Box-Ford part of his enterprise to the Harrison lathe company and transferred his other operations still under the D.S.T. banner, to the Brighouse site they occupy today. Shortly after this move Denford introduced the Viceroy lathe, a machine not dissimilar in general layout to the Boxford but of heavier build, on a safe under-drive stand and obviously intended to compete in the same segment of the market.

The 9in. lathes - an overview

With serial numbers starting at 1001 the first batch of 9in. Boxfords left the company's Box-Trees plant during April 1948. They were fitted with a 3-step flat-belt drive to the headstock, no countershaft or headstock belt guards and with the motor on/off switch built into the front face of the headstock-end bed foot.

When fitted with optional 2-step pulleys on motor and countershaft, and combined with the 3-step cone headstock pulley, these early versions had a usefully wide spread of spindle speeds, approximately: 76, 140, 250, 390, 710 and 1300 in open belt drive and 40, 67, 120, 190, 350, 640 in backgear. The backgears, though they are often damaged on used machines due to mishandling, were robust enough to allow the lathe to be easily capable of turning the largest faceplate-mounted job. Both slides of the compound rest were driven by 10 tpi Acme-form (or 2.5mm pitch trapezoidal) screws fitted with 1.6in. diameter satin-chrome zeroing micrometer dials the friction setting of which could be adjusted (or locked) by a pair of spring-loaded ball bearings.

In January 1950 the flat-belt drive was abandoned and lathe No. 1791 became the first to be fitted with 4-step V-belt drive - a much-improved arrangement that, while it did not change the top or bottom revolutions, meant that 16 instead of 12 speeds were available. The standard range consisted of: 38, 55, 87, 125, 75, 110, 175 and 250 rpm in back gear and 200, 285, 450, 650, 400, 570, 900 and 1300 rpm in direct (belt) drive. At the same time the tumble-reverse mechanism was altered to do away with the inconvenient and slow-to-change bolt arrangement and a simple, quick-to-operate, spring-loaded plunger design used instead.

The drive system remained in this new form until 1959 and the introduction, from approximately Machine No. 8755, of a range of 10-speed lathes with the motor inside the cabinet stand – the 'Under-drive' as it became known. The new lathes were sold as AUD, BUD, CUD and TUD models with the D suffix standing for 'under-drive' and A, B and C reflecting, as before, the specification. However, they did not replace the rear-drive machines but complimented them, the original versions remaining in the Boxford catalogue until at least 1977. While the rear-drive models suffered from a very deep countershaft, and consequently took up a good deal of room, the under-drive versions were very compact – with the bare stand only 17 inches front to back - and today are consequently by far the more popular buy second-hand.

From December 1973 and approximately serial no. 33000 the swing of the under-drive Boxfords was increased to 10in. but with the original back-drive lathes remaining at 9 inches. The distance between centres offered by the factory varied almost casually: 16in. to 24in. is the most commonly-encountered range, but occasionally 26in., 28in. and even 30in. rear-drive models are found. The confusion is compounded by the tendency of the company to refer in some early publications to the length of the bed - which is, of course, nothing at all like the capacity between centres. All Boxfords were 'straight bed', that is, none of them, unlike some models of the South Bend 9in. of the early 1950s, had a gap. Besides the conventional V-belt drive already described the lathe was also marketed as the comparatively rare VSL with expanding and contracting pulleys giving a mechanically operated variable-speed drive system.

Later under-drive lathes of the AUD, BUD and CUD series enjoyed a number of refinements and are known as the Mk 2 Under-drive. They were built with a 4.5in. centre height from the 1st of December 1963 (probably serial number 13513) and from December 1973 (around Serial No. 33000) as a 5in. model. The main improvements centred on increasing operator safety and ease of use: backgear no longer need two levers to be engaged, instead the movement of a single, electrically-interlocked, lever on top of the headstock first released the bull-wheel from the spindle pulley and then slid the gears into engagement.

A useful addition was a spindle lock, operated by a dished chrome-plated button on the face of the headstock; this greatly eased the removal and fitting of chucks and faceplates and obviated the need to use, and possibly damage, the backgears. At the same time the opportunity was taken to reposition the various headstock oil nipples so they could be reached without having to open or remove any covers. To give a stronger assembly and quieter running the pressure angle of the tumbler reverse gears, and their drive gear on the end of the headstock spindle, was changed from a 14.5deg. to 20deg. - although the changewheels remained unaltered.

The popular Boxford AUD when new in 1978.

The top-slide was provided with an extra $^3/_8$in. of movement (that usefully increased it to the same length as a No. 2 Morse taper) and both top and cross-slide feed-screws were fitted with ball-bearing thrust assemblies the inner and outer hardened plates of which, over time, tend to become indented and give the action at the handle a less-than-smooth feed. The micrometer dials were satin-chrome plated and fitted with an improved friction 'clutch' that did away with the need to lock the setting with an Allen key while the degree-indexing marks, to indicate top-slide swivel, were moved to an angled surface in an effort to improve their visibility.

Captive nuts were fitted to the underside of the motor-mounting plate so that adjusting the primary drive belt tension involved no more than slackening the clamping bolts and sliding the motor into the correct position; the countershaft spindle was increased in diameter, fitted with sealed-for-life deep-groove ball races and the motor cabinet door louvered to improve cooling. To avoid having to open the cabinet door the end of the countershaft was arranged to protrude through the left-hand face of the cabinet stand so that oil, injected into its end, could travel through and lubricate the countershaft bearings.

Electrical interlocks, by micro-switch, were fitted as standard to the backgear lever, changewheel guard and motor-cabinet door - but these could, if not required, be eliminated from the specification of a new machine and the price reduced by £1:10s:0d (£1.50) for each unit left off. Should you want to disable the electrical locks on your own Boxford it's possible to bridge their contacts on the terminal block fitted at the rear of the headstock-end bed foot.

To improve the appearance of the lathe some small but significant improvements were made to the fit and finish of various components including more precise mating of the headstock-to-changewheel guard and bed-to-screwcutting gearbox faces. The appearance of the tailstock was also cleaned up and, as a final touch, a modified catch (though still largely useless and easily-opened) fitted to the changewheel guard. In May 1976 the final version of the Under-drive was introduced, distinguished by its more modern-looking stand complete with a neat splash-back, standard-fit low-voltage halogen light unit and a rather elegant grey and brown finish; some people (but not Boxford) have, in the past, referred to these lathes as the Mk. 3. During October and November 1981 the colour scheme was changed, temporarily, to green - a shade that can be replicated by ordering Reseda Green B.S. Standard RAL6011.

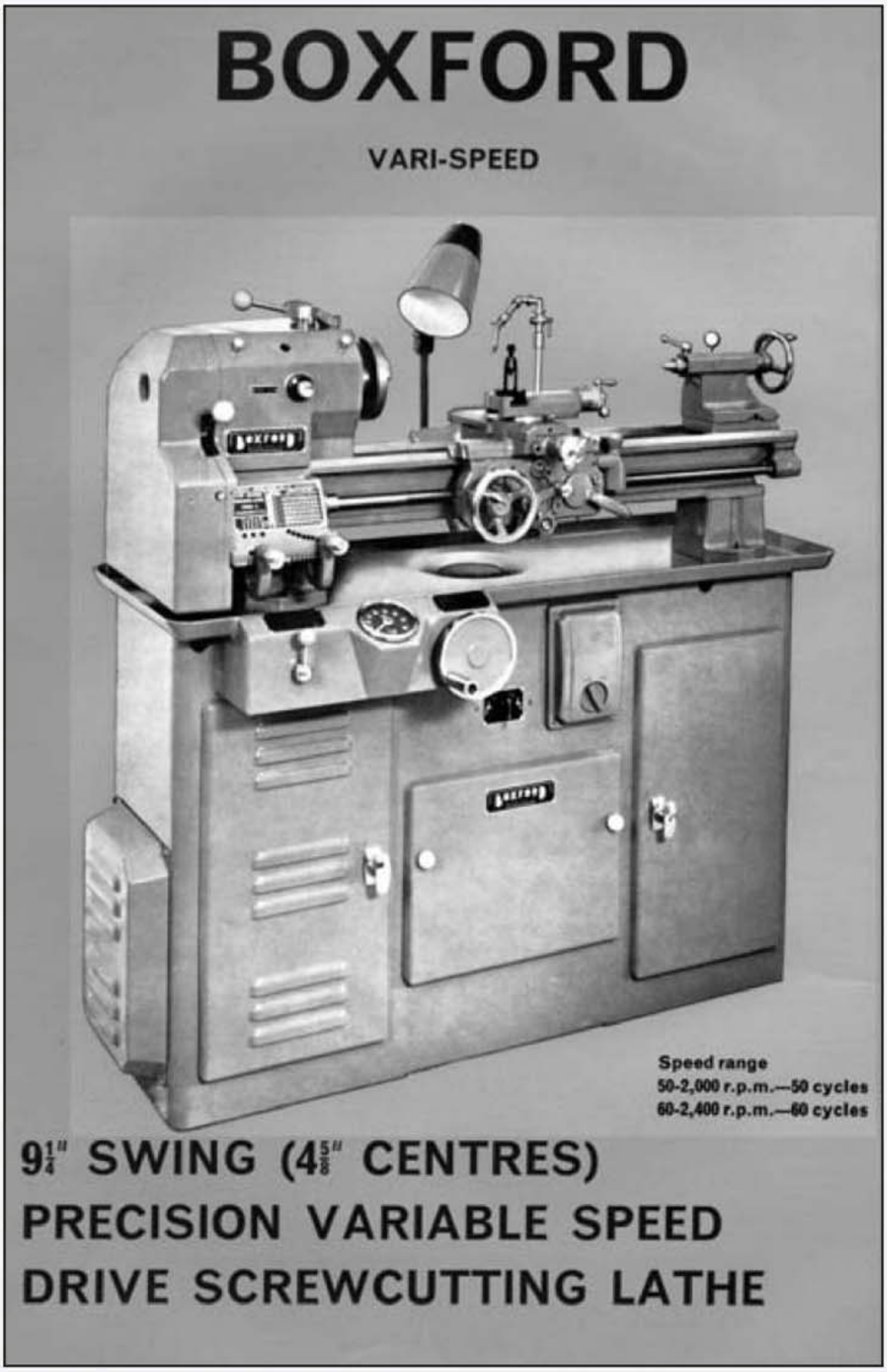
After a production run of 40 years the last of the 'traditional' style Boxford lathes left the factory during January 1988 with serial numbers finishing at around 43261. If you count manufacture of the type as beginning with the very first 9in. South Bend, the Model 405 of 1934, that would give a production span for the type of 54 years.

Model VSL

The VSL was built with both 4.5 and 5in. centre heights with the latter version being listed as the Model 500 VSL. Introduced as a 4.5in. centre height machine in January 1966 (from Serial No. 18970) both are very desirable machines - but, unfortunately, difficult to find. Apart from a very rare, non-screwcutting, capstan-equipped export version with a Harrison label, the VSL was made only in Model AUD form with an under-drive stand, screwcutting gearbox and power cross feed. On early versions only the drive system was altered, to a mechanical variable-speed type, with the rest of the lathe mechanically identical to the AUD. However, on later models, an effort was made to significantly upgrade the machine and it was equipped with a larger 1.375in. bore headstock spindle with a hardened and ground American Standard size L00 taper nose and a 5 Morse taper complete with both a short reduction sleeve (to take it down to 2 Morse) and an adaptor to accept direct-fitting C5 draw-bar operated collets.

Instead of cast-iron gears the backgears were made in induction-hardened steel and, to improve their reliability, the tumble-reverse gears equipped with needle roller bearings. On all VSL models the electric motor, positioned inside the left-hand side of the cabinet stand, had a wide 'expanding-and-contracting' V-pulley mounted directly on its shaft. Pulley movement was controlled by a cable and rod driven from a handwheel on the front of the stand. The upper drive pulley, which reacted to the movement of the motor pulley by opening and closing automatically, was carried in bearing hangers from which a second (conventional) link-type V-belt took the drive up to the headstock spindle.

The speed range was typically 50 to 2000 rpm and, because the drive was infinitely variable, either an electric or mechanical rev. counter was fitted to show the operator what was going on. If the tachometer is broken or missing businesses specialising in vintage car and motorcycle restoration can often help with replacement or repair. Some early 4.5in. centre-height VSLs were fitted with a motor with an extended left-hand shaft on which was mounted a very expensive electro-mechanical disc brake, controlled by a switch fitted to the left-hand face of the motor-control panel.



Boxford VSL with tachometer below the gearbox.

Nearly all VSL lathes were supplied when new with 3-phase motors - 930 rpm/1hp on the screwed-spindle nose models and 930 rpm/1.5hp for the L00 version. Unfortunately, because the drive mechanism fitted to them has to be accurately aligned to work properly the VSL is difficult to change to single-phase operation. In addition, because the coolant pump, light unit and safety-interlock transformers are also 440 volt 3-phase, rather than attempt to completely re-engineer the peripheral controls, it is much easier to leave everything in place and run the lathe from a phase converter or inverter. If this is done it is worth bearing in mind that, while the main motor can be easily altered from Star 440 volt to Delta 240 volt working, many of these machines were fitted with both a push-button safety starter of the front panel and another automatic contactor unit at the rear. Because the coils in the contactors are 440 volt they usually refuse to work when supplied with the 220/240 volts put out by the inverter.

Coupling the inverter (as is usually recommended by their makers) directly to the motor and bypassing the built-in controls has been known to produce a far more effective conversion. Of course, doing this means that the safety-interlocks on doors and backgear are lost and other arrangements have to be made to power the coolant pump and light unit.

Fitted to a distinctly different stand, and with a 5in. centre height, the final version of the VSL was known as the Model 500 VSL. An interesting point concerns VSL models fitted with the LOO spindle: on these lathes a screwcutting gearbox was standard but with changed internal ratios and the availability of 'compact' English/metric and metric/English conversions gears. Instead of the older 'full-size' 127/110t (inch to metric) and 135/127t (metric to inch) gears the LOO versions were, respectively: 64/54t and 76/65t.

Model ME10

From November 1976 Boxford marketed the 5 x 22in. Model ME10, a less expensive lathe - though constructed from components identical to the more expensive machines - designed for bench mounting and with a short, space-saving countershaft unit. Also available mounted on a special stand the lathe was intended to run alongside the under-drive and rear-drive models and could be had in any of the three usual A, B and C specifications.

The main difference between the ME10 and the ordinary rear-drive models was the significantly reduced amount of room required to install it. The countershaft, bolted directly the back of the bed, allowed covers to be used that, unlike earlier designs, required no extra room to swing fully open. As a consequence, fitted to its own cabinet the ME10 took up only a little more space front to back than the under-drive versions. One difference noticed on these lathes, though it is not certain that all were so equipped, was the use of quieter-running Oilite-bushed tumble-reverse gears in fibre. The fibre gears can be fitted to all other models and have definite advantages if the lathe is to be used where noise might be a problem. One (expensive) option was an effective spindle clutch - a fitting that, sadly, was never made available for other versions and remained exclusive to the ME10.

Model CSB

Another slightly cheaper machine was the 'CSB' - possibly for "Model C School Boxford". This was offered during the 1950s and 1960s and was, in essence, just a short bed (16in. centres) Model C but with a simplified 8-speed drive where a modest 0.33 h.p. motor was bolted to the countershaft upright instead of a separate, adjustable horizontal motor platform. With single-pulley drive on motor and countershaft, and using backgear, the spindle speeds were: 38, 55, 87, 125, 200, 285, 450 and 650 rpm By paying extra the motor and countershaft could be fitted with 2-step pulleys when the speeds became: 38, 55, 75, 87, 110, 125, 175, 200, 250, 285, 400, 450, 570, 650, 900 and 1300 rpm Unfortunately the makers neglected to mention the fact that to make the top speed useable a motor more powerful and expensive than the standard 1/3 h.p. was required. To adjust the motor-to-countershaft belt tension meant repositioning the motor itself - however, once this had been done it was not normally necessary to make any further changes until the belt began to wear.

Despite the CSB being a standard, advertised specification, some examples have been found with the novel, quick-action belt-tensioning device used on the lathes of the late 1940s - probably another case of using up no-longer-needed spares. Other evidence of clearing storeroom shelves was the use of an early-pattern South Bend type saddle with its simple screw-in, rather than bolt-on, cross-feed screw assembly. Ambitious advertising in the model-engineering press of the day attempted to position the CSB as an alternative to the Myford ML7; unfortunately the Boxford cost nearly twice as much and, while it did offer a range of advantages, there can have been few takers. A training version of the lathe, the CSBP, was also offered: shorn of screwcutting equipment and usually, but not always, backgear, this model was aimed at the school and college market and had little appeal for the model or experimental engineer.

Models T and TUD training lathes

Both the T and TUD plain-turning training lathes were dimensionally identical to the more highly specified models and used the same basic castings; however, they lacked any form of screwcutting, power feed and, more often than not, backgear. The rear drive system usually gave 4 speeds from around 200 to 1200 rpm - although the writer has seen examples with 2-step pulleys on motor and countershaft to give 8. The under-drive models had 5 direct-drive speeds of 210, 340, 540, 850 and 1400 rpm or, with backgear fitted, an additional 5 slower speeds. The development of the training lathes mirrored that of the more highly specified versions changing from rear to under-drive and then incorporating the other small improvements already described. The last versions were of 5in. centre height and mounted on a version of the more modern-looking stand - and even complete with the splash back, chuck guard and halogen light unit. Although an attractive proposition, because of their low price, the plain-turning versions are of limited use other than in a training role, for the very simplest of work or as a back-up lathe for roughing out.

Drive systems and countershafts

Early lathes, until machine No. 4600 in 1954, used an 'integral' countershaft unit of unusual and ingenious design where the pulley system and motor were both mounted on a platform that could be adjusted forwards and backwards on two bars fastened to the back of headstock-end bed foot. The movement was activated a quick-action, two-start thread controlled by a handle on the end of a shaft that protruded through the front face of the foot immediately below the headstock. When moving these lathes take care to support the rear of the countershaft otherwise the bars on which it sits may be bent.

On later rear-drive models a very heavily built, separate 16-speed countershaft of different design was fitted with the motor mounted on a rather over-engineered (even unnecessary) horizontal platform that could be separately adjusted to set the motor-to-countershaft belt tension. At some point the new countershaft was modified and its right-hand bearing made detachable to ease belt replacement - though it was still necessary to completely dismantle the headstock. Because the 9in. lathes had been flat-belt driven the maker, following usual practice, had set the pulleys as far apart as reasonably possible. Even though two changes of countershafts had been made, and the drive greatly improved, Boxford made no effort to get the pulleys closer together (V belts can be run on much shorter centres) and make the machine more compact.

One problem sometimes encountered with the rear-drive version is vibration at high speeds; this can nearly always be traced to either the large countershaft pulley being out of balance or either or both the drive belts being unevenly worn. Such belts fall into and then ride up the pulleys, effectively varying the drive ratio and causing the speed to rise and fall rapidly. Should you suffer this problem it is worth replacing both belts (a T-link belt on the headstock drive saves dismantling) and then, if that does not affect a cure, removing the countershaft pulleys and shaft and statically balancing them between a pair of lathe centres.

A serious problem with the rear-drive machines when used in educational establishments was the difficulty of securing the belt guards against curious fingers. Most schools had to resort to bolt-on straps and other contraptions and, as a consequence, in 1959, Boxford introduced the under-drive models, a design very similar to the competing Viceroy and as already sold for many years by South Bend, Clausing, Sheldon and other American manufacturers. With the drive now held securely in the stand behind an electrically interlocked door another advantage emerged: the depth of the machine was reduced to as little as 17in. (400mm).

Early under-drive lathes had their countershaft-spindle bushes pressed directly into the material of the motor platform itself, with the belt-tensioning handle mounted externally on the left-hand side of the cabinet. With the handle so tempting placed many owners were inclined to use it an unofficial (and dangerous) substitute for a clutch. In 1960 the countershaft was modified with the shaft diameter increased to 0.75" and, in 1966, further improved when the shaft ball bearings were fitted to removable brackets, the belt-tensioning lever repositioned within the cabinet base and the access door (like the educational versions) provided with a micro-switch that stopped the motor should it be opened by even a fraction of an inch.

While rear-drive lathes had 6, 8 or 16 spindle speeds all the under-drive machines, with the exception of the variable-speed VSL, had 10. The normal range was a useful 30 to 1400 rpm but, at extra cost, the works could provide a more powerful motor and 'high-speed' pulley set that increased the maximum to just over 2000 rpm but at the sacrifice of increasing the bottom speed to such an extent that it was difficult for beginners to screwcut.

It is well known that a lathe fitted with a spindle clutch is a good deal easier to handle than one without - and it remains a mystery why the only Boxford ever so fitted (as an option) was the ME10. Its design was similar to that used on the Myford ML7 with a brake-drum housing formed inside the countershaft drive pulley and an operating lever working through a push rod and toggle-arm that opened and closed a pair of brake shoes. Owners of clutch-equipped lathes report that the unit is not only reliable but has a pleasingly light yet positive action.

Metric and English screwcutting

Because the company had strong connections with the educational and training world, many Boxford lathes sold during the 1950s were specified as 'all-metric' machines. Interestingly, although large numbers were sold set up in this way, some were fitted (but probably unknown to their first owners) with an imperial leadscrew driven by a metric-conversion changewheel set. The factory were obviously keen to use up stocks of leadscrews that would otherwise have languished unused in their stores - and must have guessed that the likelihood of schoolchildren ever being allowed to use a lathe to cut threads was little better than zero. This, needless to say, resulted in a great deal of confusion when the machines eventually passed into private hands.

Boxford's careful control of production costs has, however, done every subsequent owner a considerable favour for, providing that the lathe has its original set of changewheels the addition of a few more produces, at little cost, a dual metric/English screwcutting machine. Later metric machines, and all the metric-gearbox equipped variants no matter what their year of manufacture, were fitted with a proper metric 3mm-pitch lead screw.

Boxford TUD training lathe without screw cutting facility.

English and metric screwcutting gearboxes were different but can be distinguished easily: the English box has the diagonal line of indent holes on the right-hand half of the box's front face while for the metric version they are on the left.

'English' threading lathes with an 8 tpi leadscrew and changewheels for screwcutting (i.e. without a screwcutting gearbox) were supplied with the following changewheels when they left the factory: *16, 24, 36, 40, 44, 46, 48, 52, 54, 56, 60, *80, *72/18 compound, *80 idler (with boss). All models of Boxford had 18DP changewheels.

*(*gears on machine as despatched from factory for standard feeds)*

To convert a non-gearbox English-specification lathe to cut metric threads the following gears are needed: 20, 100, 127/100 combination.

In addition, to cut the following five pitches extra gears are required as follows: 0.45mm = 18t gear, 0.55mm = 22t gear, 0.65mm = 26t gear, 0.7mm and 3.5mm = 28t gear metric threading lathes with a 3mm pitch leadscrew and changewheels for screwcutting (i.e. without a screwcutting gearbox): were supplied with the following gears as standard. *16, 24, 28, 30, 36, 40, 44, 48, 52, 56, 60, *80, *72/18 compound, *54/18 compound, *80 idler (with boss).

*(*gears on machine as dispatched from factory for standard feeds).*

To convert a non-gearbox metric-leadscrew lathe to cut English threads the following gears are needed: 18, 22, 26, 38, 54, 64, 88, 135/127 compound, 48/24 compound.

'English' threading lathes with a screwcutting gearbox had a standard ex-factory drive train consisting of: 20t, 40t, 56t and an 80t idler. To convert this gearbox to cut metric threads the following gears are needed: 24, 26, 28, 32, 36, 44, 48, 127/100 compound metric threading lathe with a screwcutting gearbox had a standard ex-factory drive train consisting of: 20t, 45t, 50t and an 80t idler. To convert this gearbox to cut English threads the following gears are needed: 38, 40, 44, 52, 56 and a 135/127 compound.

An interesting point concerns VSL models fitted with the L00 spindle: on these lathes a screwcutting gearbox was standard but with changed internal ratios and the English/metric and metric/English conversions gears arranged to be more compact with (instead of the older 'full-size' 127/110t (inch to metric) and 135/127t (metric to inch) gears) pairs of 64/54t and 76/65t respectively.

Headstock bearings

Early headstocks, certainly those up to the introduction of the under-drive models, were fitted with bearings having 14 rollers and marked "Precision 5" (with inner and outer races coded 2720 and 2788 respectively). Today these units are very expensive - several hundred pounds each - but, as Boxford fitted later machines with cheaper bearings (17 rollers and a shallower cone angle) there seems to be no good reason why these cannot also be used in the earlier machines - at a substantial saving.

Aprons and power feeds

Lathes with power cross-feed also benefited from a range of slower longitudinal feeds than the Model C - the reduction through the apron's gear train meaning that the feed rate was reduced by a factor of 0.3. In addition, because the power-feed drive was taken from a key running in the slotted leadscrew, the thread in the latter was needed only for screwcutting, so preserving its accuracy and saving wear on the expensive clasp nuts. The power-feed apron was identical to that used on the South Bend with the drive taken through what was, in effect a cone clutch wound into engagement by a star-shaped knob on apron's front face. If this clutch is allowed to slip (by regularly running the carriage up against a bed stop for example) the mating surfaces of the cone will eventually become polished and, no matter how tightly the knob is screwed in, will slip badly. The solution is to strip the clutch and roughen all the friction surfaces - the spilt cones and their seating - with fine emery cloth; once done this will allow the drive to once more take deep cuts with only the lightest of pressure on the control wheel.

A useful thing to know when dismantling the apron is that the screw in the centre of the clutch wheel has a left-hand thread. On late machines, to both safety and ease of use, the clutch wheel was prevented from rotating with needle-roller thrust bearings fitted to both front and back of the engagement shaft and a peg added to its end that located into a hole in the cover plate. These late-model aprons can be instantly recognised by their black plastic clutch-control wheels.

Unfortunately the clasp nuts, through of a straightforward design, do tend to fill up with swarf and dirt and so, to protect the leadscrew, it is worth removing the apron from time to time and cleaning them carefully. In the case of the Model C, where the clasp nuts are in constant use (taking the place of the power-feed mechanism) it may be necessary to pick embedded material from the thread roots with a sharp-pointed tool. An adjustable friction device, located underneath the apron towards its tailstock end and working through a spring and ball bearing, held the nuts closed or opened.

Tailstocks

Apart from the method of retaining the barrel-feed screw and a centre-height change from 4.5 to 5in., the design of the tailstock remained unchanged throughout the life of the machine (though there was a cosmetic improvement when the Mk. 2 Under-drive machines were introduced). The $^{11}/_{16}$in. diameter barrel had a travel of $2^{1}/_{8}$ inches, carried either inch or metric ruler engravings, or occasionally both, with a self-eject mechanism for the No. 2 Morse taper centre. Although the barrel clamp was a proper compression affair the operating lever was too short and it can be difficult to get enough force to lock things down solidly. The top could be set over on the sole-plate for a maximum distance of 5/16in. for taper turning and, while the bed clamp was entirely adequate, it did need careful flat-by-flat adjustment of the base nut within its retaining slot if the lever was to lock in the ideal place some 30 degrees forward of the vertical.

Accessories

Virtually every accessory is interchangeable across the model range and, in addition, many of those made for the 9in. South Bend, and Smart and Brown Sabel (and other clones) also fit. Even the fixed steady from the later 5in. lathe is useable on the smaller machine (and visa-versa) if you are prepared to give up a little of its maximum capacity. Unfortunately Boxford accessories do tend to be rare, and hence more expensive second-hand, than their Myford equivalents.

Parts interchangeability

There is a high degree of parts interchangeability between the various models - and also between South Bend 9in. lathes and Boxford; three popular improvements to the latter are: fitting a screwcutting gearbox, a power cross feed apron and a T-slotted cross slide. For the gearbox and power-feed conversion you will need, as a minimum, not only the major parts but also the correct changewheels (20t, 45t, 50t and an 80 idler with a boss) the slotted leadscrew and the correct Y-shaped change wheel bracket. The bracket used on the B and C is, incidentally, slightly different, with the bulge round the clamping bolt tending to foul the gearbox.

On early lathes it will be necessary to drill an extra hole through the bed at the headstock end to take the third gearbox mounting screw. The South Bend apron has a rack pinion gear (the gear that engages with the rack) of a coarser pitch than the Boxford and it may be necessary on some machines to make an adjustment to the height of the leadscrew by inserting shims between hanger brackets and bed. The leadscrew will also need to be swapped over, or the existing one modified to fit the gearbox, and a slot milled along its length to drive the apron worm wheel.

When everything is in place check (by hand and with the changewheel bracket removed) that the assembly rotates easily. If it doesn't, slacken the screws holding both the gearbox and the leadscrew hanger bracket and retighten them a little at a time, rotating the leadscrew while you do so, in order to locate the fault. The T-slotted cross slide is a direct replacement for the standard unit and makes the lathe a significantly more attractive to the experimental and model engineer. These are relatively expensive items but excellent new 'third-party' UK-made units are now available.

It is worth noting that, when supplied by the works with a taper-turning attachment, some lathes were fitted with a different design of cross-feed nut held on with two screws instead of the usual 'socket' arrangement.

Floor space and weights

Under-drive lathes with shorter beds (up to 24in. between centres) take up very little room in relation to their capacity. Their stands are often only 450mm (17.5in.) deep, with short-bed lathes of all types (either stand or bench-mounted) being approximately 1200mm (47in.) long (not much more than an Myford ML7) while long-bed versions run to about 1350mm (53in.).

Weights vary with bed length and specification but the approximate maximum figures likely to be encountered (as longer-bed machines) are:

Model	A	172kg	(380lbs)
Model	B	166kg	(365lbs)
Model	C	163kg	(360lbs)
Model	AUD	356kg	(785lbs)
Model	BUD	349kg	(770lbs)
Model	CUD	347kg	(765lbs)
Model	VSL	390kg	(860lbs)
Model	ME10	175kg	(385lbs)

Because a Boxford can be broken down very quickly into manageable lumps moving one is relatively easy: with the two screws securing the tailstock-end leadscrew hanger bearing removed the entire carriage can be slid off the bed; the changewheel banjo can be slipped off after pulling the leadscrew or gearbox input gear off its shaft (don't loose the key); the headstock is secured by two bolts, the front one of which poses the greater challenge and requires a very short open-ended spanner and some knuckle-scraping work to get undone. If the lathe has a gearbox leave it in place - and try not to remove a lathe from an under-drive stand; a compound was used to stop coolant getting into the wrong places and effectively sticks the lathe down; once broken the hardened sealer has to be chipped off and the joint remade.

Notes on conversion to single-phase electrics

While the rear-drive machines have a reasonable amount of space behind the lathe to fit a replacement motor (although capacitor boxes may have to be relocated) the under-drive lathes are a little tight on room and, although the conversion is perfectly straightforward, there are one or two simple points worth bearing in mind: the original motor, if 3-phase, will almost certainly be a 0.5hp if originally supplied to the education and training market, or 0.75 (and occasionally 1hp) from an industrial user. Replacing it with a modern 0.5hp 1-phase motor will mean, inevitably, that the lathe will no longer be able to start on top speed and, even if it does, will have insufficient torque to be useable.

The experience of many users suggests that a minimum of 1hp is necessary for a successful installation, while others believe that an even better guarantee is to use a 1.5hp motor. In the latter case, problems may be encountered getting it into the limited space available, especially if it's a modern type with a large plastic box shielding the capacitor and terminals. First, install the motor as far back on its mounting platform as possible (you will need to drill new holes in the plate) having first checked that there is still enough room for the belt-tensioning rod to function properly. Secondly, to enable the motor to clear the floor, lift its mounting platform as high as possible on the over-centre adjuster and use a shorter 'link' belt for the drive – it might even be necessary to adjust the length of the tensioning rod to accomplish this. Another trick is to remove the plastic box from the motor and remount the capacitor remotely, preferably in a place where replacement is easy when it fails (as it will).

Do not forget to engineer a suitably safe cover for the terminals and clip any new wires securely to the stand. As a last resort, because the base of the motor compartment is open, the lathe stand can be mounted on raiser blocks at each corner and the motor allowed to hang down into the space created.

If the original 3-phase wiring and switches are intact leave them all in place and wire the replacement motor to a new switch with fresh cabling - this makes a future re-conversion to 3-phase an easy matter, and might even enhance the value of the lathe.

Alternatively, and especially if the lathe has coolant and low-volt lighting fitted, consider running it from a 1-phase to 3-phase phase 'converter'. Although a little more expensive than a motor change, once you have one of these units it can be used to power other 3-phase machines, all of which are more readily available, and invariable cheaper, than their single-phase equivalents. Yet another option is to use a 1-phase to 3-phase 'Inverter'; these provide a variable-speed output, but will, if coupled to more than one motor - the suds pump for example - vary the speed of both. In practice many people who have combined several motors running from one inverter report that it causes no problems. With prices now at an affordable level, the advantages of inverters are becoming more widely appreciated - and a small lathe fitted with one is certainly a much easier, more versatile and safer tool to use.

If you have the slightest doubt about wiring in a new motor, or modifying the electrics on your lathe, pay a suitably qualified electrician to do the job for you – it will be money well spent.

For more details, accessories and spares for Boxford lathes, South Bend and the various clones see www.lathes.co.uk. Much is available including new T-slotted cross slides, faceplates, backplates, changewheels, cross feed screws and nuts, and so on.

The design of the T-slotted cross slide has been revised recently to improve its versatility and now includes a slot across the front - as well as three to the rear - and fully machined sides. These modifications allow the unit to be adapted as a small boring table - and provide flat vertical locations against which jobs can be registered. The later type of 'inset' rotational scale for the top slide is also included, so the unit can be used in place of the normal slide for ordinary turning operations.

T-SLOT EXTENSIONS

A commercial T-slot cutter can size the undercuts in one pass but is relatively expensive.

Peter Spenlove-Spenlove describes these useful accessories and T-slot cutting in general.

●*Part I.*

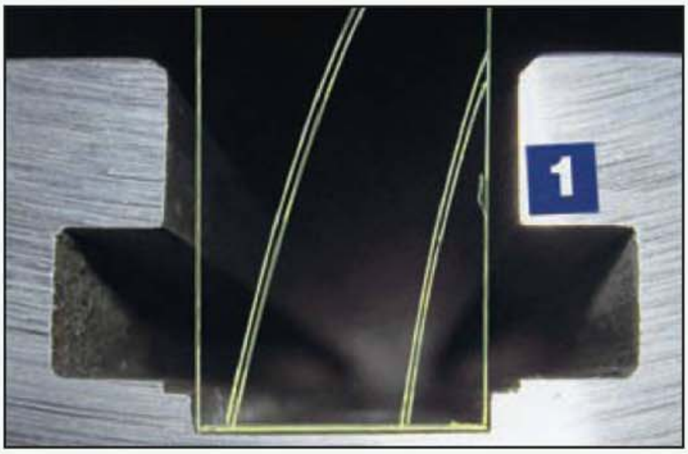
When the T-slotted table on the lathe or milling machine is found to be too small for a particular task then it may help to make and use a couple of movable T-slots. Movable T-slots can overhang the machine's table thus increasing the usable table area and providing somewhere to put clamp bolts and other work location items.

This approach is a simple substitute for the extra large T-slotted lathe cross-slide which some lathe makers could supply in the past. These were often termed boring tables as they enabled castings like steam engine cylinders to be clamped to them for boring or other machining operations.

The illustrated T-slot was machined from a piece of aluminium alloy bar because this material was available. Mild steel might be better but would be harder to machine. A T-slot is usually machined in two stages. First the main slot is cut using a slot drill. It may be widened so that the stem of a bolt has plenty of room. Sometimes it will be machined to accept standard T-nuts. Commercial machine tools have T-slots machined to standard sizes and details of these can be found in textbooks such as *Machinery's Handbook*. However, such recognised sizes are often too large for our small machine tools and some makers, like Myford for example, have introduced their own to suit the machines they make.

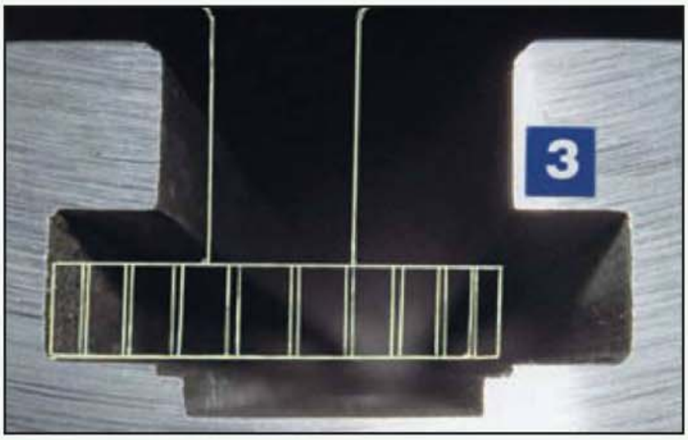
●*To be continued.*

The initial slot for the T-slot is probably best made with a slot drill like that on the left. The cutter on the right is an end mill.



Stage one of machining the T-slot is to make a pass in the work with the slot drill.

Stage two is to complete the slot to width. This may not be necessary if the initial cut brings the slot to the correct size.



Stage three is machining the T-slot undercuts. This is shown being done with a Woodruff cutter using several passes.

CLUB CHAT
With Malcolm Stride

Before I start the club reports this time I would like to make a few comments on *Club Chat*. This has been prompted by a big reduction in the number of newsletters being received at the moment. I am not sure whether this is due to a lack of interest or the fact that many clubs now do not produce printed newsletters but use the Internet as the medium for the transfer of information. If this is the case, an e-mail to the office will prompt us to look at the relevant website for the latest information. The other possibility is that because of the general confusion over the fate of *Model Engineer* earlier in the year, readers may have lost track of the latest contact details. To clarify that situation, when providing material for *Club Chat* you can contact us by ordinary post or send items by e-mail.

All correspondence should be sent to the Editor at ***Model Engineer*, Magicalia Publishing Ltd., Berwick House, 8-10 Knoll Rise, Orpington, Kent BR6 0EL** or via e-mail at **david.carpenter@encanta.co.uk** Use of the old addresses and company names will mean that items for publication will not get to us, so please check your records to ensure that the address is correct.

Please allow at least seven weeks if items for publication are time sensitive, contrary to popular belief, although the magazine is published every two weeks, it takes considerably longer to put each issue together, I am writing this at the end of October for publication during the first week of December.

Remember that the survival of *Club Chat* depends on us receiving sufficient suitable material to make up the column every fortnight. It is also worth pointing out that those clubs who have supplied regular material have often benefited by gaining new members as a result of the publicity.

Remember also that the only items we can sensibly use in the column are those news items of general interest. Many newsletters are absolutely excellent publications with lots of interesting technical and other articles. Unfortunately, although I thoroughly enjoy reading them, and often get diverted from my writing doing so, these do not yield much material of the column.

Even if you are not in a club, but do carry out model engineering activities with others which might be of interest to readers, please do send us the information.

For a final tug at your heartstrings, I am paid by the page, and you would not want to see me out on the streets looking for scrap to be able to carry on my model engineering activities, would you?

Since the next issue is due out only just prior to Christmas, I would like to take this opportunity to wish all readers a very Happy Christmas and a Prosperous New Year and look forward to meeting many of you at forthcoming events.

UK News

The running season at **Chichester DSME** has been successful with some very good running Sundays and a number of new younger members joining the society. The smaller gauge (0 and 1) tracks have seen increased use with a wide variety of locomotives being run. These range from a Shay to an Advanced Passenger Train. My own local club has also gained some junior members this year and I would be interested in news of other clubs which have done the same. Perhaps this is the start of a trend away from computer games to more constructive things?

I have received an update from Lawrence Tatton on the activities of the **Lincoln DMES** which I will reproduce in full (because I have the space).

The weekend of the 16/17 September saw the annual Open Weekend. This event did not get off to an auspicious start, as the opening of the marquee early on the Saturday morning revealed the theft of several exhibits along with the alarm system. The police attended and it was eventually decided that the event should continue in spite of the distress caused to the five members who had suffered a loss.

Blessed with glorious weather on both days the weekend was judged to be an enormous success, with three full-size traction engines and rollers, over 30 miniatures, if you include three 6in. scale vehicles as miniatures. The rest were at 4, 3 and 2in. scale with a wide variety of models and makes, Fowler being the most popular.

The public supported the event well on the Sunday although Saturday was quiet due to an annual clash with a local village fair. As well as the road vehicles there were tool stalls, two fairground organs providing the right atmosphere, vintage motor cars, a local motorcycle club, two model boat clubs and other stalls and attractions. The Lincoln based ice cream manufacturers stall actually ran out of supplies just in time for the end of the weekend.

Sunday was the day that the road vehicles went for a road run around the village which is always popular with the residents. A flypast by a Spitfire in the middle of the Sunday afternoon, timed to be just after the parade in the ring caused, as always, the hairs on the back of the neck to bristle.

The one small disappointment over the weekend was the poor turnout of visiting locomotives, only two attending, from Rochdale and Chesterfield, well short of the number that had promised to attend. In the end, however, over 1,000 passengers were carried by the visitors and club members locomotives.

The disappointment was all the greater as a lot of work had been put in over the winter period in the construction of a second station that has three roads, to eliminate the blockages that were caused by the original station layout.

Attention is now in hand to commence the building of a 200-yard long spur to a children's play area (originally planned 15 years ago!) This will be an out and back addition to the main circuit, will feature a triangle to enable entire trains to be turned and will need the manufacture of a 5in. gauge cross over, three sets of points and a turntable. Already 200 yards of chain link fencing has been erected, with another 200 yards for the opposite side of the track. This can only be erected after the track has been laid due to the amount of

Above left: The very neat working gauge glass lamp fitted to Doug Hewson's locomotive for the recent night run by members of Lindsey Model Society.

Above right: A close-up view of the working LED gauge glass lamp and bracket on Doug's locomotive.

earthworks that will be required. Substantial foundations are also required for a 30ft. long bridge that is to be built to cover a large depression in the ground, no real need for it, but as they say: *"We have always wanted a bridge!"*

Membership has grown over the year which is always a welcome sign, especially as one of the members has turned out to be a regular Saturday worker, which will ease the burden slightly on the usual stalwarts. Monthly meetings continue to be well attended with the usual activities taking place of talks and slide shows, the most recent being on the *Sandringham* Class of LNER 4-6-0s.

Members of **Lindsey Model Society** held a night run which necessitated the use of suitable tail lamps on the trains and also, rather than use torches, some drivers fitted proper miniature gauge glass lamps to their locomotives. Because the track is in an area with no light pollution, the drivers had to cope with *"completely black"* conditions and relied on the signal lamps to establish their positions. Doug Hewson reports that he took some paraffin powered three aspect Guards hand lamps into the signal boxes to provide the right atmosphere. The run was judged a great success and a production run of the gauge glass lamps is planned ready for next time.

Derek Brown gave a presentation to the **Stamford MES** on the origin of time and church clocks. Derek concentrated on the clocks he has been involved with by being asked to carry out repairs and discussed the origins of time. This is a relatively modern concept and started when the Chinese and the Romans divided each day into 12 hours. The length of the hours changed during the year because the days are longer in the summer. The concept of 24-hour days came into being between the 2nd and 12th centuries. The earliest clock in Britain was the 1386 clock in Salisbury Cathedral. The pendulum was invented in the 17th century and the accuracy of clocks immediately improved dramatically with clocks of the period achieving an accuracy of between two and five minutes per day.

There has been lots of activity at **West Riding Small Locomotive Society** with the construction of a new signal box and a security fence around the site. The latter was financed by means of a grant from Leeds City Council. Further tasks are planned for the winter and include some refurbishment of the area in front of the $7^1/4$in. gauge engine shed and the provision of caution signals at the tunnel entrance and station exit. That is the plan but, as David Batty comments, *"there are bound to be other jobs which will crop up from time to time"*.

World News

United States

Whistle Blast the news bulletin of the **New Jersey Live Steamers** reports that August was a bad day for conservation with the news that last ditch efforts to save the NYC RR tug boat No. 16 were dashed when contractors hired by a drugstore chain broke up the historic vessel before it could be moved to a museum site for preservation. On a brighter note, the Society picnic and Labour Day run was a great success, taking place on a *"beautiful August day"*.

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.

December

9	**Glasgow & S.W. Rly Ass'n.** *G&SWR Miscellany.* Contact Bruce Steven: 0141-810-3871.
9/10	**Nottingham SMEE.** *Santa Specials.* Contact Gerry Chester: 0115-9259096.
9	**Reading SME.** *Club Running.* Contact Brian Joslyn: 01491-873393.
9	**SM&EE.** *Seminar.* Contact David Boote: 01202-745862.
10	**Canvey R&MEC.** *Santa Specials.* Contact Brian Baker: 01702-512752.
10	**Chichester DSME.** *Santa Specials.* Contact Brian Bird: 01243-536468.
10	**Frimley & Ascot LC.** *Santa Run.* Contact Bob Dowman: 01252-835042.
10	**Harrow & Wembley SME.** *Santa Run.* Contact Roy Goddard: e-mail **RSGwatford@aol.com**
10	**Malden DSME.** Contact John Mottram: 01483-473786.
10	**Reading SME.** *Santa Specials.* Contact Brian Joslyn: 01491-873393.
10	**York City & DSME.** *Running Day.* Contact Pat Martindale: 01262-676291.
11	**Bedford MES.** *Quiz Night.* Contact Ted Jolliffe: 01234-327791.
11	**Melton Mowbray DMES.** *Richard Smith: Tales of a Permanent Way Inspector.* Contact Phil Tansley: 0116-2673646.
12	**Chelmsford SME.** *Monthly Social Evening.* Contact D. Blake: 01376-324205.
12	**Dockland & E. London MES.** *Christmas Get-Together.* Contact P. M. Jonas: 01708-228510.
13	**Chingford DMEC.** *Tim's Ramblings.* Contact Ron Manning: 020-8360-6144.
13	**High Wycombe MEC.** *Dr. Peter Brandham: Steam on Indian Railways.* Contact Eric Stevens: 01494-438761.
13	**St. Albans DMES.** *Club Night.* Contact Roy Verden: 01923-220590.
14	**Canterbury DMES (UK).** *Annual Society Dinner.* Contact Mrs P. Barker: 01227-273357.
14	**Cardiff MES.** *Quiz Night.* Contact Don Norman: 01656-784530.
14	**Worthing DSME.** *Christmas Social.* Contact Bob Phillips: 01903-243018.
15	**Canvey R&MEC.** *Christmas Party.* Contact Brian Baker: 01702-512752.
15	**North London SME.** *Loco Section Meeting.* Contact David Harris: 01707-326518.
15	**Rochdale SMEE.** *Meeting.* Contact Mike Foster: 01706-360849.
15	**Romford MEC.** *Bring & Buy Sale.* Contact Colin Hunt: 01708-709302.
15	**Romney Marsh MES.** *DVD/Video Evening.* Contact John Wimble: 01797-362295.
16	**Guildford MES.** *Christmas American Supper.* Contact Dave Longhurst: 01428-605424.
16/17	**Nottingham SMEE.** *Santa Specials.* Contact Gerry Chester: 0115-9259096.
16	**York City & DSME.** *AGM.* Contact Pat Martindale: 01262-676291.
17	**Ascot Locomotive Society.** *Christmas Get-Together* Contact Lee Porteus: 01344-884385.
17	**Canvey R&MEC.** *Santa Specials.* Contact Brian Baker: 01702-512752.
17	**Chichester DSME.** *Santa Specials.* Contact Brian Bird: 01243-536468.
17	**Harlington LS.** *Mince Pie Run.* Contact Peter Tarrant: 01895-851168.
17	**Reading SME.** *Santa Specials.* Contact Brian Joslyn: 01491-873393.
17	**Tyneside SMEE.** *Christmas Party.* Contact Malcolm Halliday: 0191-2624141.
18	**Model Steam Road Vehicle Soc.** *Christmas Bring & Eat Supper.* Contact Geoff Miles: 01869-247602.
18	**Peterborough SME.** *Party Night.* Contact Ted Smith: 01775-640719.
19	**Basingstoke DMES.** *Meeting.* Contact Guy Harding: 01256-844861.
19	**Chesterfield MES.** *Meeting, Photo Competition.* Contact Mike Rhodes: 01623-648676.
19	**Northampton SME.** *Christmas Drinks.* Contact Pete Jarman: 01234-708501 (eve).
19	**Nottingham SMEE.** *George Jones: The Cromford Canal.* Contact Graham Davenport: 0115-8496703.
19	**Taunton ME.** *Mince Pies & Natter.* Contact Don Martin: 01460-63162.
20	**Bournemouth DSME.** *Christmas Party.* Contact Dave Fynn: 01202-474599.
20	**Bristol SMEE.** *Jack Shettle: Hints and Tips.* Contact Trevor Chambers: 0145-441-5085.
20	**Chingford DMEC.** *Cheese & Wine evening.* Contact Ron Manning: 020-8360-6144.
20	**Leeds SMEE.** *Meeting.* Contact Colin Abrey: 01132-649630.
20	**MELSA.** *Meeting.* Contact Graham Chadbone: 07-4121-4341.
20	**Staines SME.** *Christmas Rave Up.* Contact Stan Bishop: 01784-241891.
20	**Steam LS of Victoria.** *Xmas Dinner.* Contact Graham Plaskett: (03) 9750-5022.
21	**Adelaide Miniature SRS.** *Meeting.* Contact Bob Yule: 8387-5032.
21	**Cardiff MES.** *Club Chat.* Contact Don Norman: 01656-784530.
21	**East Somerset SMEE.** *Bring & Buy.* Contact Roger Davis: 01749-677195.
21	**Isle of Wight MES.** *Meeting.* Contact Malcolm Hollyman: 01983-564568.
21	**Leyland SME.** *Annual Christmas Dinner.* Contact A. P. Bibby: 01254-812049.
23	**Chesterfield MES.** *Public Running Day.* Contact Mike Rhodes: 01623-648676.
23/24	**Nottingham SMEE.** *Santa Specials.* Contact Gerry Chester: 0115-9259096.
24	**MELSA.** *Bracken Ridge.* Contact Graham Chadbone: 07-4121-4341.
26	**Cambridge MES.** *Boxing Day Steam-Up.* Contact Rex Mountfield: 01284-386128.
26	**Canvey R&MEC.** *Boxing Day Steam-Up.* Contact Brian Baker: 01702-512752.
26	**Cardiff MES.** *Steam-Up and Family Day.* Contact Don Norman: 01656-784530.
26	**Chichester DSME.** *Boxing Day Steam-Up.* Contact Brian Bird: 01243-536468.
26	**High Wycombe MEC.** *Boxing Day Steam-Up.* Contact Eric Stevens: 01494-438761.
26	**Leeds SMEE.** *Boxing Day Steam-Up.* Contact Colin Abrey: 01132-649630.
26	**Leyland SME.** *Boxing Day Mince Pie & Steam-Up.* Contact A. P. Bibby: 01254-812049.
26	**Maidstone MES (UK).** *Boxing Day Run.* Contact Martin Parham: 01622-630298.
26	**Malden DSME.** *Boxing Day Run.* Contact John Mottram: 01483-473786.
26	**Reading SME.** *Steam-Up.* Contact Brian Joslyn: 01491-873393.
27	**Staines SME.** *Post Christmas Morning Run.* Contact Stan Bishop: 01784-241891.
28	**Cardiff MES.** *Club Chat.* Contact Don Norman: 01656-784530.
28	**Model Steam Road Vehicle Soc.** *Puff & Chuff.* Contact Geoff Miles: 01869-247602.
30/31	**Claymills Pumping Engines.** *Open Days.* Contact B. Eastough: 01283-812501.
30/31	**Romney, Hythe & Dymchurch Railway.** *New Year Mince Pie Specials.* Information: 01797-362353.
31	**MELSA.** *Sunday in the Park.* Contact Graham Chadbone: 07-4121-4341.
31	**New Jersey Live Steamers, Inc.** *New Year's Eve Midnight Run.* Contact Karl Pickles: 718-494-7263.

Are you dreading the Christmas crush?

Why not avoid the queues this year by giving the gift of a magazine subscription.

Simply call 01689 899 200 now and you can benefit from big savings! So whether you're buying for family, friends or simply want to treat yourself, a magazine subscription is the perfect present!

SAVE UP TO 25% ON YOUR CHRISTMAS PRESENTS

SUBSCRIBING COULDN'T BE EASIER...

BY PHONE: 01689 899 200, quote ref: E132
ONLINE: www.subscription.co.uk/encanta/E132
BY POST: Complete the form below and return to: Encanta media subscriptions, Tower House, Sovereign Park, Market Harborough, Leics LE16 9EF

1

☐ I would like to start a subscription to:________________________ magazine for myself / as a gift. (please circle)

☐ I am a current subscriber, please extend my current term.

2

YOUR DETAILS:
Name Mrs/Ms/Miss/Mr..................
Address..................
....
Postcode.......... Daytime tel no..........
Mobile..................
E-mail..................

RECIPIENT DELIVERY ADDRESS (If different from above):
Name Mrs/Ms/Miss/Mr..................
Address..................
....
Postcode.......... Daytime tel no..........
Mobile..................
E-mail..................

3

PAYMENT:
☐ Please find enclosed a cheque for £__________

Please make cheques payable to Encanta Media Ltd and write the SECURITY CODE (the last 3 digits on the reverse of you bank card) on the back.

☐ Please debit my:
Switch/Maestro ☐ Visa ☐ Mastercard ☐ AMEX ☐
Card No: ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐
Expiry Date: ☐☐☐☐ Switch/Maestro issue No: ☐
Signed:____________________ Date:__________

TERMS & CONDITIONS: Offer open to UK only, overseas rates available on request. Offer ends 31st December 2006. Subscriptions will begin with the first available issue. Please continue to buy your magazine until you receive your acknowledgement letter. Refund requests must be in writing to the Publisher and will not be given on accounts with less than £20 credit. A £5 admin charge will apply and will be deducted from any refund. Refunds will only be given at the Publisher's sole discretion. Encanta Media Ltd may contact you or share information with other reputable companies to let you know about products and services that may be of interest. Tick if you do not want to receive information about offers from us ☐ or from third parties ☐

A GIFT THAT LASTS ALL YEAR!

SAVE 25%
1 Year ~~£40.20~~
NOW £29.99

SAVE 13%
1 Year ~~£45.50~~
NOW £39.50

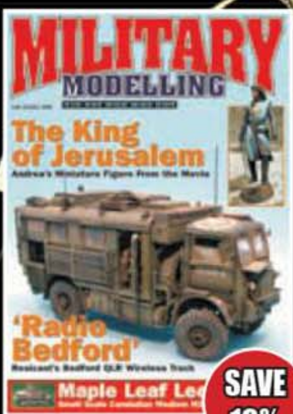
SAVE 20%
1 Year ~~£42.90~~
NOW £33.99

SAVE 10%
1 Year ~~£44.20~~
NOW £39.99

SAVE 18%
1 Year ~~£65.00~~
NOW £53.50

SAVE 10%
1 Year ~~£37.50~~
NOW £33.75

SAVE 10%
1 Year ~~£42.00~~
NOW £37.80



SAVE 10%
1 Year ~~£54.00~~
NOW £48.60

SAVE 10%
1 Year ~~£39.60~~
NOW £35.60

For multiple orders please photocopy the order form!
Alternatively call our subscriptions hotline: 01689 899 200

MODEL ENGINEER CLASSIFIED

Tel: 01689 899 215

Fax: 01689 899 266

Email: jenni.collins@encanta.co.uk

All advertisements will be inserted in the first available issue. There are no reimbursement for cancellations. All advertisement must be pre-paid. The Business Advertisements (Disclosure) Order 1977 - Requires all advertisements by people who sell goods in the course of business to make that fact clear. Consequently all trade ads in *Model Engineer* carry this 'T' symbol

MODELS & MATERIALS

MODEL ENGINEERING SUPPLIES (Romford)

Suppliers of:

Ferrous, Non-Ferrous metals
B.A. Metric – nuts, bolts
Screws. S/H & New tools,
cutters & tooling.
Boiler Fittings, oils,
stocks added weekly.

NO VAT

Send large SAE + 2 x 1st Class stamps for catalogue

Tel: 01708 341216/722346 for details

Model Engineering Products (Bexhill)

www.model-engineering.co.uk
Email: mep1@btconnect.com

Manufacturers of 5" and 7¼" diesel outline battery electric locomotives and rolling stock.
Visit our shop to see the stock.
Colour brochure inc. p&p £1.75
PHONE/FAX. 01424 223702
MOBILE 07743 337243

17, SEA ROAD, BEXHILL ON SEA, EAST SUSSEX. TN40 1EE.

NEIL GRIFFIN

- St.Albans, Hertfordshire
Engineering Services
Machining for Model Engineers
From drawing, sketch, pattern etc.
Friendly personal service.
Telephone / Fax: 01727 752865
Mobile: 07966 195910

COPPER TUBE, SHEET, BAR

and other non-ferrous metals.
Send 9" x 4" SAE for lists.
R. Fardell, 49 Manor Road, Farnley Tyas, Huddersfield HD4 6UL
Tel: 01484 661081

MODEL MAKING METALS

1/32in. to 12in. dia. bright steel,stainless steel, bronze, spring steel, brass, aluminium, silver steel, steel tubes, bolts, nuts & screws, tap dies + drills, white metal casting alloys. Fine materials, chain, plastic, Lathe milling machines and equipment, new and secondhand.

Mail order nationwide and worldwide callers Mon.-Fri. 9-5pm.
Access/Visa welcome

Send now for a free catalogue or phone:
Milton Keynes Metals, Dept. ME,
Ridge Hill Farm, Little Horwood Road, Nash, Milton Keynes, MK17 0EH Tel: (01296) 713631 Fax: (01296) 713032
Web: mkmetals.sageweb.co.uk Email: sales@mkmetals.co.uk

TAPS & DIES *for Model Engineers*

LARGEST manufacturer/supplier 27 years – EXCELLENT Quality
British quality HQS taps & dies (better then HSS) cuts stainless
AWARD winning ALL types/sizes: *BSW,BSF, UNC,UNF BSP,BSPT,NPT, BSCycle,WF,BSB, BA, Model Eng*

Over 1000 Wooden-boxes
British-made (designed by us)
in ALL above types on the shelf
3 boxes = *ME5 (30pc)* + *ME4 (27pc)* + *BA3 (35pc) covers EVERY type & size of Model Eng taps & dies*

ME5 = 1/8,5/32,3/16,7/32,1/4,9/32,5/16,3/8,7/16,1/2 (all 40tpi)
ME4 = 5/32,3/16,7/32,1/4,9/32,5/16,3/8,7/16,1/2 (all 32tpi)
BA3 = 0,1,2,3,4,5,6,7,8,9,10 (ask for prices or see website)

Metal-boxes (designed by us) with T or S or B or dies:-
ME1= 1/8+3/16+1/4+5/16+3/8+7/16+1/2 (all 40tpi)
ME2= 5/32+3/16+1/4+5/16+3/8+7/16+1/2 (all 32tpi)
Taps: 1 box=£22, 9 box=£16.50, 36 box=£13.86
Dies: 1 box=£35, 9 box=£26.25, 36 box=£22.05
World-delivery, Bankcards, SAME DAY post/VAT

1000's of all other types/sizes
Also: Drills, Reamers, Endmills, Slotdrills
Slitting Saws etc - No Minimum order

www.tapdie.com

THE TAP & DIE CO
445 West Green Road, London N15 3PL – UK
Tel: +44 (0)20 88881865 Fax: +44 (0)20 88884613

GB BOILER SERVICES

COPPER BOILERS FOR LOCOMOTIVES AND TRACTION ENGINES etc.
MADE TO ORDER
Constructed to latest European Standards
7¼" guage and P.E.D. category 2 Specialist
NO VAT
Enquiries, Prices and Delivery to:
Telephone: **Coventry 02476 733461**
Mobile: **07817 269164**

MARSHALL 7 NHP TRACTION ENGINE

3" scale MARSHALL 7 NHP single cylinder general purpose Traction Engine of 1910 'PRIDE OF THE ROAD'

BRUNELL MODELS

SEND NOW for our fully illustrated A4 catalogue with 54 models, some in full colour Stationary, Marine, Traction Engines and Locos
UK £5.50 • Europe £7.50 • Rest of world £9.50
Sterling cheque/credit card only. All incl. p&p.
Order on line at: **www.brunell.com**
Brunell Models, Unit 32, Heysham Business Park, Middleton Road, Heysham, Lancs. LA3 3PP
email: sales@brunell.com • Fax/Ans 01524 855887

ALL MODEL ENGINES WANTED ANY SIZE OR CONDITION

All steam,electric or petrol model engineered items required
Also stationary engines inc. Stuart Turner,Bassett Lowek,Bing,Marklin etc
All traction engines any size from 3/4" to 6"
All locos wanted from Gauge 1, 2 1/2, 3 1/2, 5 , 7 1/4 and larger
Also any rolling stock
Any part builts considered
Any size, age or condition considered

Will collect personally from anywhere 7 days a week

For a friendly informed chat call Kevin

01507 606772 or 07717753200

www.arceurotrade.co.uk

Unbeatable Value Engineering Products by Mail Order

Shop on-line or call us on 0116 269 5693 for our *New Catalogue No.5*

(24 hr update) **www.tradesalesdirect.co.uk** (Trade Prices)

Don't wait for the next issue! Check out the Internet Web Site above. It contains a stocklist of used lathes, millers, grinders, drills, saws, miscellaneous machinery, accessories, items of interest, etc. A stocklist is also available 'FREE' by post.
Contact: David Anchell, Quillstar Ltd, Lower Regent Street, Beeston, Notts. NG9 2DJ
Tel 0115 9255944 Fax. 0115 9430858 or you can send an e-mail to: **david@tradesalesdirect.co.uk.**
WORLDWIDE SHIPPING. TRADE SALES DIRECT IS A SUBSIDIARY OF QUILLSTAR LTD.

Dreweatt Neate

AUCTIONEERS AND VALUERS ESTABLISHED 1759

SPECIALIST STEAM AUCTION

ENTRIES NOW INVITED

LIVE STEAM MODELS, MODEL STATIONARY ENGINES, LOCOMOTIVES, TRACTION ENGINES, LATHES & EQUIPMENT, BOATS and STEAM TOYS.

A 2 inch scale Fowler Showmans Engine which sold in our last auction for £8,400.00

Consultant: Michael Matthews MRICS.IRRV Tel: 01404 47593. Email: mmatthews@dnfa.com
Auctions to be held at Dreweatt Neate-Bristol. St John's Place, Apsley Road, Clifton, Bristol. BS8 2ST.

Mallard Metal Packs Ltd

53 Jasmin Croft, Kings Heath, Birmingham, B14 5AX.
Tel/Fax: 0121 624 0302. E-mail: sales@mallardmetals.co.uk
Supplier of all Ferrous & Non-Ferrous Metals.
NO MINIMUM QUANTITY ***CATALOGUE AVAILABLE***
Worldwide mail order. www.mallardmetals.co.uk

KITS FOR TWO TOOL AND CUTTER GRINDERS

THE SOPHISTICATED ***THE SIMPLE***

THE QUORN

THE KENNET

FOR INFORMATION ON THESE AND OTHER KITS S.A.E. TO

MODEL ENGINEERING SERVICES

PIPWORTH FARM, PIPWORTH LANE, ECKINGTON, SHEFFIELD S21 4EY
PHONE 01246 433218
M.E.S. Website: www.lawm.freeserve.co.uk

CLOCK CONSTRUCTION & REPAIR

Books by John Wilding and others

Free Catalogue
01420 487 747
www.ritetimepublishing.com

ALL 3½" GAUGE LOCO's WANTED

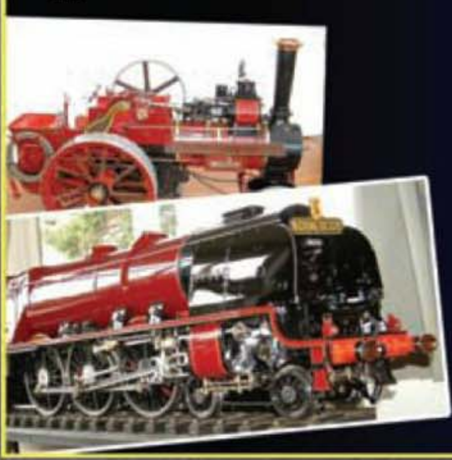
Tich, Juliet, Rob Roy, Firefly, Jubilee, Maisie, Doris, GWR Hall, Britannia, Hielan Lassie, etc

ALL 5" GAUGE LOCO's WANTED

Hunslett, jinty, Simplex, Speedy, BR Class 2, Horwich Crab, BR 8400 tank, Maid of Kent, Black Five, Jubilee, Royal Engineer, BI Springbok, Torquay Manor, Castle, A3/A4

ALL 7¼" GAUGE LOCO's WANTED

Hunslett, Hercules, Jessie, Romulus, Bridget, Dart, Holmeside, Paddington, GWR Mogul 43xx, GWR King, Black Five, A3, BI, Brittannia, etc



ALL TRACTION ENGINES WANTED

Minnie, Burrell, Royal Chester, Showmans, etc

ALL PARTBUILT MODELS WANTED

We also purchase WORKSHOP EQUIPMENT
Regular collections made throughout:
SCOTLAND, ENGLAND AND WALES
For a professional friendly service, please tel:

GRAHAM JONES M.Sc. 0121 358 4320

visit our website: www.antiquesteam.com

ALL LOCOS AND STEAM ENGINES REQUIRED $3^1/_2$" – 5" – $7^1/_4$"
Part built or Finished in any condition. Complete collections purchased
FOR CASH – Distance no object, available 7 days a week
Please telephone Kevin on 01507 606772 for a friendly and informal chat

ENGINEERS TOOL ROOM

The tool supplier for Professional & Model Engineers
CUTTING TOOLS: HSS – COBALT – COATED

Drills: Metric, Fractional, Jobbers, Long Series, Boxed Sets
Reaming: Metric, Fractional Hand and Machine.
Threading: Taps, Straight Flute, Spiral Flute, Boxed Sets, Metric, Imperial, Unified, BA.
Dies: Split Dies, Solid Dies, Die Nuts, Metric, Imperial, Unified, BA.
Milling: End Mills, Slot Drills Plain and Screw Shank, Horizontal Cutters, Slitting Saws, Collets.
Turning: HSS Tool Bits, Tungsten Carbide Tipped Turning Tools, Insert Tools, Collets.
Measuring: Micrometers, Verniers, Dividers, Callipers, Setting up Tools
Workshop Machinery: Lathes, Milling Machines, Pillar Drills, Band Saws
Machining Services: full machining service available, turning, milling, grinding, wire and spark eroding, tool and mould making

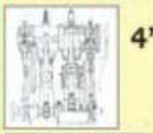
"New" Tool Catalogue available FREE – Send for one today

CHECK OUT OUR SPECIFICATIONS & PRICES BEFORE ORDERING YOUR MACHINES – Contact us for a Quotation
Part Exchange on some machine tools welcomed
Tel: 01443 442651 Fax: 01443 435726 Mobile 07770 988840
Web Site: www.engineerstoolroom.co.uk
Email: regpugh@aol.com
UNIT 28, ENTERPRISE CENTRE, LLWYNYPIA ROAD, TONYPANDY, RHONDDA CF40 2ET

Ortec

Ortec are manufacturers of low cost, high quality, precision digital readout - DRO for machine tools such as milling machines for the hobbyist and model engineering user. We offer a complete range of readouts from 1 to 3 axis in a variety of encoder lengths.
Phone +44 (0)1481-235708
www.ortec.freeserve.co.uk

DRAWINGS AND CASTINGS



4" scale *Tasker* "Little Giant" Steam Tractor
3" & 5" x 4" Marine Compound Engine
3" scale *Rider-Ericsson* Hot Air Pumping Engine

For full details send a large SAE - or see our website.

Camden Miniature Steam Services
Barrow Farm, Rode, Frome, Somerset. BA11 6PS
www.camdenmin.co.uk Tel: 01373 - 830151

THE 10NHP McLAREN ROAD LOCOMOTIVE
THE ENGINE WITH BUILT-IN PERFORMANCE

Drawings and castings for this engine in 3" and 4" scales are now available.
A 6" scale version is under development. Some parts are ready now.
A video of both 3" & 4" sizes of engine at work is available at £6.00 per copy. Carriage included
INJECTORS 3",4"and 6" scale, Penberthy-style, up to 200 PSI W/P.
FITTINGS Water gauges and lifters, whistles and sirens, lubricators, steam and water valves.
RUBBER TYRES Now available from 2" to 6" scale, e.g.2" Fowler, 3" Marshall, 4" Foster or Garrett, 41/2" Burrell
WATER TREATMENT Heatreat 502, litre or half-litre bottles.
LUBRICATING AND STEAM OILS Litre bottles. **POWELL BALER** in 3" scale, drawings and photographs

For further details please contact
Double B Designs, 172 Melford Road, Sudbury, Suffolk, CO10 1JZ
Tel/Fax 01787 375819

VISA

Carr's Solders

Cadbury Camp Lane,
Clapton in Gordano, Bristol. BS20 7SD
Tel:**01 275 852 027** Fax:**01 275 810 555**
Email: sales@finescale.org.uk
www.finescale.org.uk

NEW! - Lower cost, compact, high performance speed controller and motor combination.

The new CL range features start, stop and emergency stop buttons and speed control with forward, reverse and jog. It comes complete with high quality motor and is ready to mount, plug in and go!

Call us now for more information and friendly advice on
01925 444773
or visit www.newton-tesla.com

From only £390 inc VAT

NEWTON TESLA
The Driving Force in Automation
Unit G18, Warrington Business Park, Long Lane, Warrington, Cheshire WA2 8TX, UK

Practical Scale - Drawings, castings, laser cut frames, etc for designs by Neville Evans (including the Highland Locos - Loch & Jones Goods, Penrhos Grange and the forthcoming Schools Class) are now available from
Polly Model Engineering Limited.
Tel: 0115 9736700
or see web page
www.pollymodelengineering.co.uk
for further details

BOOST PHASE CONVERTERS

- Price Guarantee
- Performance Guarantee
- 3 Year Warranty
- Worldwide Delivery
- Outstanding Design
- Comprehensive Support

Boost Energy Systems
Park Farm, West End Lane,
Warfield, Berkshire RG42 5RH
Tel: 01344 303 311
Fax: 01344 303 312
Mob. 07952 717960
www.boost-energy.com
info@boost-energy.com

HIGH QUALITY UK PHASE CONVERTERS SINCE 1957

FOR SALE

Wanted any drawing and casting for 7 ¼ 0-6-0 basseett lowke **Tel: 0117 982 425**

Raglan 5" x 24" lathe stand variable speed powered crossfeed screw cutting gearbox vertical slide face plates steadies single phase £1,000.

5" g Speedy part built chassis by professional engineer. All castings drawings – j-pegs, £500 **Tel: 01652 661 224**

Colchester bantam 800 lathe, V G C, Q.C.T. 3 jaw, 4 jaw, varios tooling, 3phase £950.00 ONO BUYER COLLECTS
PHONE 07761149642 HAMPSHIRE

Wanted 5" Gauge battery powered toby for grandsons **Tel: 01992 584 725**

3 in 1 centre lathe with Mill/Drill head lath SPEC swing over bed 300mm dia swing over cross slide 440mm dia betaum centres 500mm. With 5" 3jaw chuck £325 **Tel: 01285 851 805**

V.L Churchill vacuum pump unit motor 220/240 Bhp 0.25 Offers **Tel: 0117 978 0542**

5 g metro partbuilt chassis, swindon copper boiler, castings drawings £1050 **Tel: 01274 881 803**

For sale Brooks ¾ HP phase motor for super 7 with push button starter. Set of 12 myford HSS lathe tools with toll boat in box. Long cross slide for ML7 with feed screw and gib. Offers. ME magazines 1973 – 2004, boxed with index.
Free to whoever will take them away,
Tel: 0131 332 3401

Chester UK Ltd

WWW.CHESTERUK.NET

New Range Of Variable Speed Machines

DB7V LATHE
£475.00

DISTANCE BETWEEN CENTRES	300MM
SWING OVER BED	180MM
SPINDLE BORE	21MM
RANGE OF SPINDLE SPEEDS	50~2500RPM
MOTOR	3/4HP
DIMENSIONS (LxWxH)	780x480x420MM

DB8V LATHE
£695.00

DISTANCE BETWEEN CENTRES	400MM
SWING OVER BED	210MM
SPINDLE BORE	21MM
RANGE OF SPINDLE SPEEDS	50~2000RPM
MOTOR	3/4HP
DIMENSIONS (LxWxH)	1050x560x570MM

CHAMPION 20V
£775.00

MAX. DRILLING CAPACITY	20MM
MAX. END MILLING CAP.	20MM
MAX. FACE MILLING CAP.	63MM
TABLE SIZE	700x180MM
SPINDLE TAPER	MT2
RANGE OF SPEEDS	50~2200RPM
MOTOR	1HP
DIMENSIONS	670x550x860MM

DB10V LATHE
£895.00

DISTANCE BETWEEN CENTRES	550MM
SWING OVER BED	250MM
SPINDLE BORE	26MM
RANGE OF SPINDLE SPEEDS	50~2500RPM
MOTOR	1HP
DIMENSIONS (LxWxH)	1150x700x570MM

DB11V LATHE
£1195.00

DISTANCE BETWEEN CENTRES	700MM
SWING OVER BED	280MM
SPINDLE BORE	26MM
RANGE OF SPINDLE SPEEDS	125~2500RPM
MOTOR	1HP
DIMENSIONS (LxWxH)	1390x700x630MM

Visit Our Online Shop

www.chesteruk.net

All Prices Include Vat & Delivery*

Call For Our Latest Catalogue

*UK Mainland only

Chester UK Ltd | Clwyd Close | Hawarden Ind. Park | Chester | CH5 3PZ | **Tel:** +44(0)1244 531631
Fax: +44(0)1244 531331 | **Email:** sales@chesteruk.net | **Web:** www.chesteruk.net

Midlands Showroom

Rotagrip Ltd | 16-30 Lodge Road | Hockley | Birmingham | B18 5PN | **Tel:** +(0)121 551 1566
Fax: +44(0)121 523 9188 | **Email:** rotagrip@blueyonder.co.uk