

MODEL ENGINEER

Vol. 195 No. 4253

5-18 August 2005

*75th MODEL
ENGINEER
EXHIBITION*

29-31 December

*SANDOWN PARK
ESHER
SURREY*

**HOT
ENGINES
FOR
KIDS**

**ENGINE
DESIGN**

**SUPER NORTH
AMERICAN SHOW**





OPEN WEEKEND 3rd & 4th September

ATTRACTIONS INCLUDE CLASSIC MOTORCYCLES AND CARS.

Supported by Guildford Model Engineer Society with a selection of finished and part finished models. Roy Darlington will be exhibiting a selection of his Stirling Hot Air Engines. On site catering.

Huge range of Warco ex-demonstration and shop soiled machines at bargain prices. Part exchange machines, Myford, Boxford, Elliott, Bridgeport and more, all at clearance prices.



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- Coolant system £130 inc VAT
- Tailstock die holder £39 inc VAT

- THE ULTIMATE MODEL ENGINEERS LATHE
- HARDENED AND GROUND BEDWAYS
- TAPER ROLLER BEARING HEADSTOCK SPINDLE
- TEE SLOTTED CROSS SLIDE
- POWER CROSS FEED
- NORTON THREAD CUTTING GEARBOX
- 2HP SINGLE PHASE MOTOR
- BACK GEAR WITH 50 RPM LOW SPEED
- 1 3/8" SPINDLE BORE

SUPPLIED WITH ACCESSORIES AT NO EXTRA CHARGE

- 6" 3 JAW CHUCK
- 8" 4 JAW CHUCK
- 10" FACE PLATE
- FIXED & TRAVELLING STEADIES
- FOUR WAY TOOL POST
- IMP/MET THREADING
- STAND, COOLANT TRAY, REAR SPLASH BACK



Warco Mini Lathe

ONLY £375 inc VAT & Delivery

- 3 1/2" CENTRE HEIGHT X 12" BETWEEN CENTRES
- SUPPLIED WITH 3 JAW CHUCK
- FACEPLATE
- THREADCUTTING
- COOLANT TRAY AND SPLASH BACK
- VARIABLE SPEED 0-2500RPM WITH BACK GEAR FOR MAXIMUM TORQUE
- HARDENED AND GROUND VEE BEDWAYS
- ACCURACY TEST CERTIFICATE WITH EACH LATHE
- RELIABLE USA BUILT PRINTED CIRCUIT BOARD - THE HEART OF THE MACHINE
- OPTIONAL ACCESSORIES STEADIES AND VERTICAL SLIDE,

Special offer
Tailstock drill chuck and TCT indexable lathe tool set with each machine.



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Optional floor stand £99

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- SPEED SELECTION BY LEVER
- PRECISION GROUND VEE BEDWAYS
- LARGE BORE SPINDLE RUNNING ON TAPER ROLLER BEARINGS
- COVERED LEADSCREW
- SET OVER TAILSTOCK FACILITY
- INDIVIDUAL ACCURACY TEST REPORT
- SAFE ELECTRICAL INTERLOCKS TO CHUCK GUARD AND GEAR TRAIN COVER

SPECIFICATION:

- CENTRE HEIGHT 4"
- DISTANCE BETWEEN CENTRES 14"
- SWING OVER CROSS SLIDE 5"
- SPINDLE BORE 3/4" CLEARANCE
- SPINDLE SPEEDS (6) 140/1710 RPM
- HEADSTOCK TAPER 3MT
- TAILSTOCK TAPER 2MT
- RANGE OF IMPERIAL THREADS 8-24 TPI RANGE OF METRIC THREADS 0.4MM - 3MM
- MOTOR 1/2 HP 1 PHASE • DIMENSIONS 38" LONG x 19" WIDE x 15" HIGH • WEIGHT 230 LB

SUPPLIED WITH:

- 4" 3 JAW SELF CENTERING CHUCK
- 4" 4 JAW INDEPENDENT CHUCK
- FIXED STEADY
- TRAVELLING STEADY
- FACE PLATE
- FOUR WAY INDEXING TOOL POST
- 3MT AND 2MT DEAD CENTRES
- METRIC & IMPERIAL THREAD CUTTING CHANGE GEARS
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- REAR CHIP GUARD

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Technical Consultants
Mike Chrisp
Stan Bray,
J. Malcolm Wild FBHI,
D. A. G. Brown
Editorial Administrator
Laura Ellis (01689-886677)

PRODUCTION

Design
Carol Philpott
Production Manager
Alan Scott
Printed by
Polestar (Colchester)
Origination by
Ateller Data Services

SALES & MARKETING

Group Sales Manager
Colin Taylor (01689-886649)
Sales Manager
Tony Robertson (01689-886650)
Subscription Marketing Executive
Voula Browne (01689-887209)

CIRCULATION

Circulation Director
Brian Donnelly (020 7608 6723)
Non-newstrade Distribution
Mike Reynolds-Jones
(0121-788-3112)

MANAGEMENT

Publisher
Jez Walters
Divisional Director
Dawn Frosdick-Hopley
Group Financial Controller
Tom Stringer
Managing Director
David Nizol

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IN THIS ISSUE

● Vol. 195 No. 4253 5 AUGUST 2005 ●

SMOKE RINGS

Editorial news, views and comment.
PAGE 129

POST BAG

Letters to the Editors.
PAGE 130

NAMES 2005

Report from Peggy Hodgson on the North
American Model Engineering Symposium,
with details of some excellent models.
PAGE 132

SPRING HAMMER

Continuing the description of making this
interesting and attractive model, by the late
David Lammass.
PAGE 136

IN THE NEXT ISSUE

Looking forward to a full report on a most
interesting IMLEC 2005 at the
Northampton club.
PAGE 137

I/C ENGINE TOPICS

More from the scribe of our special I/C
correspondent, Nemett, including engine
performance, design and software.
PAGE 138

ACROBAT

Martin Rooks describes how to make a
fascinating classic toy in plenty of time for
this year's Christmas stockings.
PAGE 141

ANNA

Supplying the water, setting out the
plumbing and details of the various valves
for this impressive NG locomotive.
PAGE 145

ELECTRO-PNEUMATIC CONTACTORS

Colin Beckwith competes the description
of the final part and brings this fascinating
series to a conclusion.
PAGE 149

MG TC

Stephen Atkinson describes how to make
the engine, radiator and the wheel
spinners.
PAGE 152



On the cover ...

Model V-twin Harley pan head built by
Ron Colonna and exhibited at NAMES
2005, the main show in the United States
for Model Engineers. In this issue we
report on the show, some fine exhibits,
and some interesting modellers. Visitors
were summoned to the Harley by the
sound of Ron's other exhibit, the mighty
roar from his model Offenhauser 270
Indianapolis racing car engine. Around
4,000 visitors attended the show.

(Photograph by Peggy Hodgson)

HOT ENGINES FOR YOUNGSTERS

James G. Rizzo tells the story of three
boys, their grandfather and three special
Stirling engines.
PAGE 156

LETTER TO A GRANDSON

M.J.H. Ellis recalls the models of the
Uruguay-reared J.J. Constable, and a spot
of Spanish bother.
PAGE 159

LILLIAN

Keith Wilson looks at those vulnerable
essentials the drain cocks, and recalls
some tricky moments.
PAGE 160

CONVENIENT LOCOMOTIVE BUILDING STAND

Colin Abrey presents a simple design
proven in the workshop, which takes up
little space.
PAGE 162

CLUB CHAT & CLUB DIARY

Recent activities and forthcoming events.
PAGE 164

TURN TO PAGE 128 FOR GREAT OFFERS ON SUBSCRIPTIONS

INDEX to ADVERTISERS

Arc Euro Trade	125	Jade Products	125
Book Ad - Information	174	Leofric	127
Bristol Model Engineering		Machine Mart	121
Show	123	Mag and Light	166
Camden	125	Maxitrak	127
Chester	176	Peter Clark	123
Chronos	124	Polly Models	127
Classified	168 - 173	REEVES 2000	122
Compass House Tools	123	Stirling-Technik	125
G & M	127	Stuart Models	126
GLR	120	Subscriptions	128
Greenwood Tools	127	Tooling Direct	120
Hemingway Kits	125	Triple H Machinery	120
Home & Workshop	175	WARCO	118



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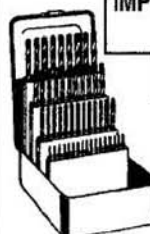
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• 1.58 dm air displacement
• 2.8 Bar Max Working Pressure

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SB30	Large Cabinet	Floor	£249.95	£293.69

Clarke 12 SPD MILL/DRILL

ONLY **£599.95**
£703.92

Precision engineered with cast iron head, base & column
• Spindle speeds 100-2150rpm
• 4 Hp, 230v, 1 Ph motor
• Accessories available
• 63mm milling cutter
• 16mm chuck
• Table size 585x190

MODEL	SIZE (LxWxH MM)	EX VAT	INC VAT
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CWB1500	1500x650x880	£149.95	£176.11
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MODEL	SIZE (LxWxH MM)	EX VAT	INC VAT
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CWB1500	1500x650x880	£149.95	£176.11
CWB2000	2000x650x880	£169.95	£199.41

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CSB20	Compact Cabinet	Bench	£94.95	£111.57
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CSB20	Compact Cabinet	Bench	£94.95	£111.57
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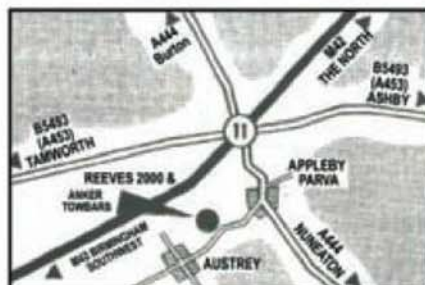


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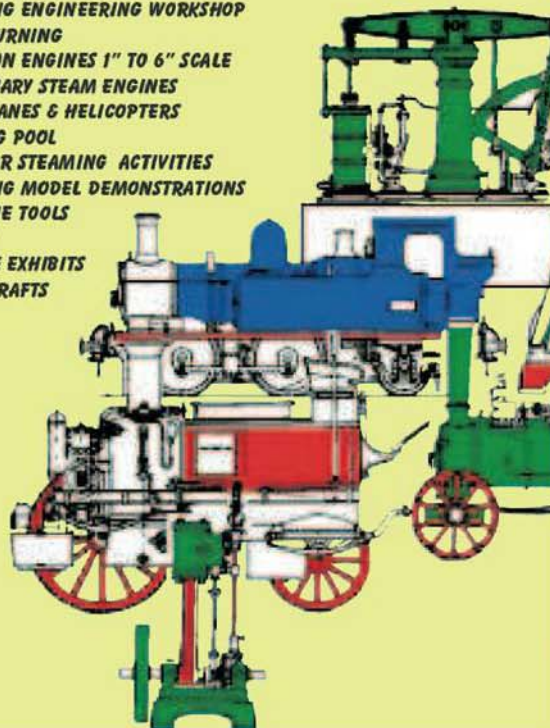
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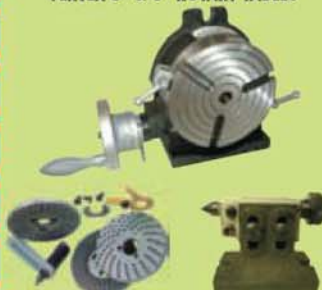


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SMOKE RINGS

With the Editors

Where are they now?

Looking around in recent months, we have seen plenty of super new models that we would also like to see at the Model Engineer Exhibition at Sandown Park later in the year. It would also be good to see a few old favourites return.

This year's show will be the 75th. To celebrate that milestone, it would be great to see a good selection of winners of medals and other awards from earlier years, whether they have been kept in cotton wool or seen regular use to gain some character.

If you can bring a loan model, either a past competition exhibit or an unfinished model, or one you would rather not be judged, you will be doing more than helping to make this a special show, and getting free entry. If we can put on a really first-class display of the best in model engineering, not just for this year, but also from the past and looking towards future years, we can do a real service to the model engineering movement.

Regular visitors go to get their annual fix of inspiration by seeing what others have achieved. By putting on something extra special this year, we can set out to inspire others, including newcomers to the hobby.

The future of model engineering will depend on newcomers. Gaining their interest can best be achieved by putting on a great show.

So, if you are a past exhibitor do please display your model again at Sandown Park this year. If



you have a friend with a model that would make an interesting exhibit, get to work on him. If you have bought one, you will be most welcome, too.

Engineers can be a reticent lot at times, disliking anything that smacks of showing off. That is understandable. However, joining us and many of the world's greatest model engineers in December will mean far more in terms of promoting our hobby.

Let's make the 75th show really special. After all its 25 years to the next major anniversary.

COMPETITION

Just in case you missed it in the last issue, we are planning to revive publishing hints and tips, or workshop wrinkles, from readers. So, let us have your ideas, simple or complex, long or short, for the benefit of people who have not come across them before. In the issue we will publish a few wrinkles.

You can also win a prize. We have a Stonefly Mag and Light, worth almost £50 to give to whoever submits before the end of September the best idea in the entirely subjective opinion of the editors.

Sir Hiram was apparently satisfied that he could fly whenever he wanted to, so left it at that. That was in 1894. So his contentment meant that he gave up the opportunity to become the first man to fly a heavier-than-air power-driven aircraft. See also *M.E.* 156 21 April 1904.

Sounds like Maxim's machine would be worthy of some research with a view to producing a model, perhaps to run on club rails, loco men permitting!

Change of company

Eagle eyed readers will have noticed that *Model Engineer* is no longer part of Highbury Leisure. Most of that company has been sold, but the sale did not include the sub-group of special interest magazines that includes *M.E.* This group, including *M.E.*, is not now for sale. With the sale of Highbury Leisure, we are now part of the parent company Highbury House Communications plc.

Everything else remains unaltered. All the same people doing the same jobs.

An apology

Unfortunately some copies of issue 4250 dated 24 June 2005 were late in arriving due to a distribution problem. We should like to apologise to those subscribers who receive their copies by post for any delay they experienced. Normally subscribers receive their copies a few days before they appear in newsagents.

Subscription by post is normally the best. You receive it earlier, while saving 25% of the cost.

More steam aircraft

Since preparing the article on the Comet, the steam-powered aircraft built by Edward Perera (*M.E.* 4248, 27 May 2005) we have learned a little more about full-sized steam planes. We have received a couple of letters already telling us about two steam-powered aircraft that flew.

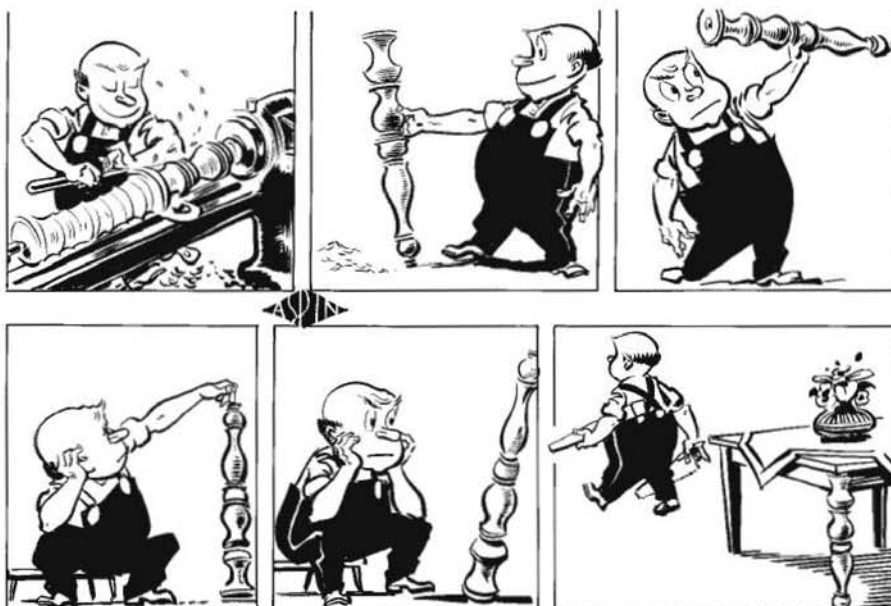
Then, looking through an old booklet edited by our illustrious predecessor, Percival Marshall, entitled *1001 Mechanical Facts Made Easy* (price half a crown) we found two more. Mention is made of Henson's 'Aerial' of 1840, which was based on Henson and Stringfellow's successful steam-powered model.

He also mentions early work by Sir Hiram Stevens Maxim, better known eventually for the famous machine gun that bears his name. His 'Flying Machine' was powered by a "steam engine of remarkable design and construction."

This aeroplane actually ran on a set of rails, but thanks to check rails was restricted to flying only a few inches off the ground. On trial enough lift was generated to tear up the restraining rails, and had Sir Hiram not shut down the aircraft would probably have gone into free flight. Instead the outfit was wrecked.

CHUCK, the MUDDLE ENGINEER

by B. TERRY ASPIN



Vernier couplings

SIRS, - Further to Mr. Spenlove-Spenlove's article on verniers, readers may be interested in further uses of this principle, which is quite often used in engineering and particularly on aero engines.

I am enclosing a copy of the timing gear layout of the Rolls-Royce Kestrel engine, which was the forerunner of the famous Merlin and Griffon engines. The Merlin layout was virtually identical and it was probably the same in the earlier Rolls-Royce engines.

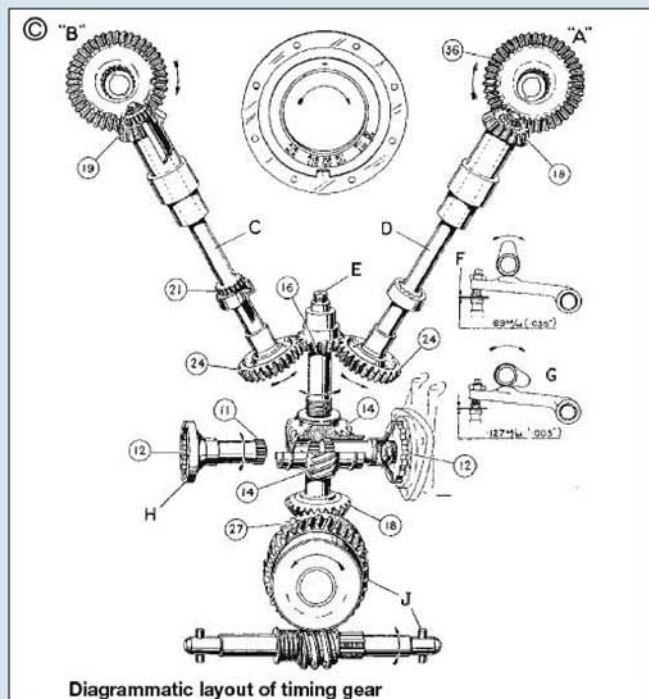
In the diagram the port side couplings are shown lifted up and therefore disengaged while the other side is shown engaged. Couplings C and D drove the camshafts and H or 12 the magnetos. Both of these had 21 splines on one end and 19 on the other. This allowed timing to be adjusted to within less than one degree.

Napiers used a similar system for timing but instead of splines they used flanges bolted together with unequal numbers of holes.

I am not certain, but if I remember correctly the coupling described in the article was known as a 'Simms coupling'. No doubt some other reader will be able to confirm.

I hope this might be of interest to other readers who might not have had the privilege of dealing with Rolls-Royce engineering.

Derek S. Moxley, Somerset.



furniture! I also admit to making tools - another dirty word to the absolute steam fanatic. If the fanatics had their way this magazine would be steam locomotives from cover to cover for a few months and then dead, I can remember the days when this magazine also carried articles on:

1. Model boats.
2. Model aircraft.
3. Toy manufacture.
4. Machine Tools.
5. Workshop buildings.
6. Petrol engines.
7. Model buildings.
8. Making workbenches.
9. Windmills.
10. Watermills.
11. Visits to historical sites.
12. Etc, etc & etc.

Pressure from the locomotive lobby over the last 25+ years has resulted in the parent company floating new magazines to specialize in boats, aircraft, tools, etc. If much more is hived off to satisfy that lobby there won't be anything much left. I will also mention that I am not anti-locomotive either as I am building a free-lance 3 1/2 in to 1 ft. 0-4-4-0 mallet on 7 1/4 in gauge as a first model locomotive.

Many insist that the days of 'LBSC' were the best, well just have a look at the range of subjects in the articles he wrote. There are few alive who remember Model Engineer of the 1920s and 30s but many clubs have copies, I suggest examination of those pages and also pre WW1 as the magazine then included a large variety of different topics.

With due regard to the above I am not sorry to say that Mr. Moon is out on a thin limb, as the history of this magazine shows an extremely wide ranging and catholic interest in any matter that can by the greatest stretch of the imagination be related to 'Model and Experimental Engineering' and long may it be so.

Peter King, New Zealand.

Water in the fuel

SIRS, - I read with interest the article by Dr. Malcolm J. Metcalfe (M.E. 4247, 13 May 2005) about the use of injecting water into an internal combustion engine.

In fact this is not a new idea, it was used during WW2 on the American Air Force P40 Mustang aero engines which utilised turbo charging and fuel injection. The addition of a controlled amount of

water delivered a considerable boost in power output and caused the engine to run more efficiently and cooler. The German Luftwaffe apparently was the first to experiment with the Mercedes and BMW aero engines prior to the start of the war. There is some data to support the belief that the Wright Brothers in their first powered aircraft used a crude form of water injection, they indeed did use the very first example of fuel injection although many regard it as a carburettor.

I have also experimented extensively in this subject and published several articles which have been posted throughout the world on various internet sites. The most recent being on the Fiat Uno Turbo website where a two part article can be found that covers the physics and also the practical manufacture of the necessary hardware. In this modification the power output rose some 20% and the turbocharger air outlet temperature dropped over 60deg.C before the intercooler. This is a dramatic reduction as the intercooler at best can only manage about 40deg.C at high forward speed.

I have over the years seen various commercial exploitation of this topic. It seems none of the various attempts have ever been a commercial success.

The basic principle is quite simple. The addition of a water mist, the finer the better, lowers the temperature of the air going into the engine. Cold air is denser than hot air and can therefore support more fuel to be burnt. It is the lowering of the temperature and hence density that allows more power to be developed. The lower the air temperature entering the engine the more power the engine can develop before the onset of detonation. For this reason it is common to use an air intercooler on supercharged and turbocharged engines.

In fuel injected petrol engines an air temperature sensor monitors the air temperature and adjusts the amount of fuel delivered by the solenoid injectors. Hence, if the air is very hot the mixture is leaned out and conversely if the air is very cold the mixture is made richer. Detonation is more prevalent in an engine operating on a lean mixture. So anything that can be done to lower the inlet air temperature will bring about an increase in potential power output with a reduced

Variety of articles

SIRS, - With reference to the "No Relationship" letter in M.E. 4246, 29 April 2005. If Mr. Moon wants to see articles on any particular subject published in our favourite magazine, how about his writing some? The biggest problem all magazines have is getting people to write useful articles.

The biggest problem the writers have is the number of readers whose immediate reaction to any letter or article that does not concern railway locomotives is to write a derogatory letter. Heaven help them if they make a mistake as

they are pilloried immediately - there are few who understand that debate is not the kindergarten that parliament has degenerated into. Alas many writers take these kicks to heart and never write again - our hobby and the magazine readers are the poorer.

I have to admit that I enjoy reading articles on any aspect of modelling as there is always something more to learn. I read the articles on clock making as I find them interesting, though I will never make a clock; likewise I read the articles on road locomotives, hot air engines and dolls house

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potential for detonation. Enthusiasts who mistakenly fit an after market cone air filter within the engine compartment do not realise that for every 5deg. C rise in air entering the engine the power drops off by about 3%. Car manufacturers go to a great deal of trouble in designing the air inlet pickup to take the air from the coldest part of the car, often close to road level, because hot air rises!

In my experiments I noted a considerable reduction of engine vibration due to the suppression of minor detonation. This detonation is not normally harmful to an

engine but it does set up unwanted torsional vibration products in the crankshaft. Many modern engines which utilise active knock-detection tend to run the engine at a borderline detonation condition in an attempt to gain more power and lower emissions. This is why an engine on a cool foggy day appears to run smoother, albeit any extra

power might be a disadvantage due to lack of adhesion on a wet road surface. It is in the racing engine where the technique could be exploited best if the rules allow but many racing formula rules specifically ban the use of water injection.

John Fielding, Durban, South Africa.

More wet fuel

SIRS, - Reading the article by Dr. Malcolm J. Metcalfe (*M.E.* 4247 13 May 2005, page 575) rekindled memories and thoughts.

As a teenager in the 1950s, I avidly read just about all the motoring and I/C engine related books in the local library. Unfortunately I cannot remember titles so am unable to refer back. (The one title that does stick is "*Maintaining the Breed*", a history of MG, more recently reprinted)

Two items I do recall concerned economy/fuel consumption. One book carried a few paragraphs describing a series of experiments. I cannot identify the firm which undertook the trials but do remember that it was of significant repute.

They had varied the compression ratio and introduced water injection. In the extreme, with high compression and water, it was possible to dispense with the cooling system, and exhaust gas temperature was much reduced. Economy was improved by, I think, some 50%. Perhaps other readers may be able to shed more light on the research.

Back around 1993 when catalytic converters became a requirement, it was evident from some new model catalogues at the time, that the addition of the cat had reduced power and economy. Has this been overcome or does clean exhaust carry a fuel consumption penalty, leading to yet more tax revenue for the treasury coffers?

Returning to the topic of moistened fuel, the water methanol injection used on aircraft piston engines during take off is well known. Car engine tuners are nowadays using water injection, but I believe this is more of a temperature control approach for high boost pressures.

A related avenue of development concerns the amalgamation of water and fuel. During a motor club visit to a research facility at the East Kilbride NEL site several years ago, we were shown a diesel engine running on a fuel which contained, if the memory functions correctly, about 20% water. At the molecular level, the fuel was wrapped around the water so that the components of the fuel system saw only non corrosive fuel. At the time, significant claims were made for economy improvement, but I have seen no sign of commercial exploitation. Again perhaps others may know more.

David Fenner, Scotland.

'Dynamo Eyebolts'

SIRS, - I refer to the article by Keith Wilson (*M.E.* 4247, 13 May 2005) in which he recommends the use of 'Dynamo bolts' screwed into the buffer beams of his current locomotive, for lifting purposes. 'Dynamo Eyebolts' to use their full name are so-called because they were, and still are, screwed into the top of the casings of industrial size dynamos and motors, to enable them to be lifted. The problem with Mr Wilson's suggestion is that dynamo eyebolts are only intended for use where the direction of the lift is in line with the threaded portion, not at right angles to it. Indeed BS 4278 (Eyebolts for lifting purposes) warns that lifting by even 5deg. out of line, imposes undue stress on dynamo eyebolts.

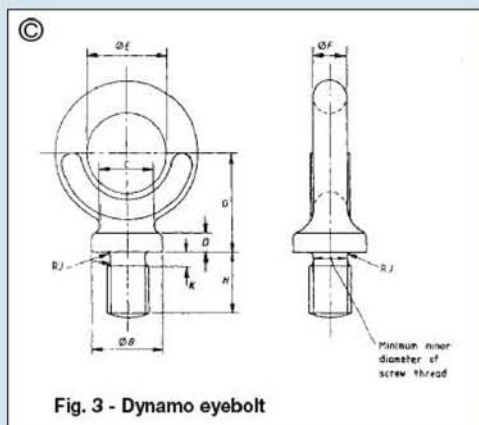
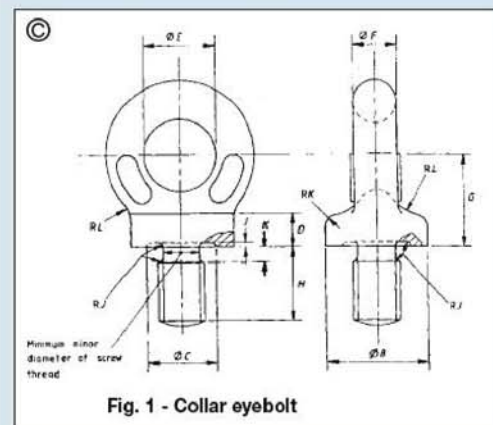
Eyebolts for lifting at an angle to the thread are called collar eyebolts, and are a more robust version of the dynamo eyebolt. It is difficult to explain the difference, but I enclose diagrams from the BS 4278, to illustrate the point. Even so, there is a problem. Collar eyebolts used for lifting at right angles to the thread (it is called 'trunnion lifting' in the BS) have their load carrying capacity reduced to 25% of the safe working load for axial lifting. The SWL for axial lifting should be clearly marked on the eyebolt, along with the thread type, 'M' for metric coarse, 'BSW' or 'UNC'

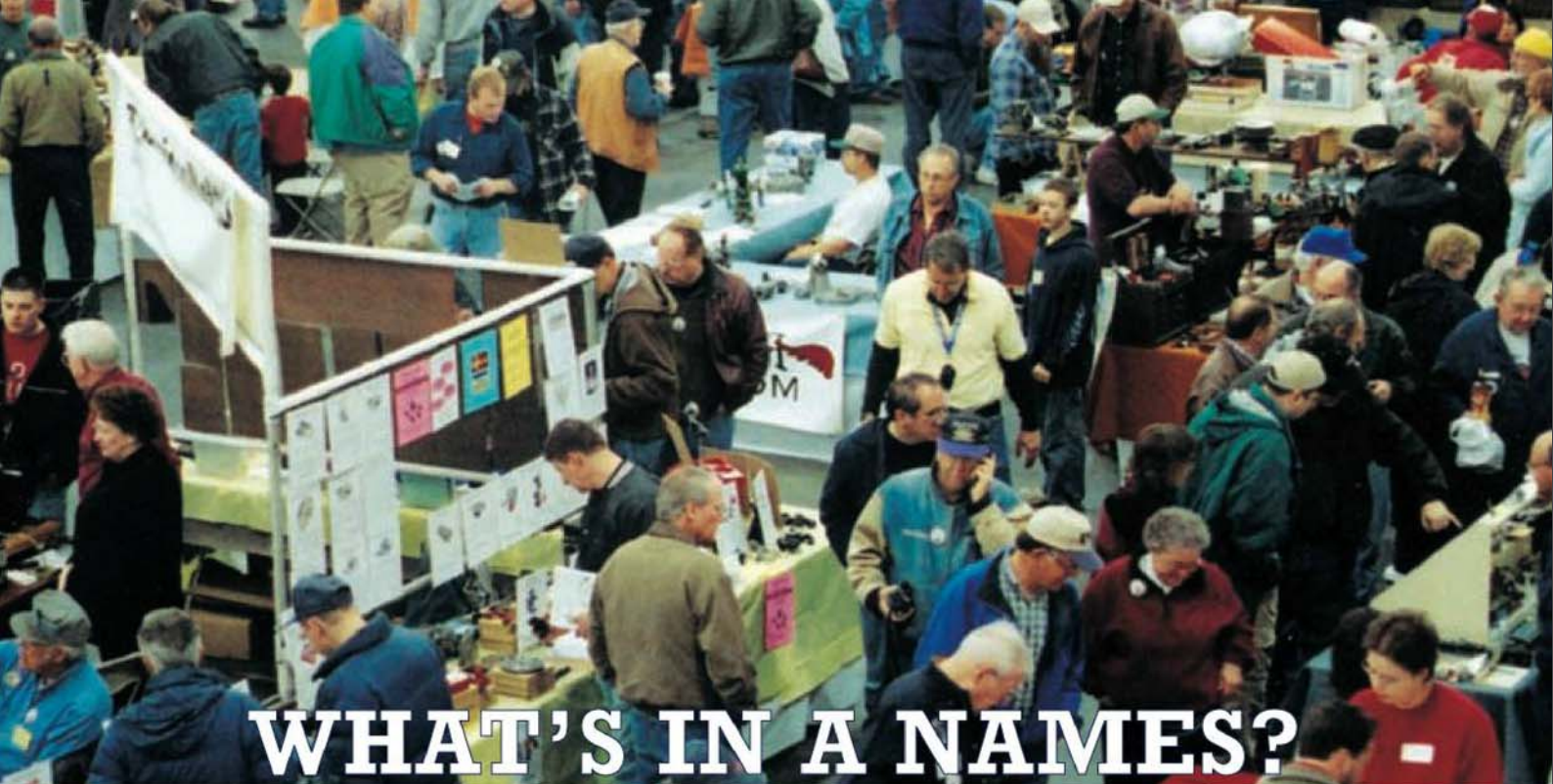
Mr Wilson states that his eyebolts are approx 1in I/D, 1 7/8in O/D and have a 10mm thread. The smallest metric eyebolt on the BS has a 12mm thread, although there are imperial eyebolts with a 3/8BSW thread. The I/D and O/D quoted seem about right for the smallest imperial dynamo eyebolt. It seems that he has been supplied with a non-BS product, and in any event, as a dynamo eyebolt, these are not suitable, as explained above. If 'Lillian' weighs 750lb, then to lift the completed locomotive needs two collar eyebolts with SWL of 1500lb. The closest to this is a 0.8tonne collar eyebolt which has an 16mm thread, or a 0.9tonne collar eyebolt with a 5/8 BSW thread. They must be used with a spreader beam, and the lifting hooks should not be fitted directly to eyebolt, shackles should be used. The plane of the eye should be vertical. If it won't tighten up to vertical, don't force it, or leave it loose, use shim washers. The eyebolt must be screwed right home as it relies on the collar for stability. Even using two eyebolts at each end, the smallest suitable collar eyebolt is 0.4tonnes, with a 12mm thread. As at matter of interest, using one eyebolt at each end, screwed into the coupler hole, when is the point in construction reached that the loco becomes top heavy, and tries to turn over when lifted?

Further useful information on the safe use of eyebolts can be found in BS 4278, especially for lifting using multiple attachment points.

Finally, to those who think that this is a load of 'nanny state' nonsense, go right ahead, it's your private workshop; you can do what you want in it. Just don't say you were not warned when your heavy, expensive locomotive ends up in a heap on the floor, with your feet under it.

R. P. Wilson, Staffordshire.





WHAT'S IN A NAMES?

Report from Michigan on the models and modelmakers at this year's NAMES. By **Peggy Hodgson.**

The North American Model Engineering Society Exhibition has become as much a reunion as a show. Seventy-seven exhibitors and 75 vendors — many also model makers selling plans and castings — welcomed around 4,000 visitors for the 16th annual show in April near Detroit, Michigan.

This show is a good mix of seasoned model makers who have become NAMES veterans, and relative newcomers to the hobby.

Joseph Papp, 84, looked like a new father with his running quarter-scale model of Henry Ford's 1896 Quadricycle. He started bringing it to the NAMES show five years ago. *"The first year I just brought the wheels,"* he said. He's been making models for decades, but this was his 'Holy Grail.' He vowed he'd build it the first time he saw Ford's original first automobile 27 years ago at the Henry Ford Museum in Dearborn, Michigan.

R.L. Ronnie of South Dakota gave us a first look at his V-12 in progress. It's roughly

modelled on Eric Whittle's V-8 that was featured on the cover of *Model Engineer* in 1995.

Ronnie is a master engraver who has built an impressive array of full-sized watchmakers tools circa 1880, all intricately engraved.

"My goal is to make a pocket watch from the 1780s and also make all the tools to make it," he said. He calls the V-12 *"a diversion from my normal work."* It is his first attempt at an engine.

He has completed the cylinder heads, crankcase and gearing for the supercharger.

"I'm building this as a preliminary to a 1:3 scale Rolls Royce Merlin. This helps me figure out how to build the Merlin," he said. The V-12 will be about 12in. long when complete.

Exhibitors showed off polished brass Corliss steam engines that would fit on a dinner plate, 7 1/2in. scale steam locomotives, running radial aircraft engines, flame ignition engines, and hit-and-miss engines running on compressed air.

The NAMES board made a policy from the beginning that it will not hold a competition, so there are no official winners or awards. The closest thing to the best of show is the featured model, which is rendered on the 2in. 'buttons' that everyone wears to verify that they paid for

their admission.

This year's feature was Richard Carlstedt's 1:8 scale model of an 1805 hypocycloidal steam pumping engine. That design was invented in 1802 by Matthew Murray of Leeds.

The model is scratch built of polished cold rolled steel and cast iron.

Carlstedt first saw the engine in the Henry Ford Museum in the early 1970s.

Construction took 1,500 hours. *"The project actually took 30 years,"* Carlstedt said. *"I think this is the only model of its kind in the world."*

He developed his own plans based on more than 150 photographs he took at the museum. Museum officials wouldn't let him touch the original.

"I was able to get a few measurements that were critical," he said.

"I knew the square nuts are 3in. across the flats, so I could scale from that measurement, using the photographs. It took about three years to develop a comprehensive set of drawings," Carlstedt said.

"I was intrigued by its complexity, and the engineering solutions to the problems at hand," he said. *"This is an incredible piece of machinery. It was there in the museum and no*



Joseph Papp and his Ford Quadricycle of 1896



Offenhauser 270 Indianapolis racing car engine by Ron Colonna



Work by Master Engraver, R.L. Ronnie.

one was paying any attention." He said several hypocycloidal engine models have been built, "but to my knowledge, no one has done this water pumping version."

He decided early that he would not paint it. "That presented a challenge. I didn't want to silver solder the parts because I didn't want that gold line."

Parts are press fitted together using intricate key ways. Some are threaded or taper fits.

"Quite a few parts are heat forged to give the look of the original," he said. To get the polished finish, he used 100 sheets of 400-grit wet-or-dry emery, three Dremel tools, grinding stones, burrs, cartridge rolls and rubberized abrasive called "Cratex". "Two-thirds of the model is getting the finish," he said.

He displayed the engine in a Plexiglas case that he removed for closer inspection, warning everyone not to touch the model. A thin coat of Carnauba wax offers some protection from fingerprints and rust.

His next project is a model of the steam engine on board the 1860s warship the *USS Monitor* from the Civil War.

"I've spent 25 years researching it," he said. "Most of the patent drawings were lost in a shipyard fire."

One of the youngest model makers at the exhibition was Zachary Brumberger, 13, of Rochester, N.Y., whose 1:6 scale working tools won



Working tools to 1:6 scale by Zachary Brumberger, 13.

the youth division of the Sherline Challenge - the only contest at NAMES. It is sponsored and judged by the Sherline company, which makes small lathes and milling machines. The competition is for engineering projects suitable for small machines. The longest dimension allowed is 5in.

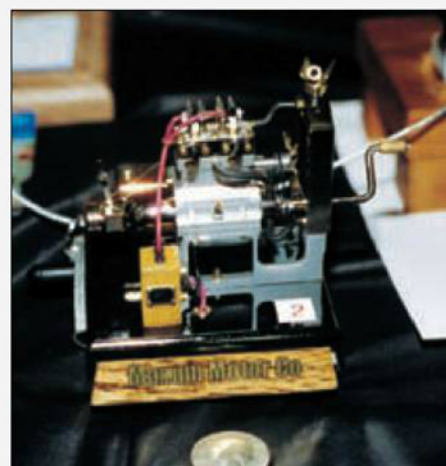
The overall Sherline Challenge winner was Steve Peirce's 22 Calibre Bullet Engine, a 1:3 scale model of the late Bob Shore's popular Silver Bullet model engine.

Peirce's engine is a two-cylinder Achilles with $\frac{3}{16}$ in. bore and $\frac{1}{4}$ in. stroke. He changed the crank to fire the cylinders 180 degrees apart and redesigned the valves to run on compressed air. The model has more than 160 machined parts and can fit in the palm of your hand. The entry was a tribute to Shores, who died last year.

This one was the farewell show for Michigan. The 2006 NAMES exhibition will be April 29 and 30 in Bowling Green, Ohio, about an hour south of Detroit. The new Expo Center there can house the growing crowd in one large hall instead of the two adjoining halls NAMES has been using for several years.

Bowling Green will be the fourth home for the exhibition. It was started by a group of Michigan and Ontario model makers returning from the London show in the late 1980s lamenting that there was nothing like it in the United States.

It didn't take long for them to decide to create their own show. They pooled their resources and



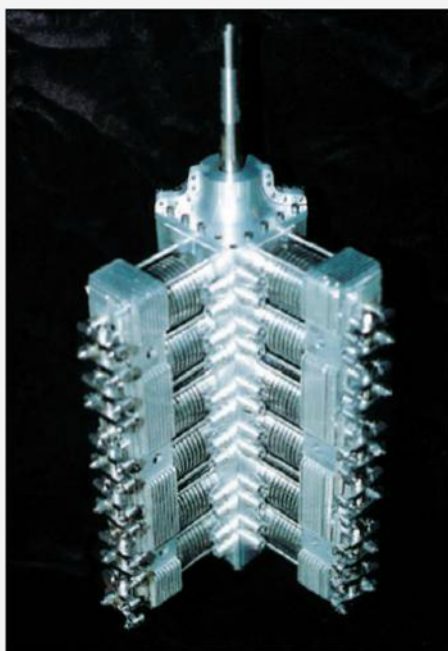
Sherline Challenge winner.

rented Domino Farms in Ann Arbor, owned by the makers of Domino Pizza.

"Then they put out an invitation to come. They didn't know if anyone would show up," said NAMES board member Barbara Parkinson.

The first show had a half dozen vendors and a respectable number of model makers. Stockton and four other founders of that first show continue to serve on the NAMES board. But the show has long outgrown pot luck suppers.

See web site www.modelengineeringsoc.com



The V-12 is 'a diversion' for R.L. Ronnie



Bridgport Mill to 1:12 scale by Gerhard Spielmann



Richard Carlstedt with hypocycloidal engine

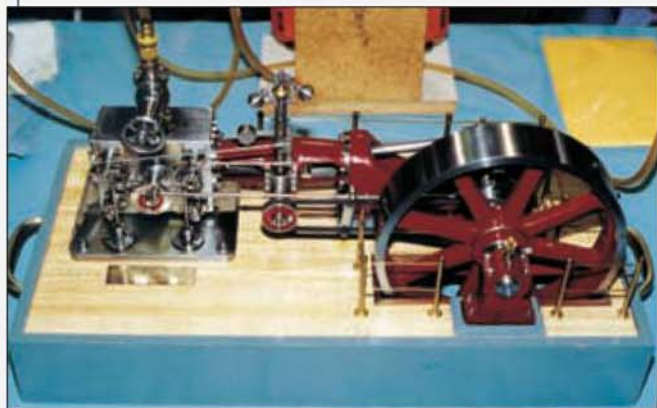
MEET SOME OF THE MODELLERS

John McDivitt, Sarver, Pennsylvania Corliss models

John McDivitt's business card shows him to be a man of letters - D.D.R. - M.G.G. "That stands for *Ditch Digger Retired - Member Greatest Generation*," the 85-year-old explained. Before he retired, he worked in the physics department of the Carnegie Institute of Technology and with U.S. Steel. He was part of the utility crew in the bomb group that dropped the bomb on Nagasaki.

McDivitt has made more than a dozen Corliss steam engine models, including four Coles models and three using castings he found third-hand in South Carolina.

"The Corliss is an intricate piece of machinery with a multitude of parts. You employ every facet of machine shop technique. If you can make that engine, you can build anything," he said over the percussion section of running Corlisses.



"My dad was a mechanical engineer in a power plant. He hated the Corliss engines. He called them click and clackers. They were loud engines."

The complaints just made the younger McDivitt more interested in machinery, he said.

He uses an index vertical mill, Southbend and Rockwell lathes and an Atlas horizontal mill. His current project is a duplex Corliss.

Doug Schneider, New Orleans, Louisiana

Gatling Gun 1:3 scale

Schneider

saw his first Gatling gun in 1939.

"My father repaired them for the movie companies, for Westerns," he said.

"Warner Brothers, Universal, would send them from California to my father's shop in New Orleans."



He built his first Gatling Gun in 1950. The one he displays is his show model, built in 1989. "It's a simple model, not meant for firing," he said. But it has full working mechanism, with rotating gun barrels. He sells plans for the gun and also for lathe and milling machine tools.

Lee S. Wehlann, Fraser, Michigan 1888 10-wheeler 7 1/2 in. gauge locomotive

Wehlann usually changes the subject when model maker friends ask what he did for a living.

"I was a baker and candy maker and cake decorator," he confided, as he stood front of his master work - a late 19th century locomotive he kit-bashed from an Allen Models plan and castings out of California.

"If I'd have built it to the drawings, it would be a 1915 to 1920 locomotive. I wanted an 1880s locomotive," he said.

He started the project in 1990 and completed it seven years later.

Wehlann learned machining from his father, who worked for the Packard Motor Car Company and made model racing boats in the 1930s.

"I'd sit at the tail end of the lathe and watch him for hours," said Wehlann, 72. "My mother always said 'I don't care what you do, but don't work for a car company.'" He took a commercial baking course in high school ended up owning a bakery, but never escaped the lure of the machine shop.

In the 1970s he joined the Great Lakes Live Steamers with an Atlantic steam locomotive he bought and reworked in his dad's shop.

"I always liked trains, but all the others I had were someone else's mistakes or something I rebuilt. This is the first where I built the whole thing."

The boiler barrel is a 10 in. blued stovepipe he bought in an Amish hardware store. Running boards are hot rolled steel plate, incised with a ball end mill to resemble boards. It has Stevenson valve gear and 8 in. drivers.



Joseph Papp, South Bend, Indiana

1896 Ford Quadricycle

The model has a four stroke, 4 cycle engine with 5/8 in. bore and 1 1/4 in. stroke and low-tension ignition. "The only thing I bought was the #25 chain. It's the smallest chain they make and it comes close to scale," he said. He scaled the original's 28 in. bicycle wheels with steel rims and 40 spokes. "The engine was easy in comparison," he said.

The tiller has a tiny brass knob that activates a bell on the front. "Henry Ford's has a street car bell," Papp said, touching his tiller to activate the clacker on his own bell. Papp tooled leather to match the stitching pattern of the original upholstery. "I couldn't find red and green jewels the right size for the lantern, so I cut them out of tooth brush handles."

Like the original, Papp's Quadricycle has no brakes and no reverse.

What's his next project? "I'm 84. At my age I don't make any long plans," he said. "But I'd like to make the engine the Wrights used."



Peter Renzetti, Arden, Delaware
Helped found ABANA, Artist
Blacksmith's Association of North
America

He builds, collects, restores and exhibits models of all kinds, but his lifelong passion is blacksmithing. Examples of group projects created for the ABANA convention drew a steady crowd of admirers at his table at NAMES.

He designed the intricate locking mechanism on a Gothic chest used as a portable safe. "Listen to this," he said, closing the lid. Twelve spring-action locks clicked in unison. A key inserted in a hidden keyhole must be turned, inserted deeper and turned again to open the locks simultaneously.

The chest was a joint project, with fellow artisan blacksmiths creating the ornate handle, keyhole, raised figures in decorative panels and spiral feet. In an elaborate door lock, Renzetti created the figure of a blacksmith in Medieval robes in a central archway.

"Blacksmithing is such an infinite trade. Any type of machine work relies on someone to make the metal tools. In the early days, the blacksmith made the tools for the carpenters, the surgeons. Artsmithing combines art with the functional aspect," he said. That's much like Renzetti himself.

He is a machinist and self taught blacksmith who has run a machine shop and done tool and die work. At 62, he owns an historic forge and also plays the mandolin, guitar and fiddle.



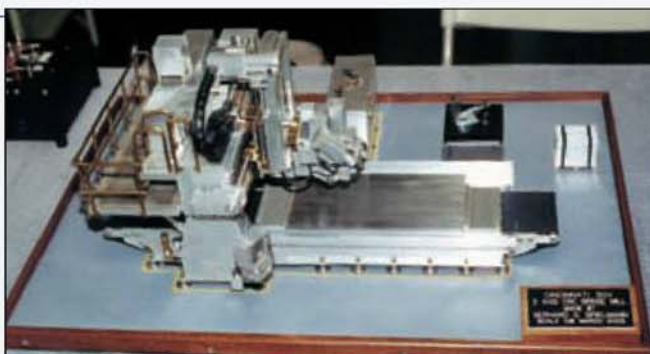
Gerhard Spielmann,
Northport, N.Y.

1:12 scale
 Bridgeport mill
 1:12 scale
 Cincinnati 30V
 5-axis CNC Mill

Spielmann spent 1,150 hours building his CNC machine - a model of the one he uses at work. He built it on his manual Bridgeport, which he also modelled.

"The most difficult part was finding electric motors small enough to power it," he said, "and activating the automatic tool changer on the CNC."

Spielmann is 77. He worked for an aircraft parts manufacturer in Hauppauge, N.Y.



Dale Detrich, Attica, Ohio

Twin and 4-cylinder horizontally opposed engines

Detrich is a retired electronic technician who started building models about 11 years ago. "I went to a show and wanted to buy a Gatling Gun," he said. "One of them sold for \$10,500. I knew I couldn't afford to buy one, so I started gathering tools and equipment to make one".

He studied tool and die making and had machining training in school, but ended up working for a printing company.

His first engine project was a Stirling hot air engine. His table at the NAMES show was lined with intricate brass 2-cylinder and 4-cylinder horizontally opposed engines on polished wood stands. He tries to add an engine every year.

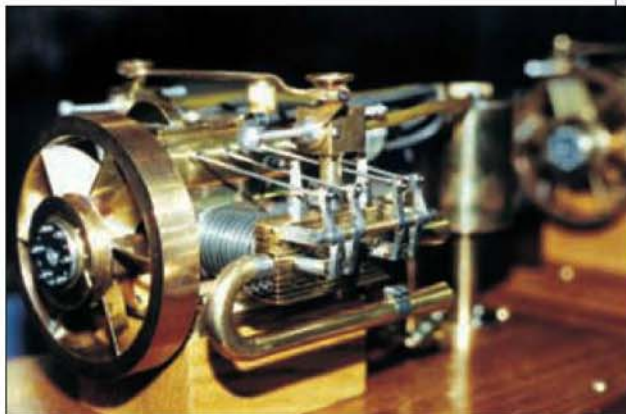
"A lot of people were interested in the 4-cylinder and wanted me to put out plans," he said. "So I tore it down and made photos and plans." He's done the same with the twin cylinder engine. His

newest project is a variable compression engine with an overhead camshaft, and is 1in. bore and 1in. stroke. The next project is a water-cooled V-6.

He makes everything on a Smithy three-in-one lathe, mill and drill press. "As I'm working on one engine I'm thinking of two or three more," he said. "The first engine I got to run was almost like having my first son."

It's alive, breathing, working."

Oh yes, his table also sported two Gatling guns.



Ron Colonna, McKeesport, Pa.

V-Twin Harley pan head
Offenhauser 270 Indianapolis
racing car engine

Ron Colonna sits quietly behind his engines and lets them do the talking. The Offenhauser is the loudest, with its throaty roar revving like a dinner bell at a model feast.

Builders crowded around when the Offenhauser called, but they stayed to check out Colonna's latest project - the V-Twin Harley pan head motorcycle engine.

"I was looking for something nobody's done. I like the look of the pan head," he said. He bought service manuals and used photographs of parts being sold on the E-bay internet auction site.

"People take real good pictures when they're trying to sell something," he said. The engine gleams like jewellery.

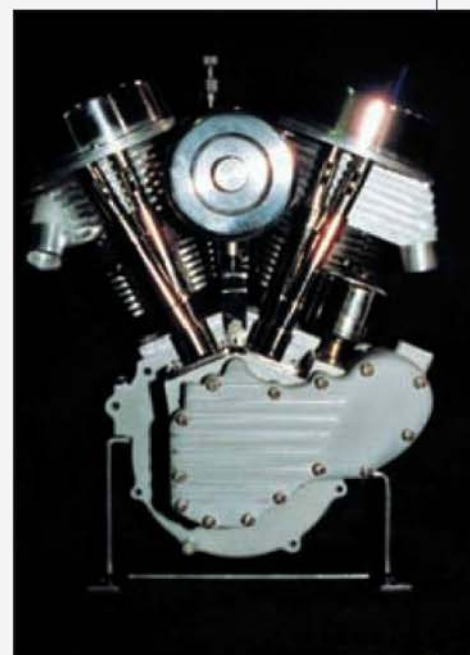
Colonna started making models in 1978. "I had a lot of free time on my hands after I was injured in Vietnam," he said. He got a degree in mechanical engineering, but the injury still keeps him out of the traditional workforce.

His first model was a locomotive he saw in a magazine. "I ended up building six of them," he said. "I started gasoline engines as a diversion. I hate the smell of gasoline. It gives me a headache. But I love the engines, the mechanics of them. They're art that you can put to use."

He built the Offenhauser from photographs and an article by Don Francisco in an old Hot Rod Magazine. "The article had one drawn side view and explained all the journal sizes and cam drives," Colonna said.

"His work enabled me to do mine. Everybody in this hobby pushes another one forward."

Colonna sells his drawings and machining instructions for the Offenhauser. But don't ask for the Harley plans. "I'm doing that one just for me," he said. "The Harley people protect their designs. I won't do plans for that one."



A MODEL POWER DRIVEN SPRING HAMMER

The series comes to a conclusion with the final parts and painting.

By the late **David Lammas**

●Part IV continued from page 21
(M.E. 4251, 8 July 2005)

The shape (fig 14) of the shaft is such that the pulley must be located without end movement but the clutch disc must be free to slide on the shaft, it must also be possible to assemble the components, a point that is sometimes overlooked at the design stage! This is a simple enough turning job preferably between centres for accuracy unless collets are available. Aim for a good bearing surface on all diameters including the $\frac{5}{16}$ in. dia. or sliding might be impeded.

If no Woodruff cutter is possessed it is quite easy to make one from $\frac{1}{2}$ in. dia. silver steel (fig 15). Face the end of the metal very slightly hollow by setting a knife tool at a slight angle and feeding it towards the chuck while cutting right to the centre. What do you mean it chatters? If the lathe is properly adjusted it should not, even my crude old machine will do it with no trouble!

Next feed in with a parting tool at just over $\frac{3}{32}$ in. from the end to a depth of $\frac{1}{8}$ inch. Open out the groove in stages until it is $\frac{3}{8}$ in. long then bring the tool back to the beginning, setting it at a slight angle away from the chuck to trim the shoulder of the cutter with a slight hollow on the inside. Feed the tool away from the chuck cutting at full depth until the cutter is exactly $\frac{3}{32}$ in. wide. This slight, and I emphasise slight, hollowing can be done with a right hand knife tool if preferred. I filed four teeth spaced by eye on my cutter, hardened, tempered and honed it and it works very well, just make certain that the teeth are properly backed off for clearance or it will only rub instead of cutting.

The position of the key slot in the $\frac{5}{16}$ in. dia. portion of the shaft is not critical lengthwise but the cutter must be set exactly central radially. It is fed in to a depth of $\frac{1}{8}$ inch. No need to measure, just take it in until the shank touches the shaft.

The key itself is merely a slice parted of a length of $\frac{1}{2}$ in. dia. steel. If parted off a couple of thousandths of an inch too thick, it can be rubbed down on a sheet of emery paper laid on the surface plate. The disc should be a tight push fit in the shaft slot but carefully remove all burrs before trying it. Saw the disc in half, press home into the shaft then file until it stands just $\frac{1}{16}$ in. proud, that is 0.375in. by micrometer according to my reckoning. Lightly chamfer the top. Before attempting to assemble the whole of the rotating parts try slipping just the shaft fitted with key through the rear, bearing boss minus its bush and into the

front, bearing bush. If necessary file the slot in the rear housing just sufficiently for the key to enter freely. Now you can try the whole assembly. Place the clutch disc within the pulley and with the key way uppermost hold in the gap between the bearing housings while the shaft is slid into place. Push the rear bearing bush partly home in the housing. With a finger pressing the end of the shaft forward place the crank disc on the front end tightening the grub screw to lightly mark the shaft. Remove the crank disc so that a small flat may be filed for the grub screw to seat on. Replace the disc, checking that the pulley is free to revolve without end play and also that the clutch disc slides easily on the shaft.

Brake fitting (fig 16)

When the treadle bar is released and the tension spring pulls the clutch out of engagement the clutch disc rim is arranged to move back against a brake pad attached to the uppermost lug on the body casting, this rapidly brings the hammer to rest, clear of the anvil. The parts of the brake are very simple. Tap the plate keeping the tap at exact right angles to it and Loctite the threaded rod into it using the high strength grade for a permanent job. Glue a strip of very thin leather onto the curved face of the brake with Araldite adhesive. Screw a nut onto the rod right up to the plate before fitting it into the lug from the front side. This will have to be done with the rotating items absent just prior to final assembly after painting. A second nut at the rear enables the brake to be finely adjusted for best results.

Connecting rod (fig 17)

The upper part is made from a length of $\frac{1}{2}$ in. square steel by marking out and drilling a $\frac{3}{8}$ in. dia. cross-hole $\frac{13}{16}$ in. from the end. The metal is now centred in the 4-jaw chuck to drill the axial $\frac{3}{16}$ in. dia. hole 1in. deep and turn the outside to shape at $\frac{5}{16}$ in. diameter.

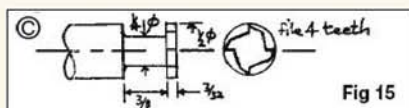


Fig 15

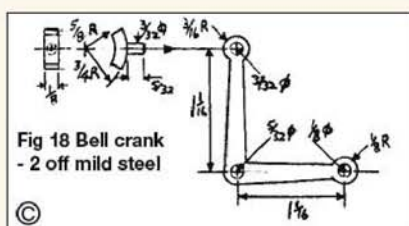


Fig 18 Bell crank
- 2 off mild steel

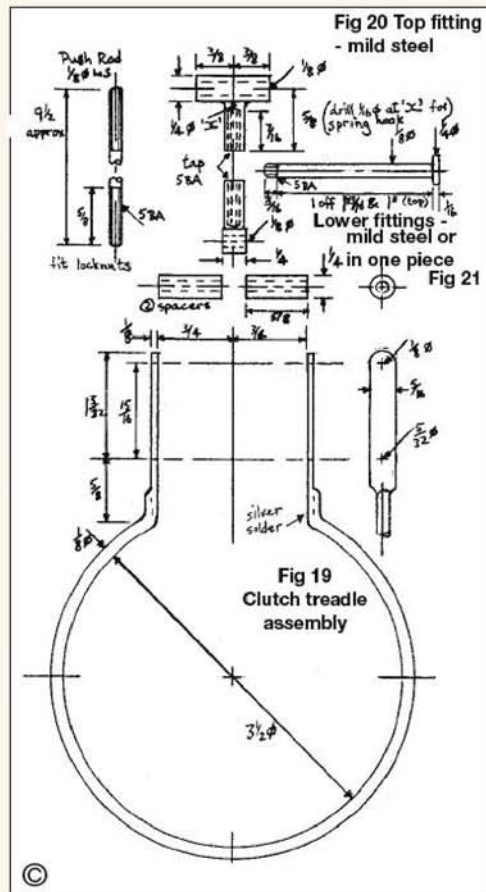


Fig 19
Clutch treadle
assembly

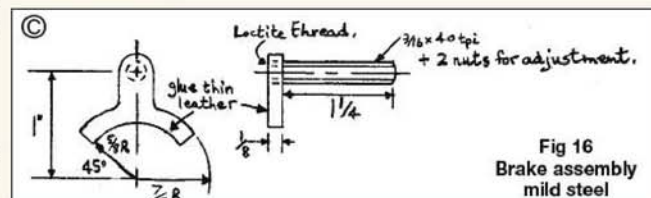


Fig 16
Brake assembly
mild steel

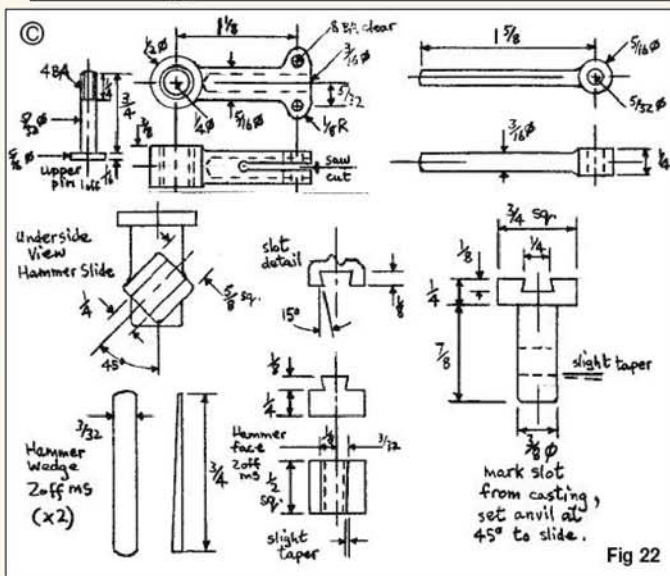


Fig 22

A round nosed tool should be used forming a neat radius at each end leaving the flange $\frac{1}{4}$ in. long.

Remove from the lathe, mark and drill the two clamping bolt holes then mill the flange to $\frac{5}{16}$ in. thick and the boss to $\frac{3}{8}$ in. thick. Next cut the slit with a hacksaw or slitting saw if your hand and eye are not too well coordinated to do it the quick way. Lastly saw off from the parent bar before milling the eye to circular shape.

Make the lower part from $\frac{3}{8}$ in. square steel in similar fashion, i.e. drill first, turn down, mill to thickness, saw off and round the eye, the whole process ought to be quite familiar by now.

The upper boss is fitted with a bronze bush $\frac{1}{4}$ in. bore to fit the crank pin. Two off, 6BA hexagon headed bolts and nuts secure the two parts together.

Clutch operating gear (fig 18)

The pair of bell-cranks are made from $\frac{1}{8}$ in. thick steel sheet. Mark out one of them and drill the holes then use it as a jig to drill the other one before filing or milling to shape. The brass pads are most easily made by marking a $\frac{5}{8}$ in. dia. circle inside one of $\frac{3}{4}$ in. diameter. Scribe a line across the diameter indicating the position of the pivots. Set up in the 4-jaw chuck to turn each pivot in turn then saw and file to outline. If preferred, the pivots could be made $\frac{1}{8}$ in. dia. the same as the thickness of the metal but in that case the bell-cranks would have to be made with both ends drilled $\frac{1}{8}$ inch.

The flat arms of the treadle (fig 19) are of $\frac{1}{8}$ x $\frac{5}{16}$ in. section. Again, drill them as a pair. Curve the $\frac{1}{8}$ in. dia. steel rod around a former about $2\frac{3}{4}$ in. diameter, because it will spring back a surprising amount when released. Adjust the diameter to fit easily outside the casting base and bend the 'legs' sharply backwards to overlap the flat arms by $\frac{1}{2}$ in. or so. File the inside portion of each leg flat so

that it can be silver-soldered to the arm.

The push rod consists of three separate parts screwed together. Make the end fittings first so that the length of the rod itself may be gauged with the machine assembled, the treadle should be horizontal with the clutch released.

The top fitting (fig. 20) is shown as a T-fabrication with an $\frac{1}{8}$ in. hole for a connecting bolt but an alternative is to leave the top bar solid and turn a $\frac{1}{8}$ in. dia. x $\frac{1}{4}$ in. long pivot at each end. Drill a $\frac{1}{16}$ in. dia. cross-hole near the junction of the 'T' into which is pressed the end of a wire hook holding the tension spring for releasing the clutch. The other end of the spring attaches to another hook screwed into the rear of the casting at about the level of the second slide cover stud from the bottom. The actual position will depend upon the size of spring that you decide to use. My spring was $\frac{3}{16}$ in. dia. by $1\frac{1}{2}$ in. long, closed length with the coils touching each other.

The lower fitting is shown as a short 'T' with separate spacers but this one can also be made solid in one piece with turned pivots as an alternative (fig 21).

Anvil (fig 22)

No mention has been made yet of this component which is detailed on the drawing as a dovetail-slotted block $\frac{3}{4}$ in. square having a $\frac{7}{8}$ in. long spigot attached to the underside. This spigot fits into the hole in the casting in such a way that the wedge slot holds it at 45deg. to the slide. It is best to scribe the slot position on the spigot when the anvil is set in the casting in the correct configuration. An alternative form of anvil may be used in which the $\frac{1}{2}$ in. square face that contacts the hammer head is milled from the solid rather than being fixed by the dovetail, i.e. the $\frac{3}{4}$ in. square part is partly drilled to leave the top $\frac{1}{2}$ in. square by $\frac{1}{8}$ in. deep.

Suggested livery

I think that just about wraps up the construction details so we can move on now to the question of a suitable finish for the various parts. At the time the prototype was in use there is little doubt that a coat of black paint overall would have been fashionable but I think we can improve upon that for purposes of 'preservation' and exhibition.

One line of thought is that moving parts could be red (for danger perhaps with the casting a contrasting colour say green or black. Another scheme would be to have some of the smaller items heat-blued or oil-blackened to resemble natural forgings, the spring linkages and the hammer and anvil faces for instance. The moving parts remaining then being one colour and the casting another. This was the scheme I chose but got carried away slapping on red paint (didn't stop to think!) so some moving parts are red and some black and I am not taking it all apart again to alter the scheme.

I would advise anyone considering frequent running of the model at exhibitions or rallies, etc. to case harden the lower con-rod eye and pin as well as all the spring linkage components, bell-crank eyes, etc. This will give a very much longer life before wear becomes apparent. The slide covers and sliding member faces would also benefit from such treatment. Needless to say regular oiling and cleaning would pay dividends too.

A fairly heavy base of ample size is necessary for an unbalanced machine of such ferocity if it is to remain in one place when working. As to the question of a power source, a steam engine would be the obvious answer though an internal combustion engine or even an electric motor would be suitable as well. A countershaft providing some speed reduction would be required for the latter. It is said that the full-size machine worked with as little as $\frac{3}{4}$ hp at the belt.



IN THE NEXT ISSUE



Results and full report from IMLEC 2005



Also in this issue:

- Ornamental Turning
- Claude Reeve Clock

And all the regular favourites

ON SALE 19th August 2005

(Contents may be subject to change)

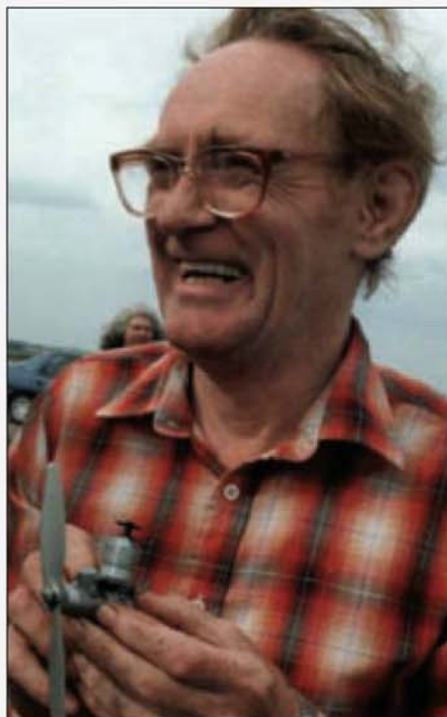


A PASSION FOR TWO-STROKES

Nemett reports on one man's contribution to the development of high performance two strokes

●Part III continued from page 23
(M.E. 4251, 8 July 2005)

As you will all be aware from reading this magazine, at the editorial offices we regularly receive information from readers about their model engineering activities which is one of the many pleasures of this occupation. Occasionally the pleasure is heightened when, following further investigation, we discover a major contribution to our hobby. Recently we received some information from a gentleman tucked away in the middle of England who has, what can only be described as, a passion for high performance two stroke engines. That gentleman is Gordon Cornell and he has spent many years involved with the design and development of such



The author, Gordon Cornell having just recorded 22,700rpm on a 6 x 3in. propeller.



The earlier Dynamic 21D produced using a crankcase casting.

engines and it is his design manual *Model Engine Mechanics* and the associated ICE computer program that form the subjects of this month's column.

The topic will be of interest both to those who are just interested in most things to do with I/C engines and also to those who are actively designing and building two stroke engines. No doubt readers of this column fall into one or other of those categories.

Gordon Cornell

Gordon has been actively involved in the design and development of model aero engines since the 1950s when he worked on the development and testing of ED and Frog engines. I am sure that many readers will remember these as the leading popular commercial makes of model engines at the time and that there are many of you out there who owned (and maybe still own) such notables as the ED Racer or the Frog 150R.

Following a period in the motor industry Gordon turned to producing his own range of high performance diesel (more strictly 'compression ignition') engines sold under the Dynamic label. These have built on the development work Gordon did during his earlier years and are among the leaders in the field of high performance model aero engines. The range also includes some glow ignition examples.

It was during the development of the Dynamic engines that the ICE computer program was developed as a 'tool to assist in the development of the internal combustion engine'. Also during this period the foundation of the book *Model Engine Mechanics* was laid with a series of articles published in the magazine *Model Engine World*.

Dynamic engines

The development of the Dynamic range of engines started in around 1960 with the first engines produced being the Dynamic 049BB which featured drum induction with a ball raced crankshaft and the Dynamic Tutor 049 which was aimed at beginners and featured a plain bearing crankshaft with crankshaft induction. The prototype of the Tutor was lost in a contest on Cobham Common when it out climbed an ETA 29 powered model.

Following this early success the engine development project stalled until 1989 when the Tutor was redesigned and became the larger Dynamic 061D - 90 series which complied with the new rules for F1J free flight competition. Further development followed through the 91 series with radial porting (which included a Schnuerle ported glow version) and the 92 series which further developed the Schnuerle ported version and importantly for free flight



The latest CNC machined prototype version of the 21D.

competitions reduced the overall weight.

After further success with the new engines, the range was increased and the Dynamic 21D Dominator was born around 1993. This was further developed with the second version being produced in 1995 which had the cylinder rotated 45deg. and circlips to retain the gudgeon pin. The circlips were used in order to enable greater freedom of port layout by avoiding possible problems with the gudgeon pin moving and fouling the ports. As a consequence of ball race problems with experimental designs these engines retained plain bearing crankshafts.

Following acquisition of a Wabeco CNC milling machine, development is now concentrated on producing the engines from solid using CNC machining. Redesigned prototypes of the Dynamic 21 in both diesel and glow ignition versions have been produced together with prototypes of the Dynamic 09DBB and Dynamic 15DBB.

The Dynamic 21 variants are machined from billets whilst the 09 and 15 are produced from castings. Future engines are likely to be machined from billets because this avoids possible supply and quality problems associated with using castings.

The development so far has been a significant undertaking, not least because Gordon's approach is to make the engines in batches (typically 10) in order to ensure that engine performance is consistent across several examples of the same version of each of the engine designs.

Performance

The Dynamic engines are high performance engines designed to be used for various types of model aircraft competitions at the highest international level and as such have impressive power output figures.

As an example the 92 series Dynamic 061D has quoted figures of 0.3bhp with a target of 23,000rpm when turning a 6 x 3in propeller. Don't forget this is for a 1cc capacity diesel engine weighing only 80gram.

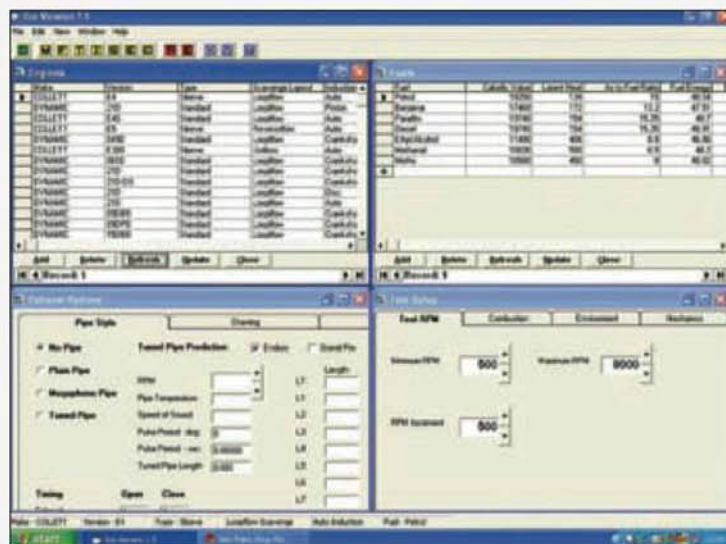
The larger (3.5cc) 02 series Dynamic 21D weighs in at 91gram and produces 0.6bhp at 15,000rpm using a 9 x 4in propeller.

One of the reasons for the development of the ICE program was to evaluate the potential effect of small changes to the engine design. At this level any benefits tend to be very small (measured in low hundreds of rpm) and the program helps identify those changes that are likely to produce improvements before cutting metal.

Design manual review



Some of the engine parts for a Dynamic 21D.



Screen 1: The opening screen of the ICE program showing the four data windows.

Design manual review

The book *Model Engine Mechanics* has been written in order to "provide guidance regarding engine design and development" and because the Dynamic range is so successful the information contained in its pages ought to be essential reading for those interested in high performance two strokes.

One point I will make at this stage is that the book has been written and produced by Gordon without outside help but has not received the attentions of any professional editors and because of this and the simple page layout can sometimes appear a bit daunting. However, potential readers should not be put off by this because the book contains an enormous amount of very technical information and advice and is well worth the effort.

The book is a well produced comb bound A4 size publication printed on good quality paper with many colour diagrams and illustrations. It starts off with some background relating to the development of model engines in the 1950s which I found fascinating reading with some interesting facts about the main protagonists in the field, particularly the effect of retrospective purchase tax applied to the companies during that time. It seems there is nothing new in governments causing manufacturing companies problems! This part of the book also covers the development of the Dynamic engines.

Design and development is then covered in some detail including power outputs, power to weight ratio, testing using calibrated propellers and measurement. The book then moves on to provide detailed explanations of the Otto cycle, engine geometry (including De Saxe cylinders and sleeve valve layouts). There is a very interesting section on timing optimisation which among other things discusses the relationship between the transfer, induction and exhaust curves. As I indicated previously this is a very technical tome!

Performance curves are discussed and readers may well feel on more familiar ground here because I suspect many of you will have studied examples of the classic engine performance graph which shows torque and bhp plotted against rpm. Reading this book, however, will soon make you aware of the multitude of other factors that can be plotted including such things as scavenge efficiency,

mechanical efficiency and a host of others. The reader is not left wondering what all this means because the book discusses the options open to developers who wish to improve the performance of an engine.

There is a section on materials to use in engines and this may surprise readers with its comments on the reasons for choice of different crankshaft materials. This section also includes a detailed analysis of the weight of all the components of an engine even down to the weight penalty in using cap head socket screws versus machine cut screws.

We then move on to a detailed analysis of engine volumetric efficiency which includes scavenge systems and engine porting, induction options, exhaust functions (including tuned pipes). This is followed by a chapter on Uniflow scavenged sleeve valve two strokes. The last part of the technical analysis covers engine thermal efficiency with discussion of the combustion process and theory together with the different fuels and additives available.

The final part of the book covers the

more practical issues including the workshop and sections on the jigs and methods for machining engine components. I suspect many readers would find the book useful for this section alone.

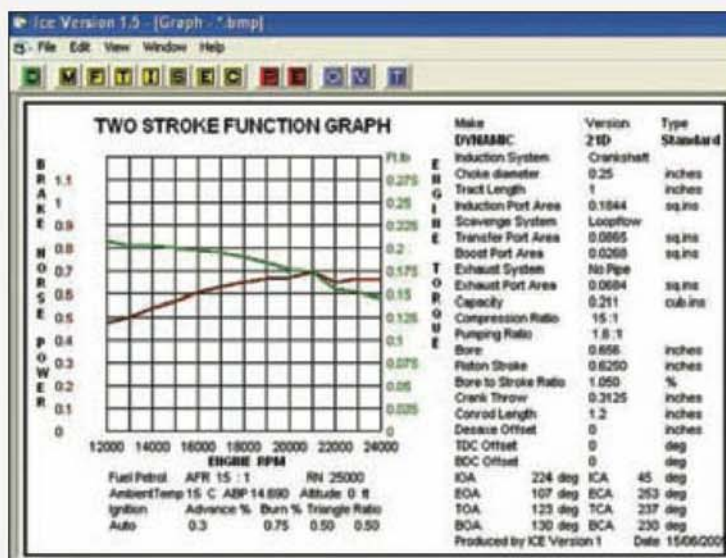
ICE Version 1.5 - [Engine Performance Table]

File Edit View Window Help

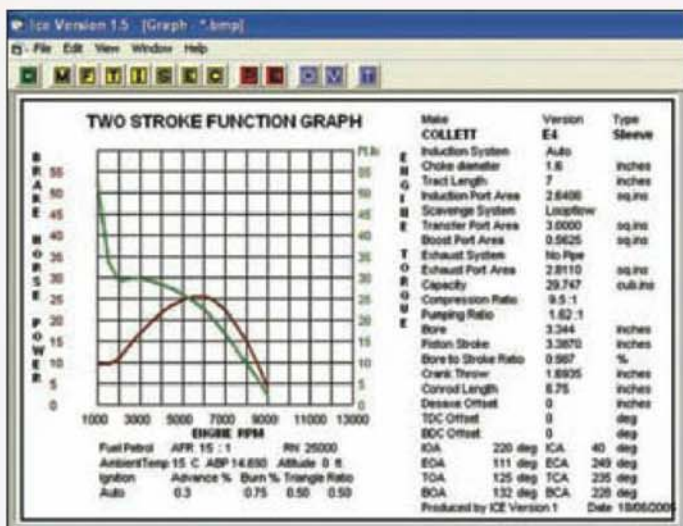
RPM (Maximum): 20000 ENGINE PERFORMANCE

RPM	Advance degrees	Combustion degrees	IMEP psi	IHP	PMEP psi	PHP	FHP	BHP
3000	9	30	92.7569030	0.2817721	2.8643365	0.0087011	0.0248147	0.248
4000	10	34	96.8614836	0.3310206	2.9955005	0.0102028	0.0271710	0.293
5000	11	37	98.1260526	0.3726025	3.0873526	0.0117232	0.0300548	0.330
6000	12	41	100.4156926	0.4194263	3.1795380	0.0132886	0.0336718	0.372
7000	14	45	101.9006777	0.4643225	3.3148464	0.0151045	0.0385218	0.410
8000	15	49	104.0012437	0.5133851	3.4228923	0.0168965	0.0437283	0.452
9000	16	52	104.3068325	0.5545008	3.4916132	0.0185616	0.0499329	0.486
10000	17	56	105.3524335	0.6000635	3.6038959	0.0205270	0.0569585	0.522
11000	18	60	105.1618436	0.6389098	3.6286665	0.0220459	0.0647817	0.552
12000	19	64	106.3350351	0.6864149	3.7808826	0.0244258	0.0738872	0.588
13000	20	68	108.7777556	0.7434881	3.9033687	0.0265732	0.0841682	0.632
14000	21	71	109.5864436	0.7906273	4.0032503	0.0288820	0.0958041	0.665
15000	23	75	109.8830721	0.8344820	4.0722269	0.0309260	0.1091767	0.694

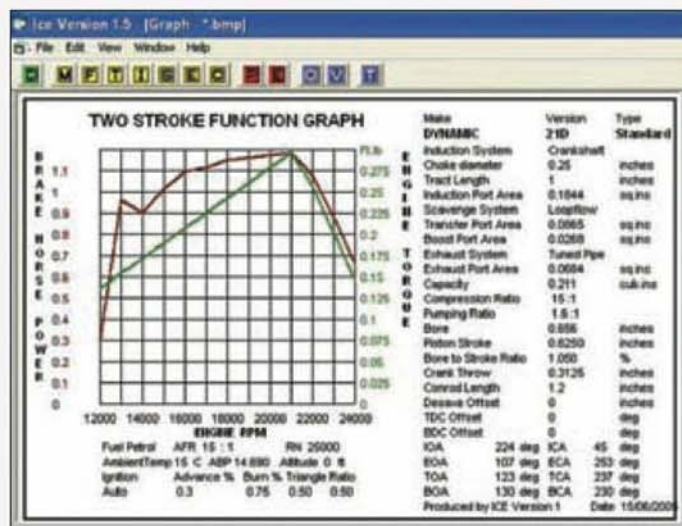
Screen 2: A typical results table, in this case the performance table for one of the Dynamic engines.



Screen 3: BHP/Torque Plot for the Dynamic 21D engine with no exhaust pipe.



Screen 4: BHP/Torque Plot for the Collett E4 sleeve valve engine. Note the much lower rpm range.



Screen 5: BHP/Torque Plot for the Dynamic 21D showing the effect of a tuned pipe exhaust system.

I can certainly recommend this book to those with an interest in I/C engines of any type, but obviously particularly for those interested in designing or modifying two stroke engines. I think our Technical Editor hit the nail on the head when he suggested that "it is a work of major importance on the subject".

ICE Program

The Internal Combustion Engine program has been developed to provide a tool for evaluating and comparing the potential performance of two stroke engines. It enables the user to establish the potential outcome of alternative design configurations.

As an indication of the power of this program, it will be helpful to list the main engine features that can be evaluated. The main calculation groups are:

Mechanics; Gas Flow; Thermodynamics; Crankshaft Mechanics; Sleeve Mechanics; Exhaust System; Induction System; Performance; Exhaust Performance.

Within these groups there are many sub-headings at the detailed level, for example under gas flow there are ten sub-headings including induction flow, exhaust flow and cylinder mass among others.

Users should be under no illusions that this is a very comprehensive analysis tool and is being developed further as time permits.

The program development was commenced around 1989 when Gordon and Bob Collett produced a computer based pressure/volume program which forms the core of ICE. This was further developed using equations generated from first principles to avoid possible mathematical errors through using empirical data.

The program is written in Visual Basic and for such a powerful program does not consume vast amounts of computer resource (perhaps there is a lesson for others here?). The program requires around 50Mb. of hard disc space and on my 2.66GHz laptop takes under 10 seconds to load and about the same time for carrying out the full performance calculations. It takes my brain somewhat longer to work out what the results all mean!

Because it is not a professionally written program, it has not got some of the niceties that they tend to have these days but once you have got used to it, is easy to use although sometimes not very tolerant of incorrect data.

Program functions

The program uses a Microsoft Access database of engine details as the basis for the calculations and this includes some 90 different data items for each engine although not all of them are used for every engine option. The database provided includes 18 different engines including the Dynamic range and several Bob Collett sleeve valve designs. These can be used during the learning process and the database can be restored from the installation CD-Rom if things get confused (by you, not the program).

The program installed on my computer using the Windows Add/Remove program option with no problems and all printing and viewing functions worked 'straight out of the box'.

I very quickly found that the program needs to re-calculate in order to respond to changes in data and that it is up to the user to specify the rpm range to be evaluated. There is a wide variation in rpm range between the sleeve valve and standard engines in the database which makes this important if the results are to be output correctly. As an example of this, if an rpm range of 10,000 to 22,000 is chosen for the Collett E4 then the graphs will appear to show no data. If in doubt I suggest a look at the performance table to see where the peak rpm lies, in the Collett example quoted the range quoted will show negative bhp values.

All this is easily solved in a few seconds by selecting a more suitable rpm range and recalculating.

The other thing I would suggest is that you all read the manual before starting. I would also suggest that reading *Model Engine Mechanics* first is helpful so that you have an appreciation of the concepts involved. I know it goes against the grain for many model engineers to read the instructions first but in this case it really is a good idea.

When entering or modifying engine data it is advisable to consult the Data Files and Editing section of the program manual as you go because there are some dependencies that the user has to maintain in order that the results are calculated correctly.

The calculation results are produced as tables of data, typically with a set of values for each 1000rpm increment or for things like the exhaust function, a set of values for every degree of crankshaft rotation. I suspect that most users will, like me, use the graph plotting functions to

display information. These are very good with the facility to select the main function (mechanics, thermodynamics etc) to be plotted followed by the X-axis data series and two (left and right) Y-axis series. The options available for the graph axis are dependant on the main option selected. Graphs can be viewed on the screen or printed out as hard copy.

An interesting option related to graphs is the ability to evaluate different exhaust pipe configurations and then to print out a dimensioned drawing of the pipe that produces the best predicted results.

I found that after a few hours learning the procedures, I could produce results easily. Interpreting them is another matter but one of the values of this sort of program lies in its 'teaching' ability. I have no doubt that anyone who has a basic understanding of two strokes will learn an awful lot by using this program. It would be an interesting exercise to measure an existing commercial engine and compare the predictions from ICE with the manufacturers figures.

The package (book and program) that Gordon has produced must rank as one of the most important sets of tools for those developing or modifying two stroke engines. In fact Gordon tells me that it is currently under evaluation by a well-known manufacturer of full size high performance engines.

I think that it is a pity that the standard two stroke engine with its inherent simplicity and small number of moving parts appears to be doomed in full size versions because of the problems with emissions. Sleeve valve engines may provide a solution, but then the number of components increases such that a four stroke may be a better (easier?) option. As always readers views on the subject will be welcomed.

I must admit to finding the evaluation and use of the ICE program a fascinating exercise and I have to thank Gordon Cornell for his assistance and permission to use the photographs and screen extracts.

At the time of writing the *Model Engine Mechanics* book and the ICE program (including manual) are on offer as a package for £45 (plus £2 p&p). Gordon can be contacted at 19 The Earls Croft, Cheylesmore, Coventry CV3 5ES or on e-mail to: G.Cornell@tiscali.co.uk

●To be continued.



Completed Acrobat with one belt connected. The figures can be made to rotate in opposite directions by altering the belt.

AN ACROBAT FOR DREIBEINER

Dr. Marcus Rooks

constructs a toy Acrobat based on a German 100 year old original, designed for use with a toy steam engine.

With the summer nights drawing to a close and winter's inevitable approach I thought that a little project to occupy the odd evening would be appreciated. The late Tubal Cain was always one for making something for his stationary engines to drive; he liked to give his engines something to do for a living. His accessories, such as a blowing fan were engineered through and through and based on prototypical machines and were on a different level

from mine. My accessories are toys based on old German designs, often as much as 100 years-old. *Troika* was described in *M.E.* in Vol 186, 2001, and I have kept with the more whimsical approach with Acrobat, which can be used with *Dreibeiner* or any other toy steam engine. The German firm, Mohr and Kraus probably made the original Acrobat at the turn of the 19th century. The toy, representing circus acrobats in traditional costume, was made completely from tinplate.

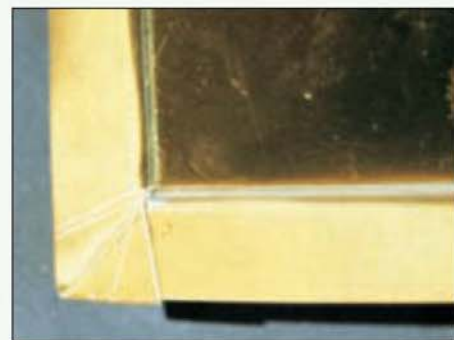
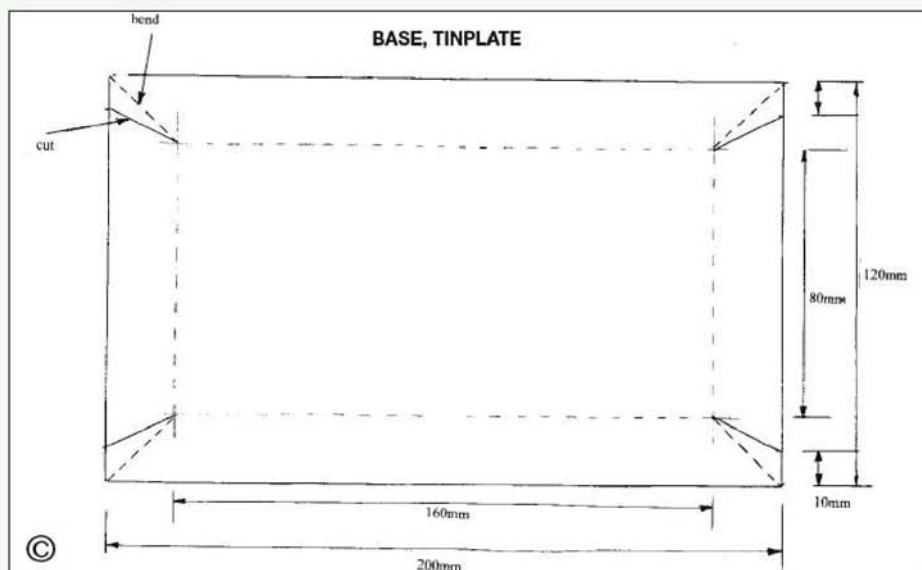
Our toy is made from whatever comes to hand and the builder should not feel constrained by the size and dimensions or even materials used, these are purely guidelines. The base is made from tinplate, the bars from commercial brass section and the figures from white-metal castings and wood. It is possible to construct Acrobat without the aid of a lathe or major machine tools as it is aimed at

those who do not possess a very great workshop. Commercially available pulleys and shafts are used but, if the builder has access to a lathe then these are very simple turnings. Tubal Cain once described a horizontal steam engine made completely with hand tools, for obvious reasons he christened it *Hand Maiden*. A visit to the late Tubal Cain was to me quite an event; he was very kind and helpful, showing me his collection of superbly constructed miniatures. The memory that remains with me the most was the need for an Ordnance Survey map and grid references to find his house in the Cumbrian wilderness!

I used the kitchen table as a workbench, as this was all that was available at the time due to a house move. Be warned, however, this can be a very dangerous procedure as the predatory housewife can take exception to any damage incurred. A simple, inexpensive workmate type of bench was used for the woodworking parts. A range of simple hand tools such as files, hacksaws, a suitable source of heat and electric drill is needed.

We shall make a start on the base, which is constructed from tinplate and forms an integral part of the toy. The size is not that important but the dimensions offered will make a base of pleasing proportions. Firstly find a scrap piece of wood about $\frac{3}{4}$ in. thick and cut to the shape indicated chamfering the edges using a simple block plane. You may find it easier to chamfer across the grain with a saw; finally the edges are sanded smooth. Another piece of wood is cut to the size of the top, which is used to sandwich the tinplate whilst bending.

To cut the tinplate tin-snips are as good as anything but, for thin tinplate, a good pair of stout household scissors does just as well. I am just recovering now after using said pair! I have also just finished secretly experimenting with a good old-fashioned paper guillotine and found that it



The corner joint from the outside.



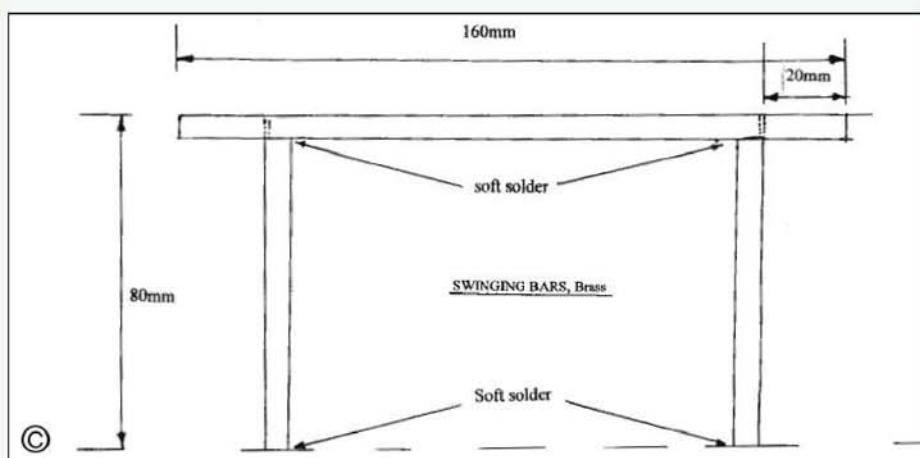
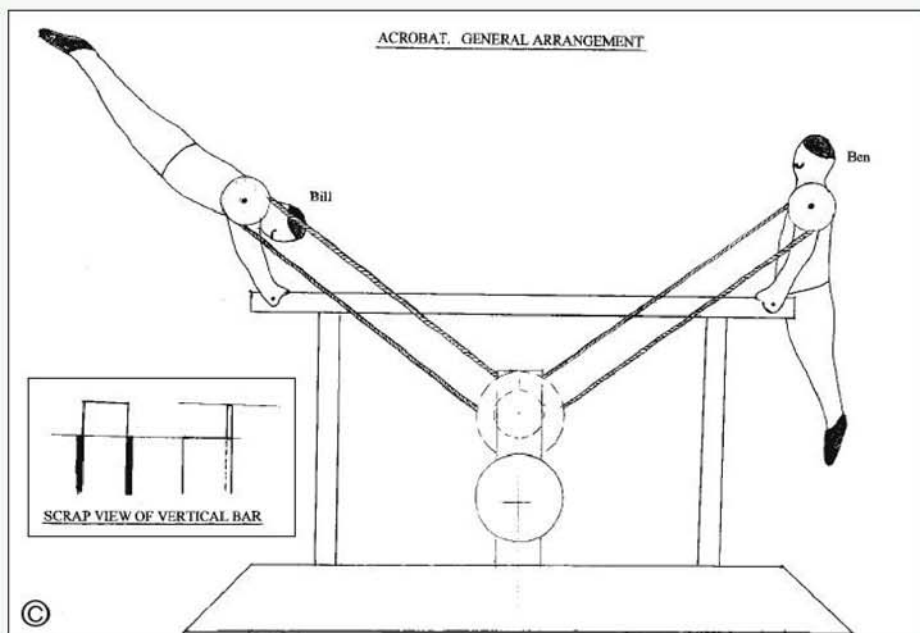
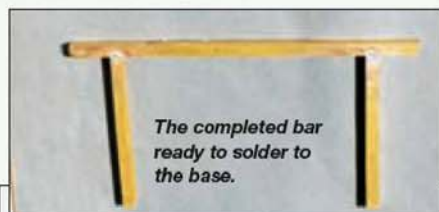
The corner joint from the inside.

works a treat. Straight edges with no sharp edges are obtained, a method I would strongly recommend. Tinplate can have very sharp edges that could cause an injury, so smooth the edges with a stone or fine emery.

Tinplate can be bought from our suppliers but very few stock tinplate nowadays, it is becoming an obsolete material so another and cheaper source is from old tins. You may need to hunt around for a tin of suitable dimensions; in fact the size of the base may have to be determined by the availability of tinplate. By placing the wooden base on the tin you will be able to assess whether or not it will be big enough.

Early tinplate bases used a number of different corner joints. The simple butt joint was not that popular as it left a very sharp edge; a variation of this was to solder a piece of round tube on the inside producing a rounded edge. The third method, which I recommend is to use an overlapping tab that holds the edges firmly in position and produces a nicely rounded corner. On the flat tinplate mark two concentric rectangles (can you have concentric rectangles?); the inner one is 80 x 160mm, the outer is 120 x 200mm. On the shorter outer sides measure in 10mm from each corner and join these points to their respective inner corners.

We are now ready to cut to size; I used the guillotine, which worked really well. Cut the outer shape first followed by the corner diagonals; when you are satisfied with the shape the embryo base is clamped between the two pieces of wood and bent to shape. Firm hand pressure and a small block of wood to accentuate the creases should be sufficient; there should be no need of a hammer. Bend the short sides first, followed by the long sides, which will produce an overlap at each end, which are folded over the short sides and burnish flat. There should be a small tab projecting below the base, which is bent up and crimped flat with a pair of pliers; we now can solder the corners.



For soldering tinplate an old-fashioned soldering iron is ideal, however, as with most good things I suspect that most people do not possess one, me included, so I used a small self-blowing torch. Apply plenty of flux and gently heat the inside; capillary action will ensure that solder fills the joint. Two pieces of tinplate are cut to a suitable shape and soldered to the ends to act as holding tabs. You should be looking at a nicely formed base; if there has been any distortion then it can be gently taught a bit of manners, as LBSC, of famous memory would have said.

The horizontal bars can be tackled next. The original toy used folded tinplate; if you feel confident you can follow suit, if not, use commercially available brass channel section. Most large DIY shops have a very convenient rack of pre-formed

metal strips and you should be able to obtain some brass channel about 6mm by about 1mm thick; the exact size doesn't really matter. Two horizontal pieces about 160mm long and four vertical pieces about 80mm long will be needed. One end of each upright is filed to the profile shown and should be a nice tight fit inside the horizontal bars and placed about 1in. from each end. They are held permanently in place with a touch of soft solder. Before we can solder these to the base plate we need to make the figures as they have to rotate freely between the bars and it is easier to make the bars fit the figures rather than the other way round!

The figures, which I have christened Bill and Ben, were originally made from pressed tinplate; in common with most tin figures they were somewhat two dimensional in appearance. The arms are fixed permanently to the bars and the body rotates about the shoulders. When I started the design I fully intended to make the figures out of cast white metal, however, the best laid plans and all that! I could get the arms to cast all right but the body just would not cast. It didn't seem to matter what I did they were always full of air holes or had a really rotten finish. I was in a quandary as how to proceed when I was using half round hardwood sections while making a new staircase. (Yes, I have to fit in the more important things in life, such as making steam toys with some of the essentials!) It's funny how these things strike you. I could see at a glance that if they were joined together a squashed cir-



cle was the result, exactly the shape that I had been looking for. So the final design used wood for the bodies and white metal for the arms. In fact this is probably not a bad combination, as the arms need to be sturdy but the body light. There certainly was a precedent for the use of wood in steam toy making; Planck often used wood with pasted on lithography.

The arms are castings made from wax patterns, as described in my article on *Troika*, to which I draw the attention of today's readers. As an aside all waxes are not the same; if you use candle wax for instance it would be far too brittle and beeswax would be far too soft. We shall use dental toughened wax, which is ideal for this application where we don't have to worry too much about accuracy. Toughened wax uses a base of beeswax, to which waxes such as carnauba and candilla are added producing a tough and easily softened wax, which is not brittle. When finely detailed lost wax castings are required a different mixture of waxes is used. The percentage of beeswax is reduced and that of carnauba and especially candilla is increased and the end result is a very tough but brittle wax that can be finely carved.

Toughened wax comes in sheets about 1mm thick, which need to be softened. The secret of softening wax is not to melt it; when it is about to melt it will turn opaque and must be removed from the heat immediately. Wave the wax a good few inches over the flame and it will start to soften and bend when it can be rolled into a flat sausage about 1/2in. thick.

As human anatomy may be somewhat of a mystery to some of our readers I have included a silhouette of the finished figure, which can be transferred to a piece of stiff card and used as a template. I think you will find that it will produce a figure of pleasing proportions, however, you can make the figures any shape you want. You may prefer to have a more attractive female figure, it's up to you but don't get carried away, remember the lady of the household will be looking over your shoulder!

The arm template is pressed onto the wax sausage, which is cut to profile using a fine craft knife and is characterised to make it look human; you will have spotted that the arms need to be



Right: A completed torso of Ben. The two halves have been glued together and moulded and sanded to shape. It is ready for sealing and painting.

Left: The arms are made from cast white metal; two pairs and the mould are illustrated here. Observe the large central sprue and reservoir to allow for shrinkage.



The bodies of 'Bill and Ben' are drawn on the half round stock, be sure to make one the reverse.



A Stanley knife is used to sculpt the figures. By holding the knife in this way you will be able to exert maximum control.

handed, if that makes sense. To do this the finished wax arm is cut down the middle, making two halves that are mirror images. Finally the hands have to be cut so that they abut snugly against the horizontal bar.

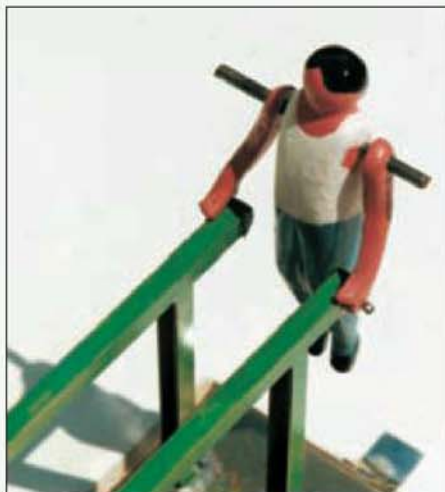
Now we can make a start on the body. You will be able to obtain the moulding, which is about an inch across the flat from most DIY places. Cut off a piece about 1ft. long and mark out the profile of the figure from the template onto the flat surface. As they have to be handed reverse the second outline for the contra lateral side. I used a Stanley knife to cut and contour the body, finishing with

fine glass paper. The two halves are stuck together with whatever is at hand and finally given a sanding. Before painting the body is dunked into some sanding sealer, filling and masking the wood grain, which makes a fine surface for painting. I think you will agree that quite a tolerable result can be achieved. We are really motoring now and will soon have the accessory finished.

We can start to do some assembling at this stage. Place the base on a flat surface and stand the uprights in a suitable position. Check that the bars are wide enough to allow the figures to rotate freely and that there is enough room at the front for



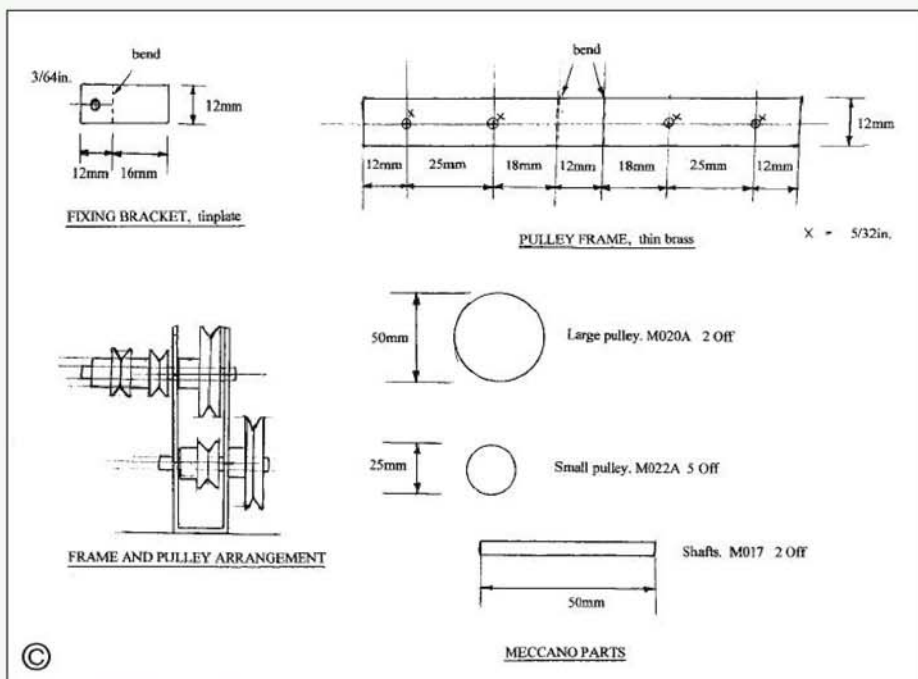
The toughened wax is softened over a suitable flame by waving it gently a few inches away until it becomes soft and pliable.



Bill temporarily in position after the holes have been drilled.



A close-up of Bill's hand showing how they are attached to the horizontal bars with split pins.



The pulley frame marked and drilled before bending.

the various pulleys; when you are satisfied they are soldered in place. The easiest way of doing this is to find a piece of wood the same width as the space between the bars which are then clamped together and will be nicely parallel in all planes.

We come to a tricky bit next, attaching the figures to the bars. I suggest that they are fitted at the ends of the bars, allowing them sufficient room to swing without crashing into each other. The first stage is to drill $\frac{3}{64}$ in. holes in the middle of the hands and the shoulders. The shoulder holes are then opened to $\frac{5}{32}$ in. (or to suit the diameter of the shaft) I used an ordinary hand-held drill for this purpose. The arms are then cranked slightly to match the body. Fit one pair of arms at a time; poke one of the Meccano shafts through the shoulders to align to two arms. The holes in the hands are then transferred to the bars and drilled $\frac{3}{64}$ inch.

The arms are held in place with epoxy glue and $\frac{3}{64}$ in. split pins from the outside and crimped to hold them steady. Next the body is placed between the arms and the $\frac{5}{32}$ in. hole is transferred to the body and drilled right through. Try to keep this nice and square otherwise the body will snag the bars when swinging. The Meccano shaft should push nicely into the hole without the need for any glue, as the wood should have sufficient spring to grip the metal. The body should swing freely without binding, if necessary open up and adjust the shoulder holes.

At this stage the figures can be painted. I used Humbrol matt paint rather than gloss as I felt that this would make them appear a little worn rather than brand new. They are painted the same except that one has red tights and the other blue. Try to make them appear as they would at the turn of the last century when fashions were slightly different from today. Remember that they would have been painted quickly without much finesse so there is really no need to go overboard.

Stand back and admire the progress, the toy is nearly finished the final stage being to make the pulley system. The toy is designed to run from a steam engine rotating at several hundred rpm so we have to gear down to maintain power and reduce the speed of rotation. A figure travelling at 600rpm would look a little odd to say the least. We are using commercially available pulleys from the Meccano range; by studying the drawing you will see how they are arranged.

The pulley frame is made from thin brass stock; anything at hand will do; mark and drill the piece with $\frac{5}{32}$ in holes, an electric hand drill would be sufficient. Next find a piece of wood or metal about $\frac{1}{2}$ in. thick, which can be used as a bending former. If the brass is thin enough it can be bent by hand, another piece of wood and hammer being used to make the bends nice and tight. If you have any doubts about the accuracy of your drilling drill the holes after bending, using the block of wood as a support.

The pulleys are standard Meccano although they are easily turned in the lathe. I noted with a certain amount of sadness that they are stamped



Pulley frame with the pulleys temporarily assembled to find the best alignment for the belts. This is best done by trial and error.

France! Frank Hornby would be turning in his grave at the thought but at least Meccano is still being made. The smaller pulleys are still a little heavy for our model so if you can slim them a little it will enhance the overall appearance.

Assemble the various pulleys and shafts according to the drawing, using Mamod spring belts adjusted for length. Make sure that the shafts are a loose fit in the frame, steam toys have very little power and friction should be reduced to an absolute minimum. The pulley frame should then be trail assembled to get the belts in the right position so they do not bind unduly; when you are happy solder the frame in position. Care will be needed to adjust the tension of the spring belts; too tight and the frame will distort but too slack and the belts will slip. Believe it or not we have virtually finished; give the base a good clean with soapy water and paint a suitable colour; a pale green is about right.

If you have already made *Dreibeiner* then Acrobat can be coupled and off you go, if not watch this space for the next instalment. Happy playing!

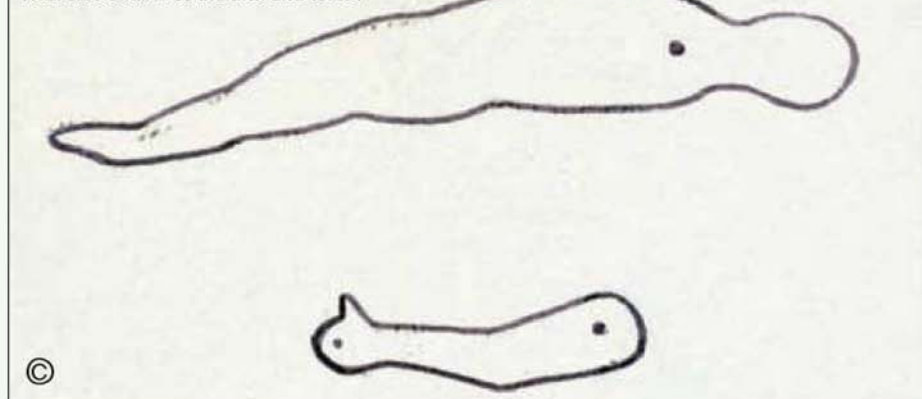
If you are a little reticent at casting the arms then I can supply them or the toughened wax at virtually no cost if you let me know at Sunnyside, Henwood, Cornwall PL14 5BP.

Addresses

Mamod: Tony Green, 19 Station Road., Thorpe on the Hill, Lincoln LN6 9BS. Tel: 01522-681989.

Meccano: M. W. Models, 4 Greys Road, Henley on Thames RG9 1RY. Tel: 01491-572436.

Real size outline of the arm and torso.



D.A.G. Brown and Mark Smithers begin the process of fitting out this well detailed model locomotive.

● *Part XVIII continued from page 32*
(M.E. 4251, 8 July 2005)

We have now completed virtually all the superstructure of the locomotive and it is time to start on the fitting out process. Truth to the original prototype is, we believe, important, so you will observe that one or two of the designs are, shall we say, a trifle unusual by the normal model engineering standards. We shall start by detailing the four methods of getting the water into the boiler during normal operation, namely mechanical pump, emergency hand pump, Giffard injector and M.E. injector. First, however, let Mark describe the historical background of the design:

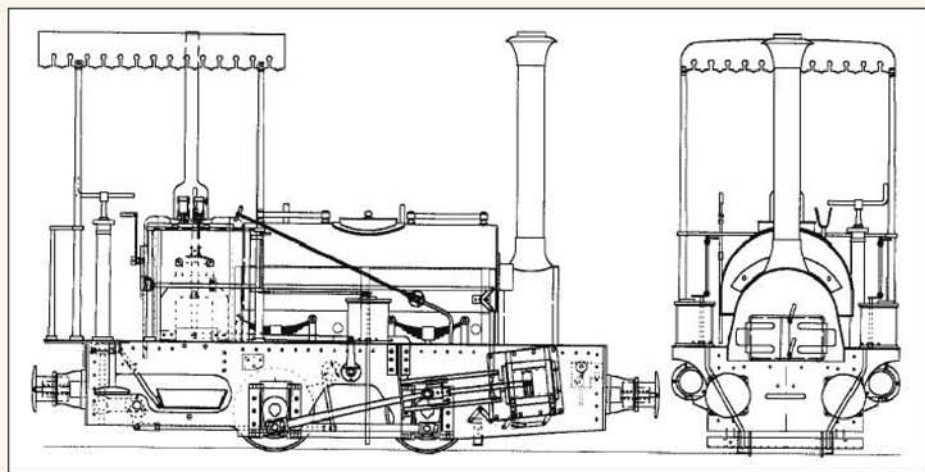
Water feed methods on early Manning Wardles

In order to understand the water feed arrangements used on *Anna*, one has to look at the arrangements used on several early Manning Wardle designs and their E. B. Wilson ancestors. The type of boiler used on most Manning Wardle locomotives made its appearance at the turn of the 1840s/50s with a number of 2-2-2WTs constructed by Wilsons and also by the Manchester concern of William Fairbairn & Sons. This fact was recorded by E. L. Ahrons in *The British Steam Locomotive 1825-1925*.

In 1851, the basic 'domeless' boiler design, with its raised firebox, was utilised again by Wilsons for a series of dummy crankshaft 0-4-0 tank locomotives built to a Crampton patent. Drawings show these engines to have had inside cylinders with two crosshead driven feed pumps.

In 1853, similar feed arrangements were used on two pivotal 0-4-2ST locomotives supplied to the Oxford, Worcester and Wolverhampton Railway as its Nos. 34 and 35, whose superstructure arrangements were to form the basis of some 0-6-0STs built for colliery use from 1855 onwards. The 0-4-2STs, with their 9in. by 14in. cylinders were certainly 'under cylindered' and it is my belief that similar cylinders were used on a (possibly slightly earlier) Wilson 0-4-0ST that saw service with a contractor who built the Dursley branch of the Midland Railway in the 1850s and later became MR 156 and 2020. Earlier statements that this latter locomotive was built in Bristol in the 1840s are clearly incorrect.

The 0-6-0ST design thus combined the superstructure of the O.W.&W. locomotives; the cylinder bore (but a slightly reduced stroke) of the Cramptons and the characteristic 'double crank boss', 3ft. wheels of the 0-4-0ST and its significance is that it went on to become the 'Old I' class Manning Wardle standard design after 1859. A photograph in Don Townsley's recent book *The Hunslet Engine Works* shows Manning Wardle works number 16 of 1860 *Waterloo Main* and reveals that another feature had made its appearance by this stage, namely a small live steam pipe running from the top of the firebox wrapper to the rear of the saddle tank. This appears to be some sort of feed water preheater.



ANNA A MANNING WARDLE LOCOMOTIVE FOR 7¹/₄in. GAUGE

There is no direct evidence for the existence of a Wilson design of outside cylinder 0-4-0ST similar to the Manning Wardle standard classes (I believe that the 0-4-0 tank locomotive auctioned in 1859 after the closure of the firm was of similar design to the 'Dursley' locomotive and that its cylinders, described as 9 x 12in., were in fact 9 x 14in.) and the true ancestor of these locomotives was a pair of large wheeled 2-2-0STs supplied to Argentina in 1856. One of these, *La Portena* still survives and it would appear to have used two axle driven feed pumps. This arrangement was perpetuated on the first 'D' class 0-4-0ST (No.13 of 1860) built by Manning Wardle, whose general arrangement drawing still survives. This engine also had a preheater pipe.

Charles Wardle proved to be an early admirer of the Giffard injector, having published a paper on its use for colliery drainage in 1861, but he would not initially place total reliance on it. Many Manning Wardle locomotives of the 1861-77 period therefore appeared with the combination of one feed pump, one injector and a preheater. This gives a clue to their *modus operandi*: the injector would have been used early in the day when the engine was stationary prior to work, and the feed pump, in conjunction with the preheater, later on when the engine was working.

From about 1877 onwards, when injectors had become more reliable, it was desired that more use could be made of them and hence the preheaters, which would have impaired their action, were quietly dropped. Although *Anna*'s design dates from the period when preheaters were in use, one will not be used on the model. All the 18in. gauge locomotives kept their arrangement of feed pump and injector for all of their service lives.

One interesting feature that found its way not only onto Manning Wardle 18in. gauge locomotives, but also onto Hudswell Clarke and Hunslet products of the same gauge (including the now preserved *Jack* at Leeds) was the means by which vacuum creation in the pump body was avoided. Instead of the straight 'by pass' valve used on their Crewe works forerunners, the Leeds locomotives used a foreshortened arrangement in which water let into the pump body at the start of operation was ejected to waste from footplate level via a valve on the cab (or what passed for

one!). It appears that the manufacturers might have been frightened of obstructions in the closed loop of a by pass valve system, but these ejecting pipes caught many visitors unawares while watching *Jack* and *Gwen* at work on the John Knowles' network during visits in the 1950s!

Clack Valves

You will already have provided four boiler branches 15deg. below the centre-line, each one tapped 1/2in. x 32. With their joints disguised by the cladding, each one is furnished with a fairly massive Clack Valve, yet another example straight from the standard gauge design library! They are so prominent on the model that we cannot afford to cheese-pare, so acknowledging that they are over-designed, here goes with their construction. In producing the design, clash tests on the CAD pointed out that our original information produced articles that would have been in conflict with the suspension and the reversing gear, so I have taken a few liberties with the dimensions, reducing them to allow installation to take place without too much difficulty. As it is, when the spool pieces are screwed into their bushes, you may have to ease the spring hangers out, to allow them to turn. You will appreciate the provision of screws fitting from the top in all cases, which will allow the spanner easy access. The pipework clears the inside of the main frames.

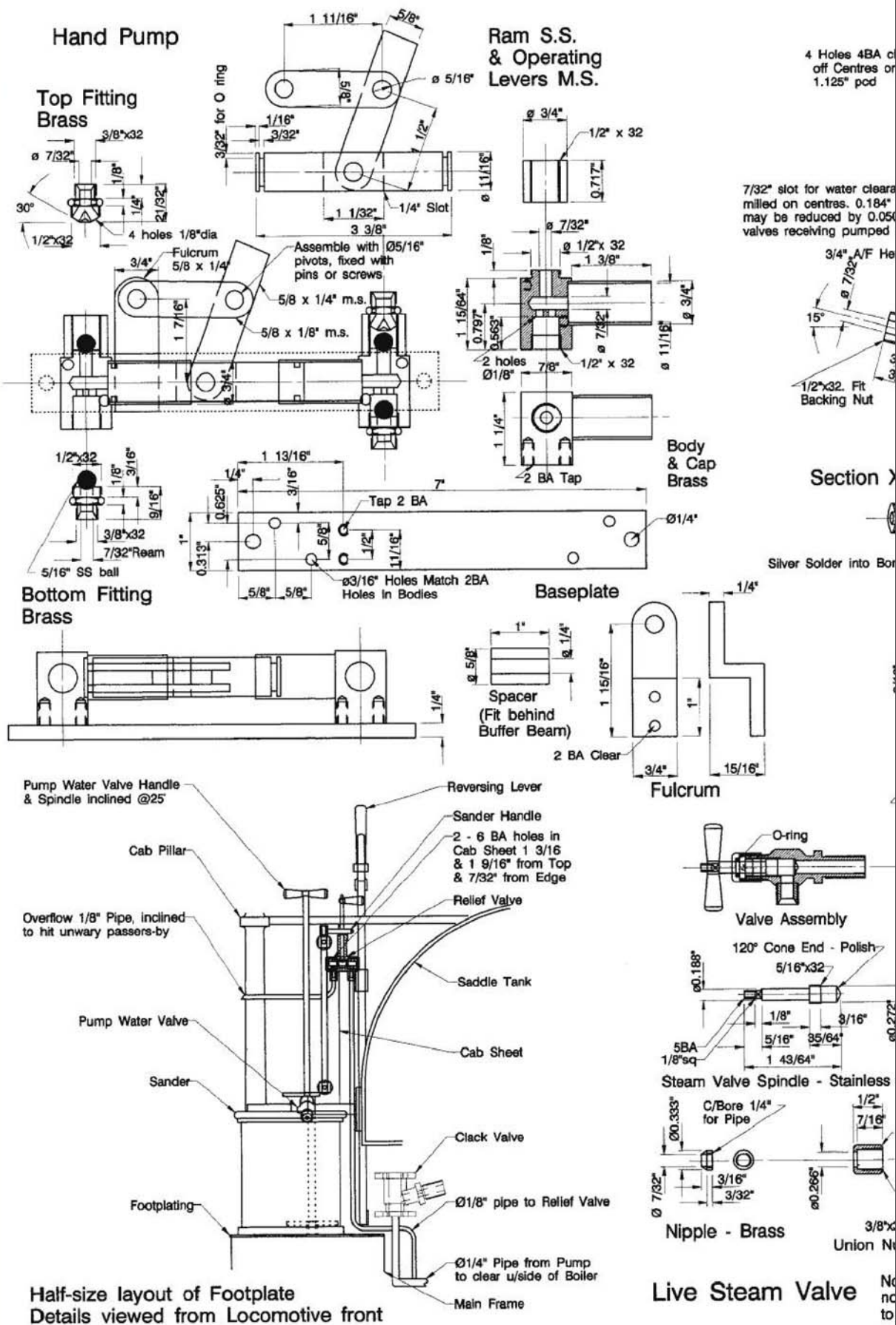
The main valve spool pieces are a simple turning job from bronze rod 1³/₈in. diameter, cored or drilled through 7/16in. dia, with the main spool relieved to 3/4in. dia. and a short section further reduced to 5/8in., merely to emulate the original shape. The drillings in the two flanges are different merely to allow 4BA bolts to be fitted from above in both cases. Take especial care to ensure that the sets of holes in the top and bottom flanges are all lined up with each other, otherwise fitting the screws may become problematical. After finishing the holes, hold the piece with its axis at 15deg to the horizontal and the holes off-centres and sink a 1/2in. dia spot face for the side branch, breaking through into the main bore for the water passage.

The side branch is specified as stainless steel, whose coefficient of thermal conductivity is far poorer than that of any of the bronzes. This is in

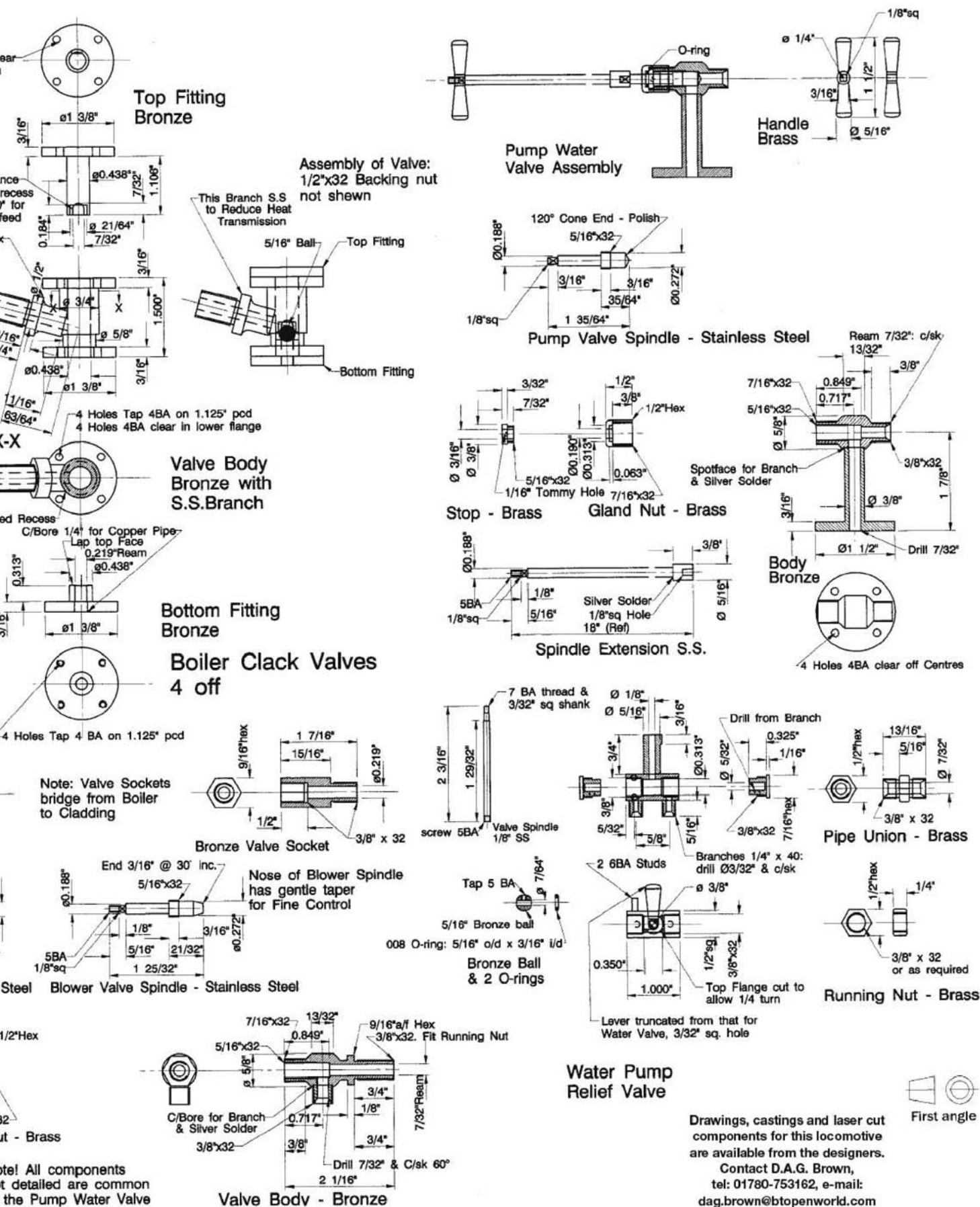
an attempt to reduce the temperature of the fitting, thereby allowing the use of Nitrile Rubber Balls. These small devils are marvellous if they are fitted to the correct size of seat, but their maximum operating temperature is of the order of 125deg. C, above which they start to lose their elasticity. Water at 90psig boils at 166deg. C, so we rely upon the relatively large surface area of the Clack Valves to dissipate enough heat to reduce the temperature at the valve seatings by 40deg. Celsius. It should work! I have seen the time during my Chemical Engineering days when we had to calculate such temperature drops - longhand! Silver soldering the branch onto the spool piece might give a little trouble, should the stainless piece be subjected to too high a temperature. When the components are heated with Easyflo flux in the joint, make sure that the temperature of the bronze (the larger component) is raised slightly quicker than that of the stainless steel. The solder should then flash nicely round the joint when it is very dull red.

Now it is the turn of the Bottom Fitting, which also starts as 1 3/8in. dia. bronze. By reaming the bore and lapping the top face, you provide the perfect seating for mating the ball; this should be done by pressing a stainless steel ball into the seat using the downwards pressure from say a milling machine quill, but interposing a piece of soft material above the ball to prevent damage; I like using a sliver of MDF for the purpose. Go easy on the lapping process until the 1/4in. copper pipe has been finally silver soldered into place.

Dealing now with the Top Fitting, the only thing of note is the clearance slot which must be milled in such a position that it allows clear access to the water path, while restraining the ball to move normal to its seat. In sizing the Fitting, you should ensure that the two valves destined for injector feed allow a ball lift of around



Half-size layout of Footplate
Details viewed from Locomotive front



Drawings, castings and laser cut components for this locomotive are available from the designers.

Contact D.A.G. Brown,
tel: 01780-753162, e-mail:
dag.brown@btopenworld.com
or mark Smithers, tel: 01609-77374, e-mail:
marks_northall.yorks@tiscali.co.uk

$\frac{3}{32}$ inch. For valves checking the flow from pumps, this lift should be halved. In all cases, assembly is by means of 4BA hexagon head set screws with washers.

Disposition of the pipework

When you have the four Clack valves, they should be fitted with the following discipline in mind:

- Left front for emergency hand pump.
- Left rear for Giffard Injector.
- Right front for Axle Pump.
- Right rear for 'extra' injector (from the tender).

This arrangement preserves that of the original, with our addition of the emergency pump and extra injector. My experience on the Hunslet is that the saddle tank water feeds the injector satisfactorily at first, but after a long hot day's running it does become too hot. However, I normally use the tank load as ballast for improving adhesion, so my injector feed comes through the lines from the tender. As I envisage things on *Anna*, the Giffard injector will very much be 'for Sunday Best and demonstration' purposes, judicious use of the pump keeping down the water temperature through frequent replenishment.

All water and steam pipework should be executed in $\frac{1}{4}$ in. dia. copper, with neat 90deg. bends. The Pump delivery turns right out of the top of the Pump; then forward just inside the right hand Main Frame, finishing vertically into the bottom of the Clack Valve. Near the Main Frame a $\frac{1}{8}$ in. dia line branches out of the top of the $\frac{1}{4}$ in. pipe and runs backwards at Footplate level to the Relief Valve, which is bolted to the front of the right hand Cab Sheet. In all the pipework, installation and maintenance are expedited by breaking the lines into manageable pieces, and making accessible joints with union fittings; it just means a few extra nipples and union nuts, the making of which will be discussed in a minute.

As Mark alluded, you can forget all the old LBSC nonsense of regulating the delivery of an axle pump by means of a by-pass. It is difficult to devise a more wasteful device, in which coal has to be burned to make enough steam to pump all the output of the pump up to boiler pressure and beyond, merely to dissipate much of it via the by-pass back into the tank. In normal operation the valve is left open, with the Water Supply Valve turned off by means of the adjacent handle. When water make-up is required, simply open the Supply Valve, wait until the jet appears from the end of the $\frac{1}{8}$ in. pipe and then shut the Relief Valve. With reasonable luck you will be able to drown the odd onlooker! Now here are details of the Relief Valve.

Relief Valve

Look at the half-size front view at the bottom left of the drawing: the Relief Valve bolts to the Cab Side Sheet through two holes which I have added to the laser cut profile which will soon be available. I am indebted to Brian Apthorpe of the North London Society for the inspiration of the design of a thoroughly good ball valve, which is detailed at the bottom right of the page. A bronze ball screwed to the bottom of the stainless spindle



Two lathe tools for working in holes as small as $\frac{3}{16}$ in. diameter. Screw cutting tool is on right.

is restrained to a quarter turn; the valve body can be brass, note being taken of the dimensions of 0.350 and 0.325in. for the various lengths. It is designed to allow just the right amount of squeeze on an O-ring; the two end pieces, having been fitted in place, are drilled through the $\frac{3}{32}$ in. branch holes to allow water and air to pass when necessary. The operating handle is merely a sawn-off version of what is about to be described as a standard water and steam valve handle, but with its bore reduced to suit the small component.

Pump water valve and other (steam) valves

I have standardised the components for this valve and those for the various steam duties, so we shall look first at the Water Valve, which is mounted at an angle of 25deg. to the axis and near the bottom of the tank. It stands well proud of the tank and may be fabricated from either bronze or brass. The operating part of the valve should be screw cut, rather than threaded by means of a tap and die. By all means finish off with this method, but we must make sure that the threads are true with the bore.

Don't be afraid of such precise boring and internal threading operations; here is a pair of small boring tools (see photo) which I have permanently set up in tool holders for the Myford, each capable of getting inside a $\frac{3}{16}$ in. dia. hole. The one on the left can counter bore to form the valve seat, and it can also remove metal from the end threads of a blind tapping. Working clearances are in general of the order of 8deg. and the top of the cutting edges is horizontal. The right-hand tool is an internal threading tool, ground to 55deg. included angle, and with a tiny radius stoned on its point. In machining the working portion of the valve, a No.4 or 5.3mm. hole is drilled ready for reaming, then the outside thread $\frac{7}{16}$ in. x 32 is formed first, before boring, back relieving and finally screw cutting the $\frac{5}{16}$ in. x 32 until it breaks into the void mentioned above, thus finishing up with a thread length of $\frac{9}{16}$ inch. Hold on to those tools; they will appear again in a minute.

The Pump Water Valve has its unique Valve Spindle, with a square end, ready to take an extension. In all other respects it is like those for the Steam Valves, which are fitted with 5BA screw threads at their ends. Make enough sets of components for Blower, two injectors, steam brake, vacuum brake and a spare, while you are about it. The nose of the Blower spindle has a slender proboscis, to make for gentle operation on initial opening. Each valve has a brass stop, which is threaded for only $\frac{1}{8}$ in., its shoulder being drilled with a $\frac{1}{16}$ in. dia. Tommy hole as a nice touch.

Gland Nuts and Union Nuts can be considered in the same breath, and will require the use of the boring and screw cutting tools mentioned above. For the Gland nuts, chuck a length of $\frac{1}{2}$ in. AF hexagon brass and drill to a full $\frac{1}{2}$ in. depth with a No.12 or 4.8 mm dia. drill. Next set the small boring tool just to touch the end of the bar, note the reading of the leadscrew handwheel and bore out to just $\frac{5}{16}$ in. dia., advancing the tool by three turns plus 0.063 inch. This forms the seating for an O-ring. Next bore out to 0.401in. dia. for a length of three turns precisely and, while at depth, bring the boring tool back by 0.018in. to undercut the end of the thread. Screw cutting should be preceded by forming a slight run-in and run-out at the thread ends. On an imperial lathe 32tpi does not require the use of the thread dial indicator! Before parting off, put a neat fillet radius on the end of the hexagon. Doing a set of these nuts does not take a terribly long time, but remember to make enough union nuts for a few pipe unions.

The $\frac{1}{4}$ in. Pipe Nipples are machined from bar reduced to 0.333in. dia. before drilling $\frac{7}{32}$ in. dia. and counter-drilling (or boring) $\frac{1}{4}$ in. dia. x $\frac{3}{32}$ in. deep. The 60deg. angle face is formed at this setting by plunging a 60deg. knife tool to a depth of 0.053in., leaving a few thou to be taken off by a narrow parting tool. This procedure ensures that the knife tool leaves a smooth finish all the way round the circumference of the cone; should you part off by mistake you will find a tiny ridge on the cone at the point where the tool stopped cutting, and naughty words will be muttered when the joint fails to be tight.

At the top of the page is drawn the Valve Handle, standard to all the valves and a typical Manning Wardle feature. Its production is a simple exercise in taper turning, the centre being drilled say 3.3mm. before enlarging into a square with its cheeks blown out by the odd couple of thou; the centres of the walls of a square used in this way serve no useful purpose, so they might as well not be there. The square can be roughed out by filing if desired, finishing off with a simple broach made from silver steel, hardened and tempered. I would commend you to Neil Read's recent article on broaching, for further advice (*M.E.* 4223, 11 June 2004).

The Valve Sockets, just below the centre of the drawing, could have been made integral with the boiler flanges, but I did not want to add another variable to the boiler components. They are required to offset the Valves by the thickness of the Boiler Cladding. They must be made from bronze. Running Nuts on the screwed ends of the valves are in brass and allow the valves to be positioned at their correct angles. The assembly is completed with a drawing of Pipe Unions, which may be put in to taste, as indicated above.

Space dictates that the Hand Pump details are considered in the next instalment.

Correction

In *Part XVII* of this series the width between the cheeks of the modified spring hangers should have appeared as $\frac{7}{8}$ inch. Regretably my CAD technique got on top of me!

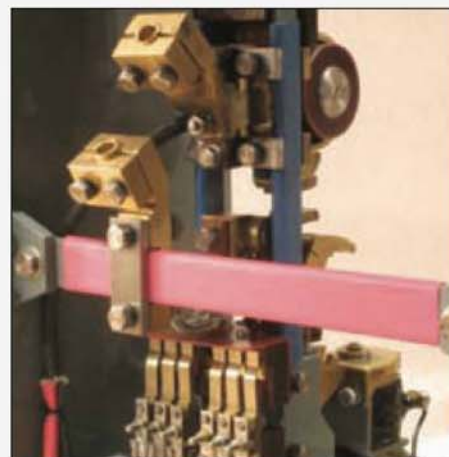
●To be continued.



The contactor with arc chute fitted. The arc is discharged through the vertical slot.



General view of the contactor with the test blow out coil fitted.



The rear of the contactor. Note the angled power terminals to aid cable routing.

ELECTRO-PNEUMATIC CONTACTORS

Colin Beckwith

completes the description of the arc chute and brings this fascinating series to a conclusion.

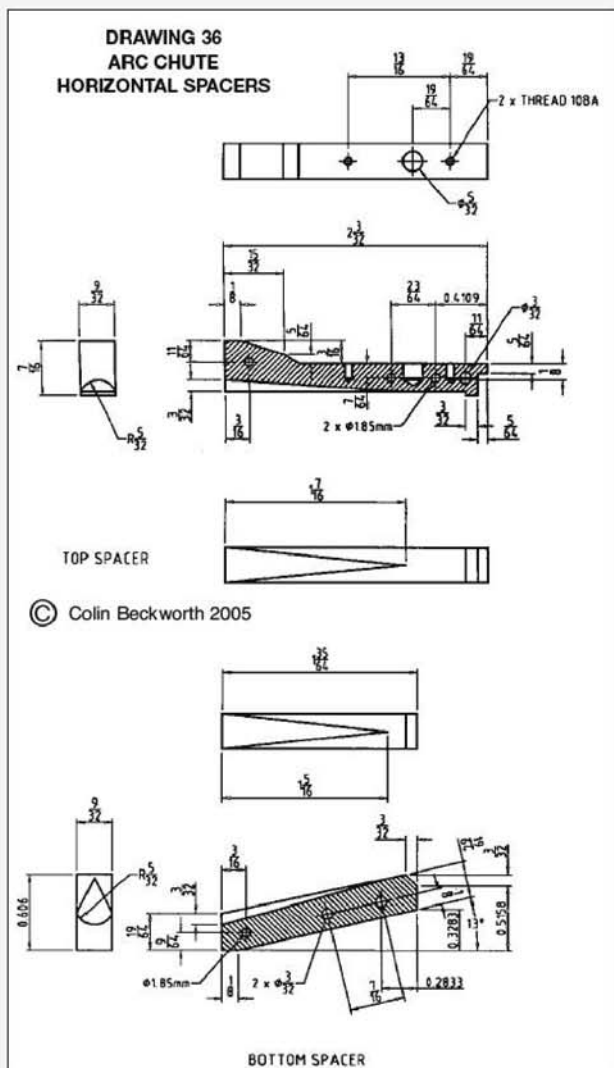
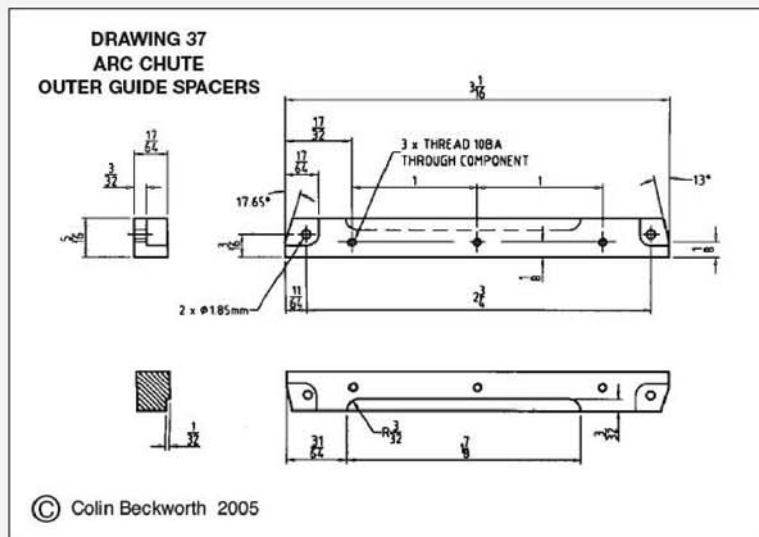
●Part X continued from page 39
(M.E. 4251, 8 July 2005)

There are two forms of spacer used on the arc chute. The first type forms the box structure around the contact tips and is shown in drawing 36. These are fitted horizontally and are clamped between the side plates with brass studding and nuts. The thickness of these parts, or you could say the gap, between the side plates is $\frac{9}{32}$ inch. Tufnol is not obtainable in this thickness so the $\frac{3}{8}$ inch thick material I used had to be filed down to this dimension. Unfortunately the laminar nature of the material made it impossible to machine satisfactorily without damage to the surface. A Millencut file is a wonderful tool for removing this amount of material efficiently. This was duly done and the profiles generated. The most taxing operation being the filing of a feathered semi-

circular slot with a rat tail file. Not absolutely necessary in the main, but it does give a pleasing similarity with the full size. Recesses for the arc chute retention catch assembly are included in the upper spacer, which can be seen on the drawing.

The outer guard spacers are handed, being subtly different by virtue of the $\frac{1}{32} \times \frac{3}{32}$ inch rebate running along the length of the component. This part is shown in drawing 37. Notice the recesses that allow the 10BA clamping nuts to fit snugly into the part underneath the outer guard plates at the outer ends of the component. Note also that the three 10BA tapped holes for the outer side plate mounting screws are shown as going through the part. This is not strictly necessary, but I just did not fancy tapping too many blind 10BA holes in Tufnol. Much easier just to take them right through and hang the expense. The material thickness being $\frac{17}{64}$ inch. did again

necessitate taking down a stock thickness to size. This is not wholly correct as far as good practice goes due to the fact that the surface finish is compromised. The surface of a Tufnol sheet has a hard skin, which is resistant to tracking. Tracking being the process of current leakage



over a surface experiencing a potential difference. Thus the tracking resistance of the material is made inferior due to the removal of this surface layer. One way round this would be to obtain a more suitable supply of material. I have other more innovative ideas, which I will not go into at this visit.

Outer guard plates

The outer side plates are quite simple items being handed as they are due to the countersunk holes for the retention screws. I have used a template for this part for the same reasons as before. This part is shown in drawing 35. The profile is as it is due to the arc chute's need to rotate as it is dismantled from the contactor. The chamfers at the right hand side allow the assembly to clear the steel contactor mounting structure during this operation. The outer guard plate is fastened with three 10BA screws as mentioned before with two extra 8BA screws. The 8BA screws fit into threaded pillars which also retain the inner side plates. This arrangement can be seen in the photograph of the partly dismantled arc chute (part IX). The outer guard plates give no causes for concern bar those already mentioned in connection with the traits of the material used.

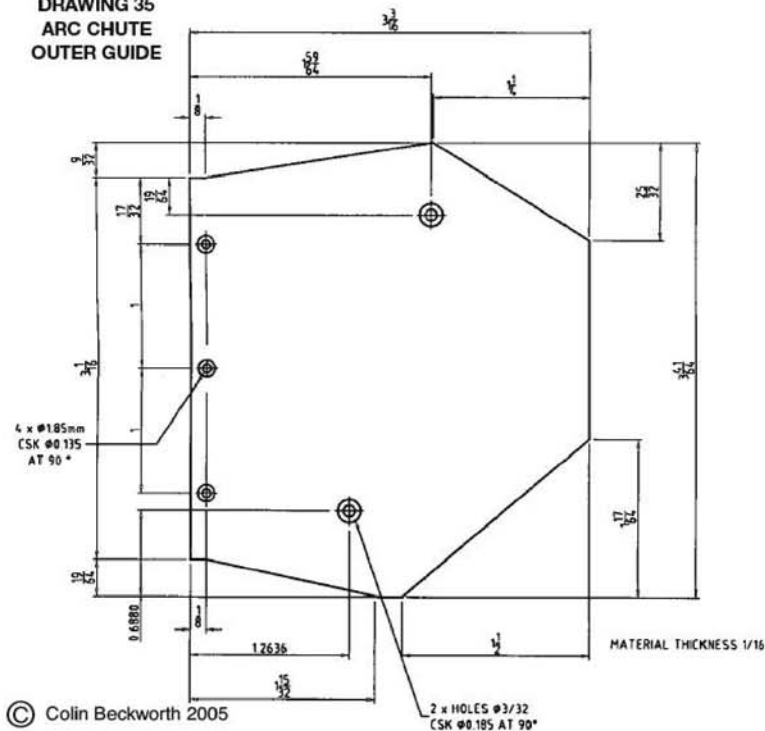
Blow out cheeks

These are shown in drawing 38 and are simple filing jobs. There are two types, which are designed to be laminated together. Therefore, there are two of each type needed per contactor. They are made from 20swg mild steel sheet being part of the reason for their being two laminated together. The other reason is the magnetic characteristics of the device and the need to avoid 'saturation' of the components. The larger of the two cheeks is retained by the outer guard spacer by virtue of that part's rebate mentioned earlier. The other ends of the cheeks are supposed to be mounted to the pole piece using rivets. This is one of those things that should be so simple. The problem is that I am not sold on that idea and the production contactor uses screws. Therefore the fixing holes are not shown on the drawing.

Pole pieces

These parts interface with the blow out coil core and are shown in drawing 39. They are in the main a filing job from $\frac{5}{8} \times \frac{3}{32}$ in. stock and are pretty simple to produce. I did not want to use countersunk screws for the mounting of these handed components. The alternative was to provide counter bored holes for the 10BA brass studs and nuts, the counter bore being needed by the restricted space given by the outer guard plates once assembled. The $\frac{1}{8}$ in. radius cut out on the upper right of the pole piece is to accommodate the other 8BA threaded pillar for the outer guard mounting.

**DRAWING 35
ARC CHUTE
OUTER GUIDE**



and require a lot of torque to be applied to the screw. This preload can put undue force on a 10BA screw which could lead to premature failure. For this reason I tend to prefer single coil helical spring washers. These are less freely available for the small sizes, but I have been lucky recently with 8BA. I managed to pick up a bag of about 2,000 of these at the recent Model Engineer Exhibition. As for 10BA, still no luck although I remain hopeful that perhaps someone can help me.

Fastener identification

Reference to the drawings 2 and 33 will show that all fasteners and related items have been given alphabetic identification. Other parts have been given numeric coding. The main

Blow out coil core

A relatively simple turning job, the main core shown on the left of drawing 40 has two shouldered ends shown on the right. The end pieces or clamps fit to the core with 8BA countersunk steel screws. Casting your mind back to drawing 2 will clarify this construction. The 45deg. chamfer on the clamp allows the arc chute to ride up over it and create an interference fit with the pole pieces and ensure a good magnetic contact.

Threads and fasteners

Reference to the text will indicate that I have mainly used the BA system for threaded fasteners on the contactor. The minimum size that appears is 10BA, which for some applications is still a bit clumsy. I was against the use of smaller sizes, mainly because of the manufacturing difficulties. It is very stressful to tap a 12BA hole in anything, let alone a blind hole in steel. In fact the minimum blind hole I have used is 8BA so I feel even safer. The most difficult choice I had to make was that about the electrical connections. All these are 10BA on this contactor which makes it more convenient for servicing and tool usage. For electrical connections 10BA is very small and I cannot remember ever seeing these in an industrial application. However, I have elected to use them for the terminals, which are of critical importance. The main problem envisaged is the time taken to connect up all the wiring. Once installed and working correctly, they should be very reliable.

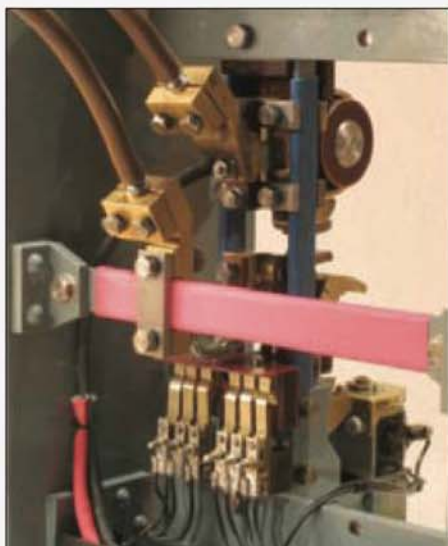
Fasteners in service

With reliability in mind, the integrity of the fastener system is frighteningly crucial. That is to say that their need to stay in place has to be addressed. Various proprietary types of locking washers are available, probably even down to 10BA. The more common and popular star washers are widely available. I am doubtful whether they work particularly well for these very small sizes. The star washers are very stiff

distinction being whether an item has to be made or not. Fasteners are almost exclusively bought in so they are given alphabetic designation. The coding for the fasteners is arranged so that each item has a unique two digit identification. The first was AA then AB, AC up to ZZ. This gives an adequate amount of unique descriptions. I can only have a finite number of combinations, but I can live with that. Each code is entered on a database, so that I can search using various criteria. Whichever drawing I look at I will know that a 6BA x $\frac{1}{2}$ in. steel hexagon head screw is designated AT. For each particular fastener there is only ever one code. The coding is simple to show on the drawings and it is clear to the user where each part originates.

Material supply

Most of the structural materials I needed have been freely available. The main exception is Tufnol in thin sheet sizes, which can be very difficult. Most of the sheet I used has been collected over a period of about twenty years and I have quite a bit. This is not convenient when making something in a thickness that I do not have in stock. This tends to limit creativity, so I have had to go to industrial suppliers for some of it. Even then it is frequently supplied in metric sizes, giving more credence to the metrication argument. The other very specialised material is electrical copper such as that used to produce very heavy coils. I need this for the blow out coil at a size of about $\frac{1}{32} \times \frac{3}{16}$ inch. How lucky I was then, when I took my Dad's car starter motor to bits and found a very suitable supply. Obviously, I did not rob this particular source, but it gave me an idea. I went to a car breaker's yard and asked the 'chappy' to sell me a few of the devices. It was all right at first, but I think he suspected me of selling them on and refused to trade further. Not to worry because I now had what I wanted, in the form of 1 x 5mm copper section. Due processing of the old field coils yielded a perfectly usable source of recycled material. Specialised insulation materials such as varnish, tapes and paper, are not readily stocked



The contactor with the power cables connected and the test blow out coil still fitted.

by model engineering suppliers. I cannot blame them, but it does not make my life any easier. Taking free samples at industrial trade shows is one way, but it is a bit cheeky isn't it and I am not proud of myself. Seriously though, this supply gap is a big problem for me and it has big implications as to what I can achieve. There is a ubiquitous, 'anacronimically' named electronic components supplier who I have been able to patronise yielding lots of opportunities.

Material dilemma

I have been frustrated from time to time, especially in the early stages of the development regarding material availability. The constant need to produce designs promotes a knowledge of what is available and in what form. Before this level is reached, there is a period of great frustration when there is a lack of information. This promotes the feeling of not being sure what to design because you do not know if you can source the material. Even if you have this vision you may not be able to get it in the correct size. After a while a knowledge of material availability will ensue giving the young model engineer a source of hope. One particular dichotomy is the sizing of angle in brass and steel. It may have moved on lately due to newer tooling becoming used, but it will be understood by many. Buy a length of bright mild steel angle and you will be specifying metric dimensions. The same thing in brass will encourage a beginner to start swotting up on imperial measure. Even something this fundamental can cause a great deal of inconvenience if it is not realised early on. Differences in measuring systems can make dimensions on drawings very untidy. I am not complaining, but just reflecting on some of my experience, with hopeful benefit to beginners. The metric system is taking over slowly and sooner or later the whole thing will be clearer. Small metric threads are an uncharted territory to me, but no matter, the BA system is metric is it not?

Drawing production

Huge task

My original desire was to produce all the drawings for everything using manual draughting techniques. My progress was always very slow, but the end products were pleasing. The drawings were clear enough, but making

changes to them was not always a simple task, let alone taking detail from a design layout. This can be a source of errors unless done carefully. I did most of my manual drawings on A1 and A0 format, each one taking about 20 hours to complete on average. Considering that the EP contactor has a pack of about 30, A1 drawings the detailing alone would take about 600 hours in total. That is before design iterations and consequences from errors in drawings. Errors will always occur when dealing with engineering drawings, even when produced by top draftsmen. Manufacturing companies will call for two or three distinct review stages to filter out these potentially expensive bombshells. Model engineering is frequently a spare time occupation for most doing it and I am no different. It is particularly galling when a mistake on a drawing causes hours of work or material to be wasted. I am not saying that my own drawings are perfect, I have a folder full up with discarded prints. These are added to as I manufacture some parts not attempted before. Usually I spot the error in time, but sometimes not. I do not really think I make that many mistakes on the drawings, it just seems that way to me. It is a well-accepted fact that, especially with drawings, you cannot check your own work. Well that is not completely true, just leave it for a couple of weeks, do something else then have another look at it. Chances are that you will say to yourself "what on earth?" You get the point I am sure.

I am a protagonist for the inclusion of even the most obvious information on the working drawings. For one thing I think it is of great help to the beginner. Inferred detail goes a long way toward simplifying the job to the experienced. For the beginner it can make it very difficult to make a start on the workbench, not to mention the sources of error possible in such a regime. The down side of this is that my drawings take about fifteen times as long to produce, or they would have done before CAD.

Notes on CAD

I do not want to go into the CAD subject too much, so just a few notes. Drafting productivity is improved markedly and I estimate a saving of 60 percent. The drawings are more efficient in that they contain less mistakes. Parts can be drawn with absolute precision. This makes it much easier to create accurate designs, which can be drawn up without the finite boundaries of paper. The details can then be copied to other files to generate the manufacturing drawings.

Drawing format

The vast majority of the drawings for the



The test rig includes a regulating valve, reservoir, distribution manifold, and electrical console.

contactor are A1 size and this simplifies CAD procedures. The drawings that I actually manufacture from are printed out on A4 and mounted in sleeves and ring binders. I have found that with a laser printer and adherence to robust drawing standards I feel the results are easily readable. I do not wear spectacles yet, but I can sense that the A4 size would not suit all. However, the drawings are easily stored and printing new copies is not expensive. Most of the piece parts for the contactor would be lost on an A4 sheet even if printed out at twice full size. This would prompt the use of single piece part drawings I hazard to guess. Not really suited to anything but manufacturing where sophisticated part numbering protocols will abound. Anyway it is a waste of paper.

Conclusion

I hope that readers will have empathised with my own particular way of thinking pertaining to the above project. I still feel that my values are recognisable even if my approach is perhaps a little unorthodox. Readers that are just starting in the hobby, I hope have been encouraged to continue with even more vigour than before. Young readers may be motivated to find out more about design and development, in any discipline. Steam men reading it may have been tempted to look more fully into the complexities of electric traction. Those familiar with electric traction will perhaps give a cordial 'here-here' to the author. Somebody reading the articles who has never done any model engineering before could be persuaded to take up the hobby. If you can all say yes to these prepositions then you will have deemed this article to be a complete success. I would be very happy to have this confirmed if applicable by the normal methods of correspondence pertaining to *Model Engineer*.



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M G Say
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BSI

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BSI/Hutchinson

Stephen Atkinson

continues his model with the wheel spinners before moving on to the engine and radiator.

●Part III continued from page 36
(M.E. 4251, 8 July 2005)

Wheel Spinners are the shaped nuts which secure the wheels to the car (photo 17). We need five of them including one to fix the spare wheel to its location behind the fuel tank. They are, however, not all alike. In order to ensure that the wheels do not come loose on their threads when the car is moving forward, the spinners on the right side of the car have a right hand-thread. Conversely, those on the left of the car have a left-hand thread. We do not need to make different threads, using standard 5BA in each case. However, the shape of the spinners differs from left to right. My drawing shows a spinner for the right side of the car (fig 14). The flat pieces are intended to be used to tighten the nut by means of a special mallet which was considered to be standard equipment on these cars.

Make them out of brass and then have them chrome plated. The one on the rear spare is probably best made as a right-hand one. It has a larger flat in the centre upon which surface can be glued an MG badge when all else is finished. To make the spinners, I took a brass bar slightly bigger in diameter than the distance across the two wings. Face off in the 3-jaw chuck and then shape the end of the bar to replicate the front shape between the wings. Part off to the correct thickness and then use a jig to shape the surface between the wings. I made a mild steel jig the shape required with a 5BA bar protruding. This was then screwed into the blank which had been drilled and tapped. With the jig case hardened, the spinner could be filed down to contact the jig making all the spinners the same shape. This method does, of course, require a left and right-hand jig but they are easy to produce.

Engine

At this point the decision has to be taken as to what amount of detail you intend to replicate. My intention was to try and produce the whole car in miniature and this, of course, includes the engine, gearbox and drive shaft to the rear axle. I have to agree that some of these parts are hardly

17

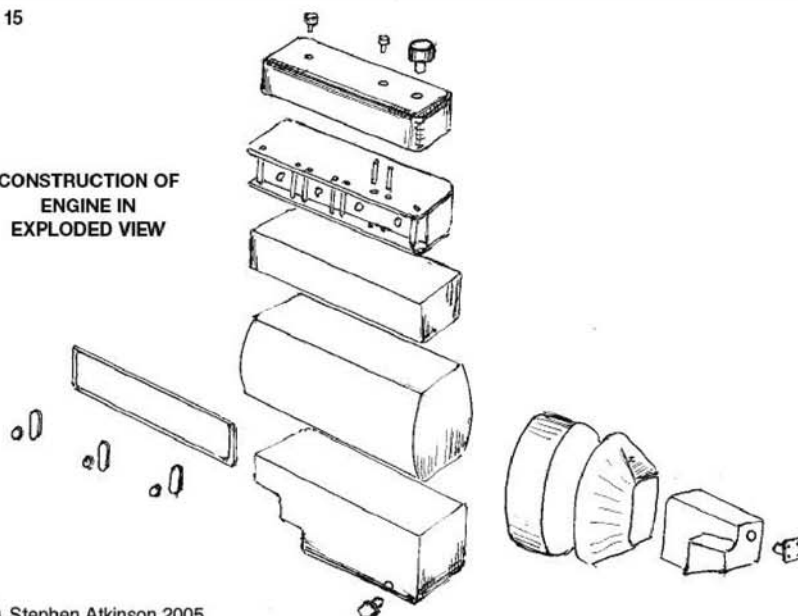


View of left of model shows wheel spinners.

BUILDING A 1946 MG TC

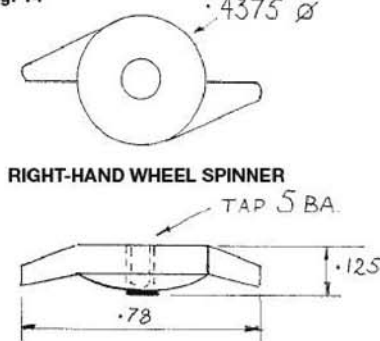
Fig. 15

CONSTRUCTION OF ENGINE IN EXPLODED VIEW



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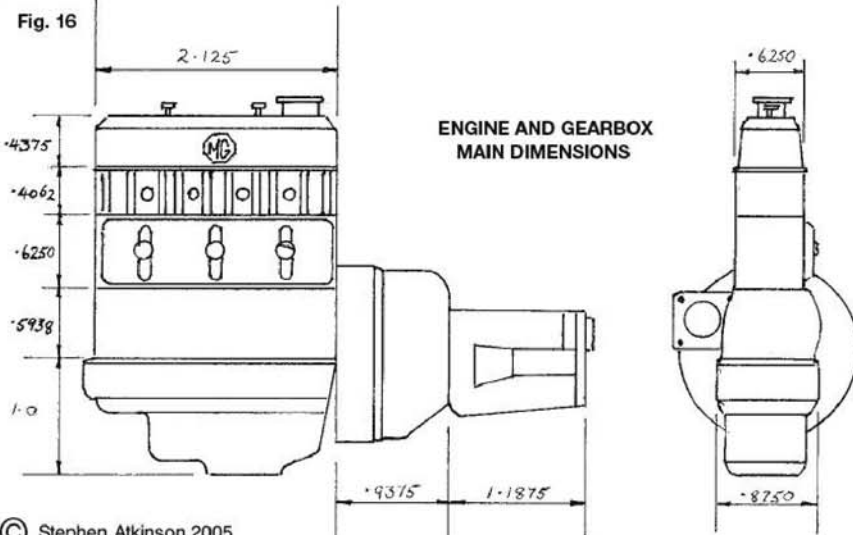
Fig. 14



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Fig. 16

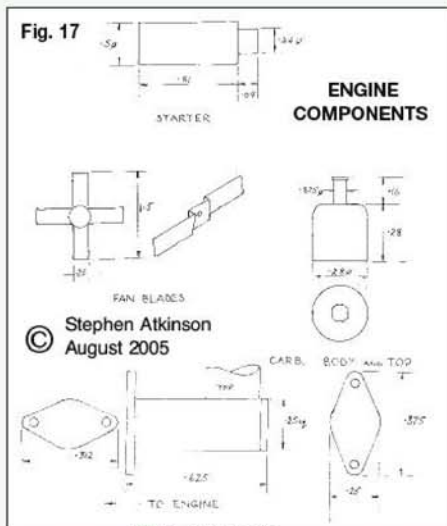
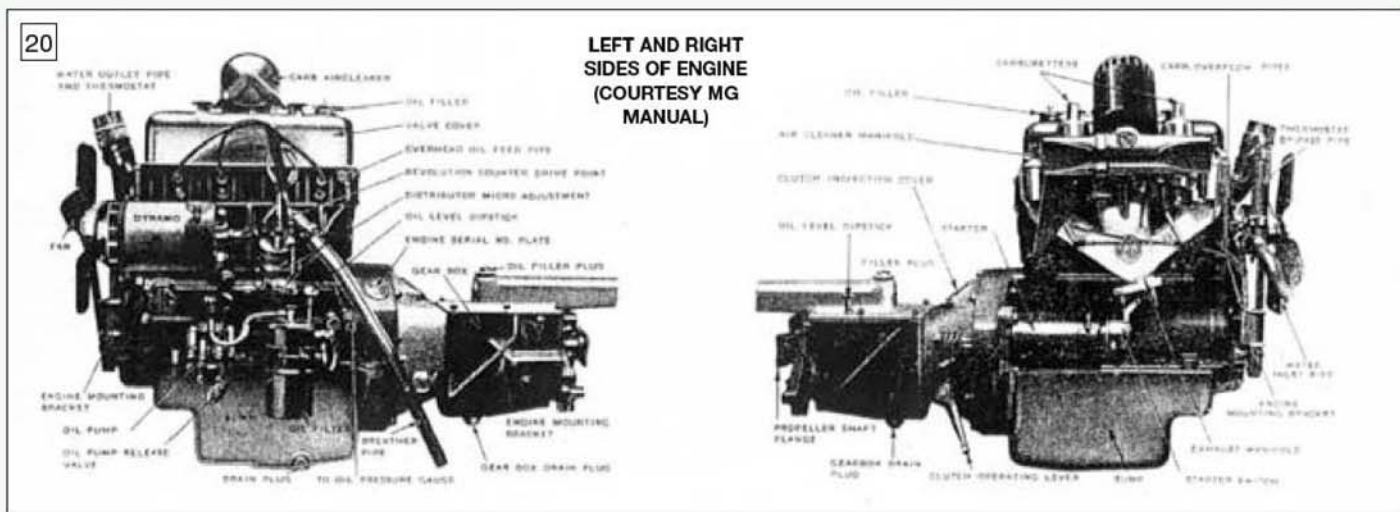
ENGINE AND GEARBOX MAIN DIMENSIONS



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Views of the right and left-hand sides of a full size engine for reference - it is up to the individual as to how much to include.



visible and one sometimes wonders if judges are aware of the detail included when models such as this are submitted for competition. That, however, is a whole new aspect of model making. If the engine is to be produced it follows that the bonnet must be hinged and able to be opened to reveal 'the works'.

I have tried with my drawing to simplify the making of the engine which was made almost entirely of aluminium (fig 15). When blocks of aluminium are required such as here I find that a good scrapyard is probably the best source of supply. If you have one within close proximity of an aircraft manufacturer so much the better!

Starting with the sump which is left in its natural state the shape can be readily milled or even filed to shape and size (fig 16). Above the sump it is as well to divide the engine into a further four sections. The rocker cover is the uppermost with a filler cap and two clamping bolts on the top. Each of these main sections I fixed together by drilling and fitting 1/8in. dia. brass rods, brazing rod is a useful source of supply for this. The whole is then fixed together with one of the metal adhesives.

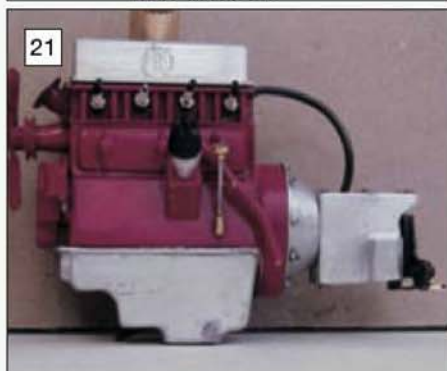
The side plate cover is a separate piece of thin brass sheet with the raised edge and the three vertical pieces shaped and silver-soldered into position. In between the sparking plugs are vertical rods made from 1/16in. dia. brass rod which are fitted once a groove has been milled along the length on the one side.

As for the sparking plugs themselves, they were built up from a hexagon nut and a piece of white plastic tube both slid onto a piece of 1/16in. dia. rod. There are lots of bits and pieces around the engine which can be made and fitted, it is up

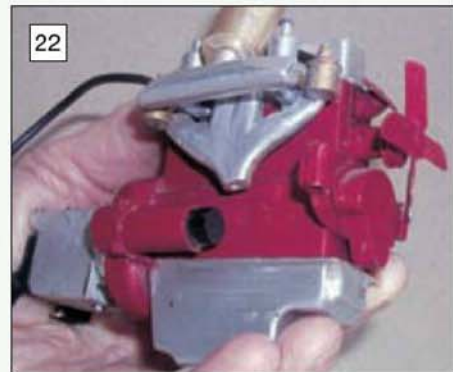
to you as to how far to go. Photographs 18 and 19 of each side of the engine will give the details.

I include dimensioned drawings of some of the major components around the engine (fig 17). Other small parts if required can easily be assessed for size and shape from the photographs. The carburetors are predominantly made in aluminium with the small cap at the top in brass. Once again we have the octagon as the shape used, it could be called the MG shape for it occurs in many places around the car. The various pieces which build up to make the carburetors are simply pinned together with a small rod turned glued in place. The float chambers, one at the side of each carburettor are again form aluminium with a brass cap fitted.

The section of round aluminium which is joined to each of the carburettors has its ends tapered on the outside and base made in its centre to take the air filter (photo 20). I find these are all enjoyable little bits and pieces.

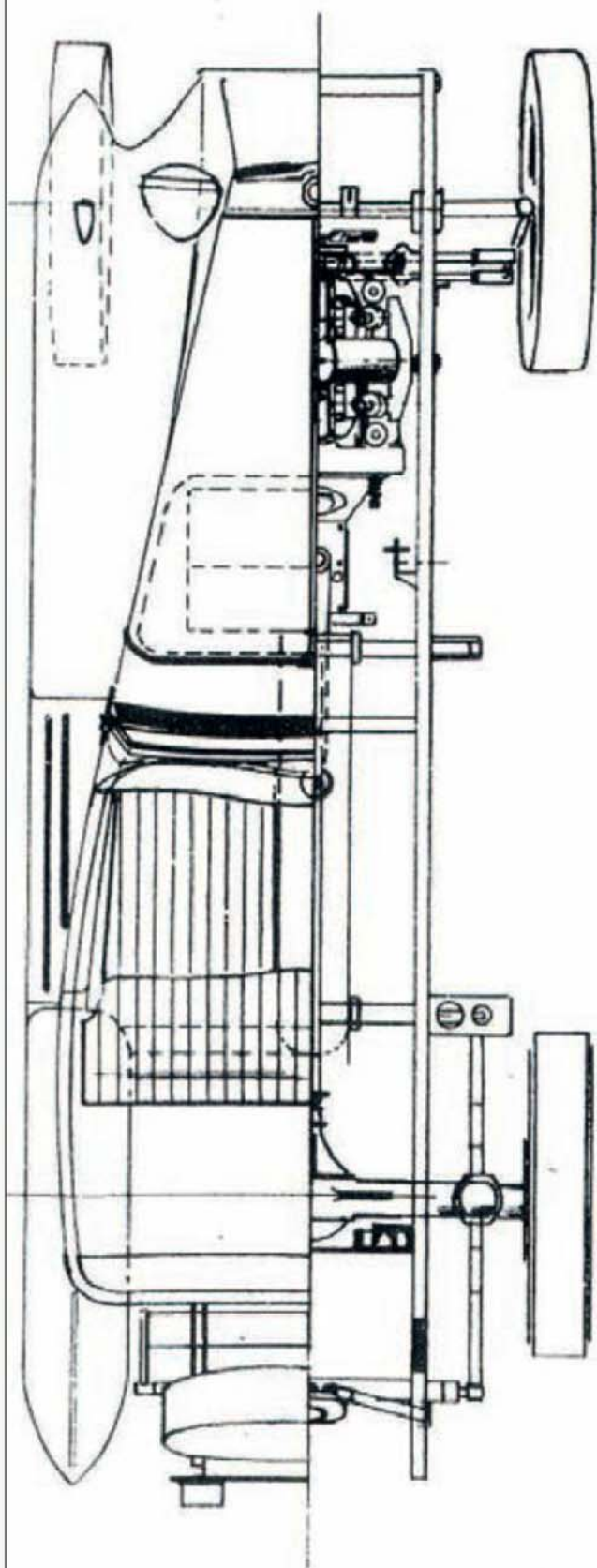


Model engine and gearbox.

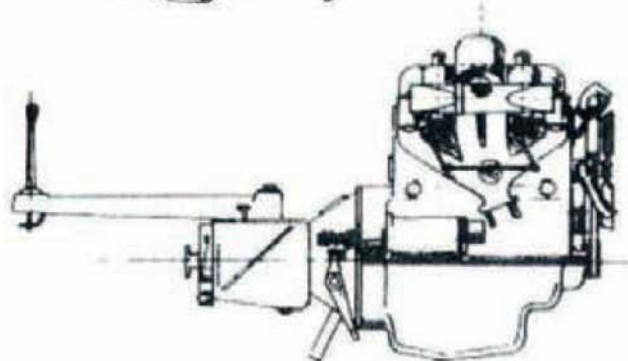
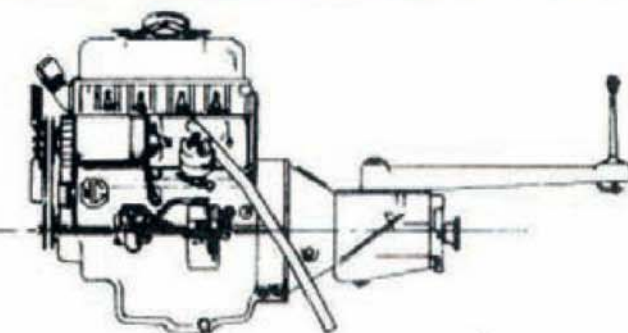
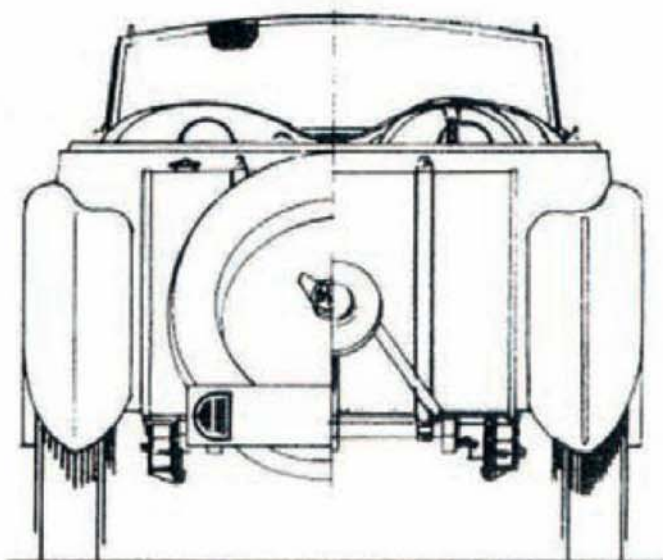
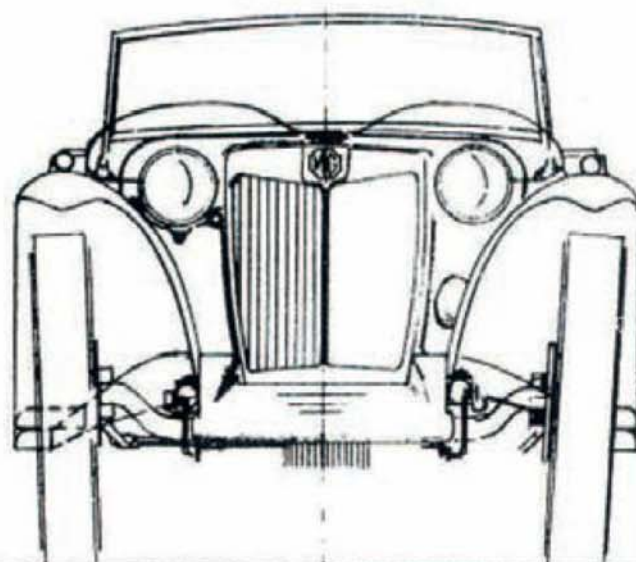


A full hand's worth of engine.

Fig. 18



©





Inside of radiator shell.

Really, the sky is the limit as to how many small parts you choose to incorporate. The photographs and the drawings I have given will enable you to fit what you require (fig 18).

I almost forgot to mention a small but nevertheless very important feature. The MG badges. These are required in a number of different sizes. There is one on the top of the dipstick, one on the rocker box cover, one on the steering wheel hub not forgetting the prominent one on the front of the radiator shell. A final one at the very rear of the car is fixed to the hub spinner of the spare wheel.

I had nine made for mine by our well-known maker of nameplates and the like Diane Carney of Glasgow, tel: 0141-557-1948.

Radiator

We have the actual radiator which is inside and linked to the engine by the hoses and then there is the outer shell which is the piece to be seen on the outside of the car. This is one of the impressive parts of the car and is, of course, chrome plated and bears the MG badge very proudly at the front. In between these two there is a frame which supports the vertical bars. In the full-size car, these bars are able to be pivoted to allow more or less of an air flow to pass through to the actual radiator for cooling purposes. The dimensions of these pieces are rather complex and should be taken from the various drawings I have supplied of the whole car.

I began by making the front shell as it seemed to be the most challenging and the other two sections had to fit inside it anyway. A good reason for making the outer piece first (photo 23). The very front piece was cut from $\frac{1}{8}$ in. thick brass sheet. The two openings were cut out with a piercing saw. Let me say at this point that in my woodworking shop I have a Hegner jig saw, one that I won as a prize at Alexandra Palace. It takes metal cutting blades as well as those for wood but for some reason I have failed to obtain success from using the machine and generally resort to a hand held piercing saw. Support the work on a small table clamped to the bench which has a vee cut out at its front. The old fretsaw table in fact. Keep rubbing wax on the blade and it really is surprising how well the job can be accomplished. By the way, a lump of bees wax is far superior to candle wax for this lubrication. Clever little blighters those bees!

When cut out, and the edges cleaned up with small files this piece is given a small bend which is from top to bottom. The plan view of the car gives you the required amount. Next cut out the development of the wrapper that bends around to



Outside of radiator shell.

give the top and sides of this shell (photo 24). I suggest making a paper template to fit initially and then when satisfied produce one in 20swg brass sheet. After a good clean up of both pieces wire them together and silver solder. The wire I recommend for this is thin soft iron binding wire obtainable in good hardware stores or failing that go to one of the few remaining silversmith suppliers. This wire can be made into small loops which are then twisted to tighten up the loop around the two pieces. After soldering, pickle and clean up the whole thing. If you have made a good joint all around the shell there should be no trace of a joint visible. This is important for as I stated earlier, the radiator shell has to be one of the eye-catching bits of the car.

Now make the frame of brass which will just slip inside the shell and onto this solder the vertical strips which show at the front. We are not going to make the slats pivot but space them out accurately on the frame before fixing them. Leave the slightest of spaces between each and of course get them vertical and parallel to each other. The slats are curved in section at the front. Half round brass beading which is available is a little too convex, use it if you like but file down the bump into a more subtle curve. There are 14 slats in all, seven each side of the central bar. Make each one out of $\frac{3}{32}$ in. wide material. These pieces are painted grey or fawn on most of the cars I have seen. When I primed and then sprayed my frame complete with slats the paint did merge between a few of the slats and this was one point the judges picked out at the Model Engineer Exhibition. Therefore, if you are



Completed radiator front with bars.



Inside of radiator and completed front.

entering into competition make certain you don't make a similar error!

The third piece has now to be tackled and that is the radiator itself (photo 25). I made the main body of this from a piece of $\frac{1}{4}$ in. thick brass and soldered the header tank to the top section. This overhangs inside the radiator and has a connection on the underside for the top hose from the engine. To simulate the radiator fins on the engine side of the radiator I used a $\frac{1}{32}$ in. thick slitting saw and cut parallel grooves $\frac{1}{32}$ in. apart horizontally all the way from under the header tank to the bottom edge. This does look quite realistic when mounted in front of the engine under the bonnet.

When the time comes for assembly, the radiator will be painted black, the front vertical bars grey and the outer shell chrome plated. Before that, however, a hole needs to be drilled in the lower part of the shell for the admission of the starting handle. Also we need two small plates to be soldered to the sides of the shell. These have holes in them to accept curved brackets which support the headlamps in their centre and help to steady the front wings (photo 26).

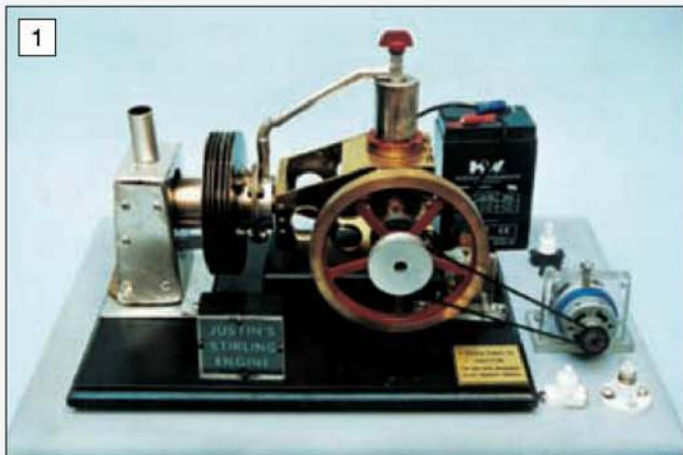
A curved rod is fixed to the chassis against the front shock absorbers, it travels upwards inside the front wing. A loop at its upper end takes the spigot of the sidelight and a loop in its centre takes the previously mentioned bracket supporting the headlamp.

If the foregoing description appears difficult to understand it will all be quite clear when read alongside the drawings and photographs of the front of the car. It would be foolish of me to try and give dimensioned drawings of most of these small parts, when you produce full size views from mine by means of photocopying you are better able to obtain all the dimensions you require.

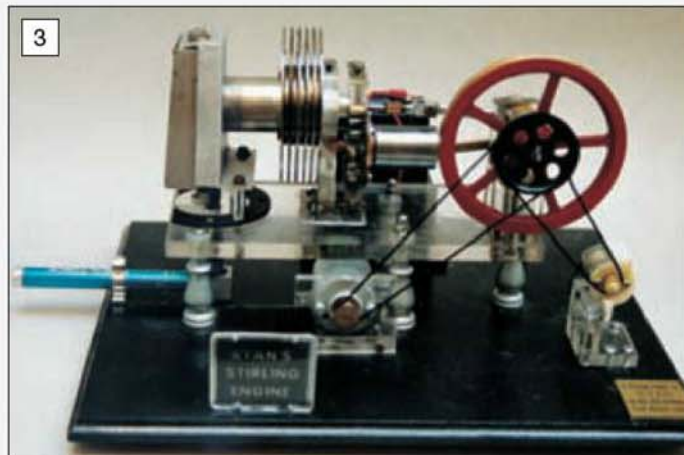
There are two parts I almost forgot to mention. These are fitted to the outer shell. First there is a thin piece of sheet material, 20swg brass is fine. This is bent to a right angle and fixed to the very top centre of the shell. It produces a position for the MG badge to be later fixed. On top of this the radiator filler cap is fitted.

Turn this and then using a dividing head on the left-hand end of the headstock and a milling cutter mounted on the top side, cut the ever visible octagon facets. The method I use for milling in the lathe is to employ a 'Quick Step Mill'. I find this piece of equipment which is available from Hemmingsway to be most versatile. I really do not know what I could do without it.

●To be continued.



Justin's Stirling engine is a V-type with a horizontal displacer cylinder and a vertical power cylinder.



Ryan's engine has a parallel displacer/power cylinder arrangement with a gear drive mechanism.

STIRLING ENGINES FOR YOUNGSTERS

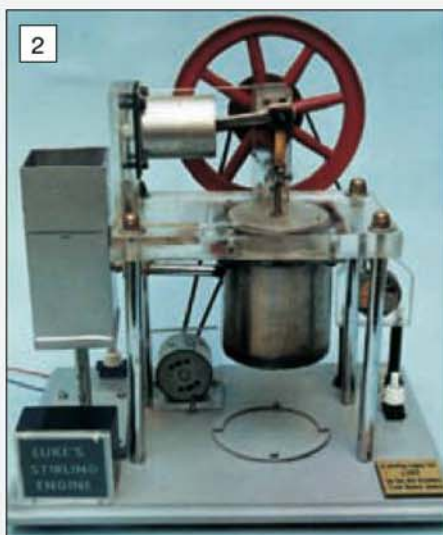
James G. Rizzo

of Malta describes how he enthused his grandsons while keeping them safe.

This is the story of three young boys, three birthdays, three special Stirling engines and a grandfather. There should be a moral at the end of the story. I hope that by the time I finish it I will have thought of one. Suffice it to say at this stage that I have three eight-year olds very enthusiastic about their engines. These grandsons were born within seven weeks of each other and are very frequent visitors to my workshop since they live within a radius of one mile from my home. They show great interest in the tools and machinery and particularly in Stirling engines, which as you may have guessed are my primary hobby.

For their eighth birthday I decided to give them each a Stirling engine. For Justin, my first grandson, this engine had been prepared a couple of years previously and was the subject of an article elsewhere. I had the engine spruced up, added on some accessories (of which more later) and the present was duly presented. There was a strict condition that the burner could only be lit by his father, in fact to be stored away until the time came for the engine to be run for Justin's enjoyment under supervision. To my disappointment, a couple of weeks after, Justin remarked: "Thanks Nannu, this is my best present", but then came the comment: "But, Nannu, we have only run the engine twice as Dad has been working very late". I made the decision there and then to provide a means whereby Justin could enjoy his engine and somehow run it himself. I should also explain that 'nannu' is the Maltese equivalent of grandpa.

Meanwhile the birthday of my second grandson (Luke) was looming up, the engine was nearly ready and I knew, well enough, that I had to find a solution quickly. The birthday came, the engine presented and the cries of pleasure justified my solution. Luke's engine (as well as the others) had an inscription, which read like those shown in fig 1.



Luke's engine is also a V-type but built on the style of a Robinson engine.

For starters the engine had to perform a function, as it would not be fun just running it. The second requirement was that there could be absolutely no danger to the child. Stirling engines of the size that I planned develop a fair amount of speed but very little power. Moreover the function I envisaged could be performed by the Stirling engine whichever way it was operated. The only realistic function I could think of was generating a small amount of electricity, which in turn could provide an attraction.

Way back in the beginning of 2000 (*M.E.*

4110, 1 January 2000) *Model Engineer* published an article of mine about a fairly powerful bell-crank engine *Hotch Potch One*. Later that year this was used in a local exhibition to light up a 3 foot high Christmas tree with some 100 coloured LEDs (light emitting diodes). With this in mind I toyed with the idea of something similar but on a much smaller scale. Finally I hit upon the idea of back-lighting a small light box with each grandson's name. Therefore the first step was to find the ideal size of electrical generator to couple to the engine flywheel. Some suggestions were sought and received including one very interesting one from my friend Manos Paradissis from Athens, Greece, for an LCD panel. Unfortunately in Malta the comparatively small stores are not so very well stocked, and this solution was prohibitively expensive, especially when multiplied by three. The alternative was to use LEDs – how I will explain later.

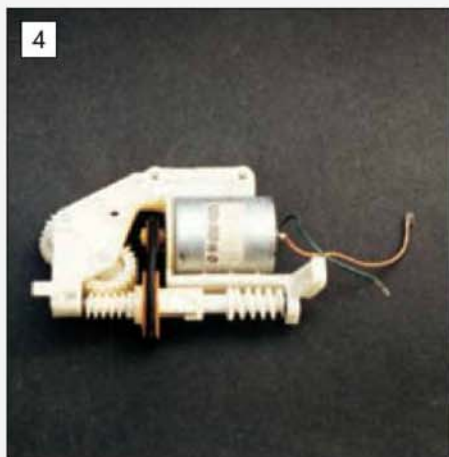
Engines

Meanwhile, I will explain briefly the layout of each engine. Justin's engine (photo 1) is a V-type Stirling with a horizontal displacer cylinder and a vertical power cylinder. The displacer is 1¹⁹/₆₄in. (33mm) in diameter, the power piston is 1in. (25.7mm) dia., the stroke is ⁵/₁₆in. (20mm), the flywheel diameter is 4in. (100mm). Heating is by a conventional spirit burner giving a run of about 30 minutes, with cooling fins previously used as heat sinks in very old computers (fig 2).

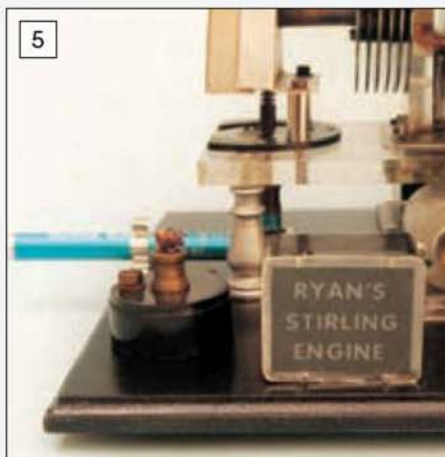
Luke's engine is also a V-type engine on the style of a Robinson engine (photo 2). Extensive use is made of Perspex for the main frame. The displacer is 1⁴⁷/₆₄in. (44mm) in diameter, the power piston is 1³/₈in. (35mm), the stroke is ⁵/₁₆in. (20mm) and the flywheel is ⁵/₇in. (130mm). Heating is also by conventional spirit burners, but in this case, because of the Perspex, water cooling by convection was used. The Perspex engine base and the displacer cylinder plug were bored to provide a cooling reservoir coupled to a small water tank. Running time is also about 30 minutes before the water becomes too hot for the engine to remain efficient. Actually this engine is the most powerful of the three (fig 3).

© A Stirling Engine for
LUKE
On his 8th Birthday
From Nannu James

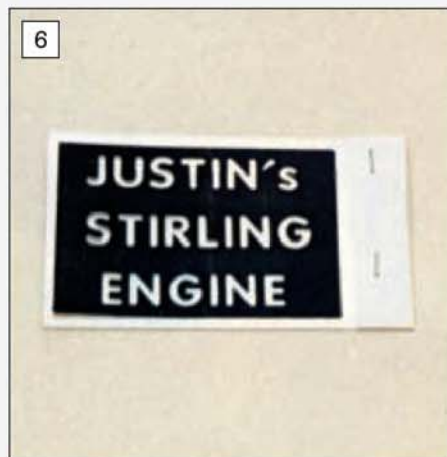
Fig 1



One of the motors taken from an old VCR with the factory supplied gear train.



Ryan's light box. The pencil torch burner can be seen in the background.



Transparencies with the caption for Justin's Stirling engine.

Ryan's engine has a parallel displacer/ power cylinder arrangement with a gear drive mechanism (photo 3). The gear drive is an excellent mechanism for small scale Stirling engines and, if properly constructed, has scope for phase variation experiments. The displacer is $1\frac{19}{64}$ in. (33mm), the power piston is 1in. (25.7mm) and the stroke is 1in. (25mm actual). Heating is by two different methods, spirit burner or a gas burner. This gas burner is also an interesting modification of a pencil torch/ burner used for soldering jobs and is available at most engineering exhibitions (fig 4). The torch burner referred to can be seen in photos 5, which also shows Ryan's light box.

A short explanation about this adapted gas burner might be appropriate. I had to do away with Bunsen burners or burners connected to gas cylinders for obvious safety reasons. I hit upon the idea of converting pencil torches found on most exhibition trade stands.

The torch was cut near the top, just below the flame control arrows pointing to 'open/ close' which remain on the main horizontal body of the burner. An aluminium block 1in. (25mm) long, $\frac{3}{4}$ in. (19mm) wide and $\frac{5}{8}$ in. (16mm) high was drilled at right angles to take the torch body parts in a precise fit. The cavity of the burner itself was filled with a type of plastic foam and so the cavity in the aluminium block between the two sections was also filled with tightly packed foam. *Super Steel* epoxy glue by Plastic Padding was used to give the burner a gas tight hold. A clip was screwed to the wooden base and the Perspex engine base drilled to take the burner tip exactly under the hot end of the displacer cylinder. The result was a gas flame powerful enough to run the engine at high speed.

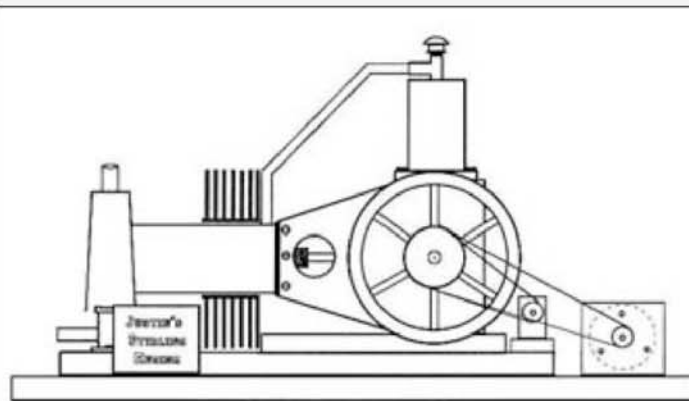


Fig 2 Justin's Stirling engine (not to scale)

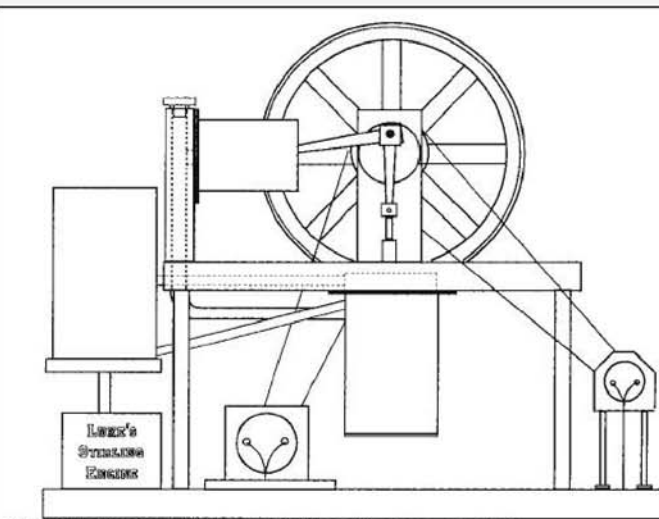


Fig 3 Luke's Stirling engine (not to scale)

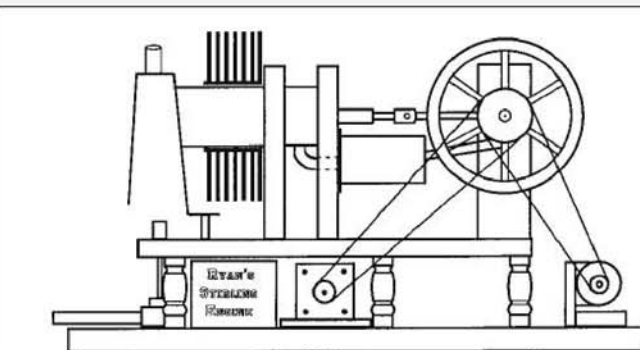


Fig 4 Ryan's Stirling engine (not to scale)

Generators

The generators used on these engines are drive motors taken from very old video recorders or video players. I have managed to salvage some six of these 'antique' heavyweight appliances, which were beyond economical repair, from a repair shop and cannibalised them for all sorts of components - motors, gears, spindles, coloured wires, some LEDs, etc. The older types of VCRs had two motors, the small one driving a gear mechanism (photo 4). This latter motor was used as the generator in two of the engines, while a larger motor was used on Luke's engine, simply because this engine is more powerful. The small diameter pulley, factory fitted, was coupled to a larger pulley on the flywheel. One wire from the generators was soldered directly to a terminal in the light box while the other was routed through a press switch to the other terminal.

Light box

The light box was made from 3mm black Perspex, 2in. (50mm) long, $1\frac{9}{16}$ in. (40mm) high and $1\frac{3}{16}$ in. (30mm) deep (photo 5). A transparent 3mm Perspex front was also prepared. The front piece of Perspex was placed on the box and four 1.5mm holes were drilled to take tiny brass nails. The labels or descriptive transparency was first printed on paper in Vagabond Outline 78 font (fig 5) the spaces between the letters and the border filled in with black felt pen, then reduced and photocopied on transparencies. Three copies were used - one is not enough to give a clear reading as the back-light tends to minimise the effect of the wording (photo 6).

The back-light was formed from a number of LEDs. I had never used or wired an LED before wiring up the Christmas tree. However, with the help of one of my sons, I got to know the positive terminal (the longer of the two) and the negative, how to wire one LED to another

and how to light up the LED. The first time I tried to light up an LED with a torch battery I could not understand why it would not light up. Now I have a test rig for this purpose – one motor running from a transformer (6 Volts is enough), coupled by a belt (a long O-ring) to another motor with two terminals marked + and -. I needed this rig to test the LED panel.

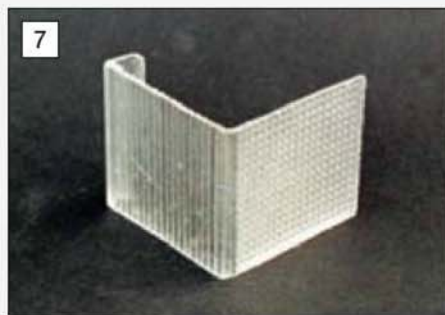
For those old timers like me, who have not had any experience with such components, let me explain what I found about LEDs. These come in round and oblong shapes (among others). The round ones come in diameters of 3mm and 5 millimetres. The colours I found locally come in red, green and yellow. I also found that on a panel it does not pay to mix colours. When I soldered alternate rows of yellow and red colours, only the red row lit up.

The size of the light box obliged me to use the 3mm size; however when I drilled a 3mm hole in a Perspex panel, only the tip of the LED appeared while a 3.2mm (1/8in.) dia. hole allowed the LED to protrude and give a better light output.

LED panel

The following is a long-winded description of the LED panel. Twenty-one LEDs (19 in the case of Ryan and Luke), 3mm size of one colour, were wired up in three rows, spaced according to the letters of the label, thus each letter had an LED behind it. Since the distance between each LED was too small to wire in series, the terminals were soldered in parallel. The first row had the positive terminals bent at 90deg. pointing upwards (north) and the negative pointing downwards (south). The negative terminals were cropped to 60% of the distance to the second row and also bent 90 degrees. The second row had the cropped negative terminals pointing north and the positive terminals, also cropped short, pointing south. The third row had the positive cropped terminals pointing north. and the negative terminals pointing south (fig 6). In this way the negative terminals of the first and second rows were facing each other and, in most cases even touching, and similarly the positive terminals of the second and third rows were pointing to each other.

A single strand of 30 amp fuse wire was soldered from right to left across the positive terminals, bent U-shape and then soldered across the positive terminals between the second and third rows from left to right. Another strand of fuse wire was soldered left to right across the negative terminals between the first and second rows, bent U-shape and then soldered to the negative terminals in the bottom



A light diffuser cut from an old fluorescent tube cover with a choice of pattern.

row. A trial run with the test jig, as explained above, uncovered any LEDs that did not light up due to faulty soldering.

The back of the light box was drilled to take the two leads from the LED panel, the positive lead connected to the positive wire from the generator, while the other was connected to the wire from the press switch. At this stage the engine, with the generator connected to the flywheel, was run to ensure that the panel fitted snugly into the light box did light up.

An experiment was carried out with light diffusers. Two pieces of a Perspex cover from an old, neon tube, light-fitting were cut to the size of the light box. One piece had a raised pyramid-like structure while the other had horizontal raised lines (photo 7). When tried in the dark the one with the pyramid structure was found to give better diffused lighting when placed against the LED panel.

Search for a solution

I now had an engine that produced enough energy to light up the boys' names, but an engine that had to be run only under parental supervision. The question remained how could the boys run an engine by themselves?

Each engine has a pressure transfer pipe between the displacer cylinder and the power cylinder. The first step was to make an adjustment whereby the pressure pipe was altered so that the engine could run freely when flicked, and returned to its original state when required to run as a Stirling engine. The three engines, each in a different place, were provided with a method for releasing and resealing the pressure pipe. Justin's engine (fig 2) had the top of the power cylinder T-piece replaced and machined in such a way that the top end was drilled and tapped 0BA (6mm) (fig 7). A bolt with a handle soldered on, with a washer and an O-ring made this adjustment just perfect. Luke's engine had the Perspex power cylinder block drilled and tapped 0BA (6mm) from the top, while Ryan's engine had the Perspex power cylinder block drilled and tapped from the side, both with similar bolts.

Once this operation was carried out the answer became obvious – an electric motor more powerful than the generator run by a rechargeable battery! In this way the Stirling engine becomes a 'slave' engine. From the junk box there emerged some larger motors, two of which were from car tyre inflators and from the small local ironmongers I bought 6 volt (4AH) batteries used in hand-held emergency lanterns for the cost of about six pounds Sterling each. Two of the engines were each fitted with two large pulleys, varying from 1 1/4in. (32mm) to 1 1/2in. (38mm), one to take a belt from the larger motor (the drive motor, I call it) and the other to take a belt from the generator. The third engine had a hobby 40mm pulley with a wide V, wide enough to take two thin (1.5mm large O-rings) at the same time.

With the Stirling engine each boy received a folder with two pages facing each other. On the left side there is a drawing (exploded version) of the engine with the name of each component against or near it. On the right side the top section reads "Instructions how to run the Stirling engine as a 'slave' engine", while the bottom section reads "Instructions how to run the Stirling engine as a 'prime mover' – with the help of Dad".

I have regular feedback from my sons about how these boys can describe to their friends (and their mothers), the way these engines work, rattling off the names of each component as if it was the most natural thing. How if they close the vents the engines will not work as a 'slave' engine, but to work as a proper Stirling engine, the vents must be closed, etc. etc. So far there is little grasp of the Stirling cycle principle, but they are aware that heating and cooling a cylinder causes changes in 'pressure' – to them at the moment 'pressure' is power to turn the flywheel.

Conclusion

The moral first: In this day and age young boys, and girls for that matter have a better grasp of practical and mechanical matters that I had imagined! I have now three happy grandsons, each with a different Stirling engine that can be run as a slave engine with the aid of a rechargeable battery. For the immediate future I have a fourth grandson who will be eight years old within a few months, so back to the drawing board!

Meanwhile, I wonder whether I have created any long lasting interest in these engines but I hope that at least in one grandson the interest is strong enough to make him a budding Stirling enthusiast.



Fig 5

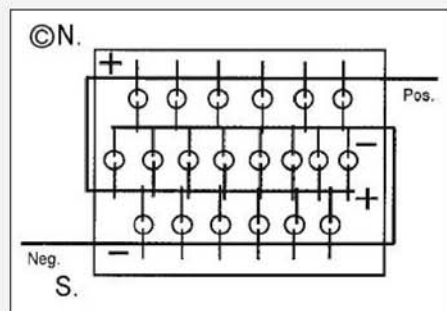


Fig 6 LED wiring diagram

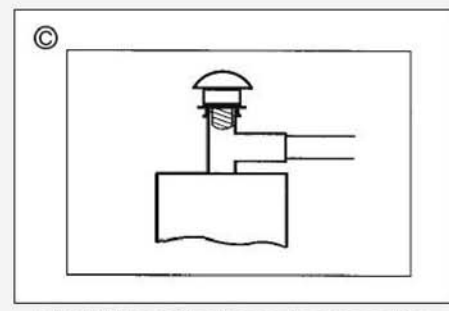


Fig 7 Modifications to pressure pipe (Justin's engine)

LETTERS TO A GRANDSON

M. J. H. Ellis

Measuring and the life and models of J.J. Constable

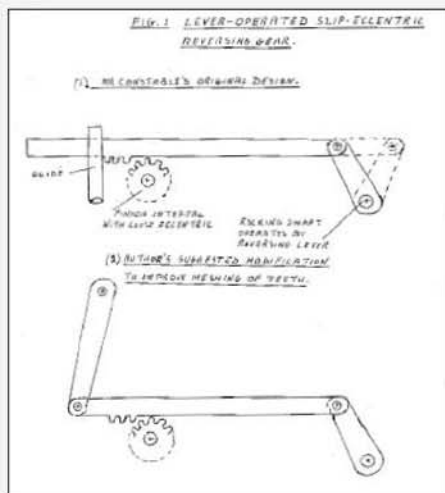
●Part LXXVIII continued from page 25 (M.E. 4251, 8 July 2005)

Dear Adrian, In my last letter I mentioned John Constable's delightful little Sentinel locomotive, and this has recalled two memories, one nostalgic, and the other, useful. The nostalgic memory is of driving the locomotive round the track at St. Mellons. I should think that it must have been unique, for it consisted of a double loop, and in order to get back to where one started from, the track had to cross over itself, and this required a tunnel. The tunnel was on a curve, and on entering it from the sunlight outside, it was pitch black. It was an unforgettable experience, for me, at least, to rocket through the blackness at all of 6mph, with the only glimmer of light that reflected from the ashpan. It is sad to think that vandalism forced the club to abandon this splendid track, which they had created with so much dedicated labour. I was not a member, but I felt very badly about it.

The useful recollection is that John used the Stuart 'Double Ten' as a ready-made design of engine. As the name implies, it was in effect two Number Tens set side by side with a common crankshaft. I built a (single) No. 10 myself, and I know that that did not have any reversing gear, so I don't suppose it was provided on the Double version either. Of course, this presented a problem; whoever heard of a locomotive which could only move forwards (or backwards)? I admired the neat way in which John solved it. He fitted a slip eccentric to either side of the engine, but he also wanted there to be a proper reversing lever. This caused a shaft, mounted parallel to the crankshaft across the locomotive chassis, to rock to-and-fro. Cranks on this shaft each moved a bar forwards and backwards. Three or four teeth projected beneath the bars, and these could engage with a pinion which formed part of the eccentric. When the reversing lever was fully forward or backward, the teeth were clear of those of the pinion, but the little racks were just long enough to move the eccentrics from forward to reverse gear, and vice-versa. There was no facility for 'notching-up', as I suppose there must have been on the prototype, but I can't say it mattered very much as the locomotive performed very well without it. I think that this resourceful arrangement ought to be better known, and to make sure, I have made a sketch of it (fig 1).

I have an eerie story to tell about John Constable. During his final illness he was nursed devotedly at home by his wife. When it became clear that his end was near, the doctors decided that he should be admitted to hospital. By this time, Mrs. Constable herself was worn out, and as he was being carried up the steps of the hospital, John turned to his son Martin and remarked "You know your mother's gone, don't you?". And it was true; Mrs. Constable, who had kept going so valiantly under great strain, had herself passed away.

While taking a break for a cup of coffee, I fell



to musing about James Atkinson. What ingenious locomotive valve-gear might he have thought of, on the lines of Baker's gear, if he had turned his talent for imagining linkages in that direction?

But I mean now to start on a completely different subject. It was a good many letters back that I wrote about Henry Maudslay and Sir Joseph Whitworth, and their quest for ever more and more precision in measurement. (It was in No. 23, Ed.). The Whitworth measuring machine was able to detect a difference of (I think it was) two millions of an inch, but what about precision of absolute measurement? Well, I have now got my act together, and I think that the story I have to tell will be an interesting one. In fact, I fully expect that it will take several letters to tell it properly.

In the distant past, no need was felt for international co-operation in regard to weights and measures, although it was seen that there was a need for standardisation within individual countries. We needn't bother about the United States at the time when I am going to start, because they didn't even exist. The scientific study of measurement, by the way, is called metrology.

I suppose that rough-and ready measures sprang up naturally, as soon as society becomes sufficiently civilised to need them, and were derived from what every man took round with him, his own body. The cubit, referred to in the *Book of Genesis* (Noah's Ark was to be 300 cubits in length, with a beam of 50 cubits) was the length of a man's fore-arm. I should think, however, that when the Egyptians built the Great Pyramid they used more precise measurement than that, for the greatest discrepancy between the lengths of the sides has been found to be only 0.63in., while the biggest angular error is no more than 12 seconds of arc. It is thought that they set out a right angle by forming a triangle with sides of 3, 4, and 5 units. I doubt whether your poor Dad understands it, but you and I both know that according to the Theorem of Pythagoras, $3^2 + 4^2 = 5^2$. The Pyramid is said to have been built around 4000B.C. The Roman mile (*Milia passuum*) was the distance marched in taking a thousand paces, in this case, left and right steps, and was 140 yards short of a statute mile. The 'foot' needs no explanation, but the

'inch' is less apparent in origin, until you reflect on the French equivalent 'pouce'; and let credit be given where it is due, even your father knows that means 'inch' as well as 'thumb'. The end joint of the thumb was supposed to be roughly an inch long. I could quote other examples, but there is no need to labour the point.

Give credit also to the ancient Egyptians; but they hardly needed to work to such a high standard of accuracy. In fact, a society which is not technically advanced does not require great precision in measurement. In measuring cloth, for example, who is going to worry about an eighth of an inch one way or the other? Nevertheless, if only to prevent fraud, some standards of weights and measures are necessary, even if, in practice, there may be limits on how closely they can, or need to be, worked to. Accuracy can be lost, and once lost cannot be recovered.

The point is worth making, that if a basic standard is arbitrary, it doesn't much matter what its value is, since, by definition, there is nothing with which it can be compared. Where accuracy is essential is in the making of copies of the standard, and then, further working copies of these primary copies.

Furthermore, when jobs are 'one-offs', for example, like the early beam engines for mine drainage, a lot can be achieved simply by making one component to fit another. It was more important for the cylinder of a pumping engine to have a bore as close as possible to a perfect shape, than for it to be any exact size, since the piston could always be made to fit it. Pity the 18th Century engine-wright, chipping away at the rough-cast barrel with a hammer and chisel!

You may like to have an outline of the development of standards of length in England, if only because the early settlers in the North American colonies presumably took the English standards with them. The present imperial system of linear measure goes back to a statute of 1305, in the reign of Edward I. A standard bar, known as the 'Iron ulna' (yard) was the ultimate standard of reference, but the statute discloses how arbitrary its length really was. I assume that the original was in Latin, but what it said was "Three grains of barley dry and round, make one inch; twelve inches one foot; three feet an ulna," and so on. It is interesting to note that Edward's 'Ulna' differed from the present standard yard by no more than 0.04 of an inch.

I will break off at this point, in order to relate an anecdote about 'J. J.' Constable. He was brought up by British parents in Uruguay, and spoke Spanish fluently. After retiring from the Post Office he got a job as a courier with holiday parties going to Spain. There, the authorities became suspicious about someone who purported to be an Englishman, yet spoke perfect Spanish - with a colonial accent! This led to him being taken into custody. Fortunately, he was able to give a good account of himself, and was released again. It does, however, make me wonder if I may myself be arrested one of these days, on account of purporting to be English, yet able to speak Welsh!

Dy Daid serchog.

●To be continued.



Wilson's Words of Wisdom:

Those who make peaceful revolution impossible will make violent revolution inevitable.

J. F Kennedy

Keith Wilson

discusses the draincocks.

● Part XI continued from page 47
(M.E. 4251, 8 July 2005)

Draincocks are essential items, but they can be cursed to operate and maintain. The Great Western type was a positive spring-loaded valve, a conical valve held on its seat by steam pressure and a spring, an extension rod on the cone protruded out of the front end and was pressed back by what appears at first to be a very crude system. A steel strip bent roughly at 90deg. was bolted to a sliding strip that could be moved forwards or backwards by the driver via linkage.

Crude or not, the fact remains that it was easily adjusted by bending the strip concerned and this applies to miniature locomotives as well.

Getting a good route for this linkage was (and is) not one of the lighter matters. It is needful to have a bolted joint or two along the main rod or else it would have been necessary to remove all the wheels and axles plus motion and a few other items in order to remove the rod. Vice versa also applies. Of course, you would have to keep on doing this whilst setting the system up in the first place. Dead boring!

When the driver pulled the draincocks lever it was held on a ratchet in the cab, kicking away the pawl on said ratchet allowed the draincocks to snap shut. I have used this system on some of my locomotives. It works well provided that too much precision was *not* made in the fittings!

This may seem preposterous at first, but as dear old Curly said, you can't scale nature! This

of course includes fits and tolerances. No way can these be scaled; a film of oil has just about the same thickness and viscosity no matter what the size, ain't no 'sich hanimal' as a scale coat of paint, etc. I discovered that until I had reduced the diameter of the stem thus allowing the cone to seat reasonably well, leaks were manifold (pun intended).

Curly developed a conical valve rotating inside a brass or bronze body. Whilst this system can of course seize up solid, it is not likely to do so in this application in view of the oil that escapes from the cylinders.

I mention this because many years ago I was given charge of a modified 10¹/₄in. gauge steam locomotive that had been fitted (by an amateur) with an injector. My co-driver and I used this injector all day, but finally the steam valve seized up solid and we realised that the installer had unwittingly exchanged the steam valve for the water valve (and of course vice versa). The real water valve was a brass cone fitting into a brass body – no problem with water, but rather useless with steam.

Polytetrafluoroethylene (PTFE - I love confusing my computer with correctly-spelt but unusual words) not being available in Curly's time, he could not have used it but he certainly would if it had been available. It makes for very good water valves in tenders, and I can see no reason why it should not do equally well in draincocks. Incidentally, my computer suggests 'draincocks' really means 'brainsick'. There must be a moral there somewhere. As a test, try your computer spell checker on the composer 'Ralph Vaughan Williams'; you might get quite a shock!

It might well be that our casting-supplier will

make a pattern up for the bodies and be able to supply bronze or gunmetal castings; however, I made up the batch for our own locomotives by fabrication from brass.

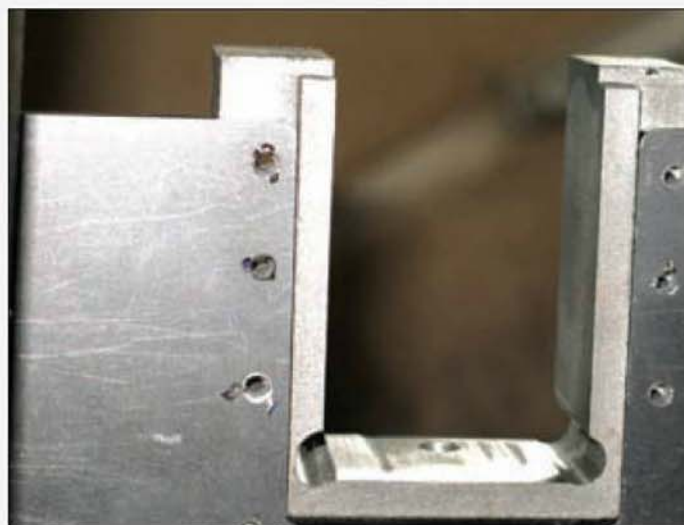
Begin by making the main body from 1/2in. square brass, a self-centring 4-jaw being most useful here. The mounting flange is cut from 3/16in. brass strip and silver-brazed to the body. The valve itself, from PTFE (Teflon) should be about 0.001in. larger than nominal - in other words, about 1 thousandth of an inch oversize. This will ensure a tight valve that is loose, beggorah! Tight to withstand pressure but free to turn, for PTFE has a very low co-efficient of friction. I believe that this material has the lowest friction co-efficient of any known solid. It should be noted that, as drawn, there is not overmuch room for putting the holding nuts on, so an extra 1/4in. in the stem might well be useful.

There is a minor problem, for although the material is ideal for the job, to attach anything to it can cause a problem; however, the method shown seems to work. The right-hand one of the two nuts drawn screws onto the end of the PTFE valve and is pinned to it. If using the stainless-type valve (I show both types) then it is best to use ground stock, hence the nut on the other end of the valve.

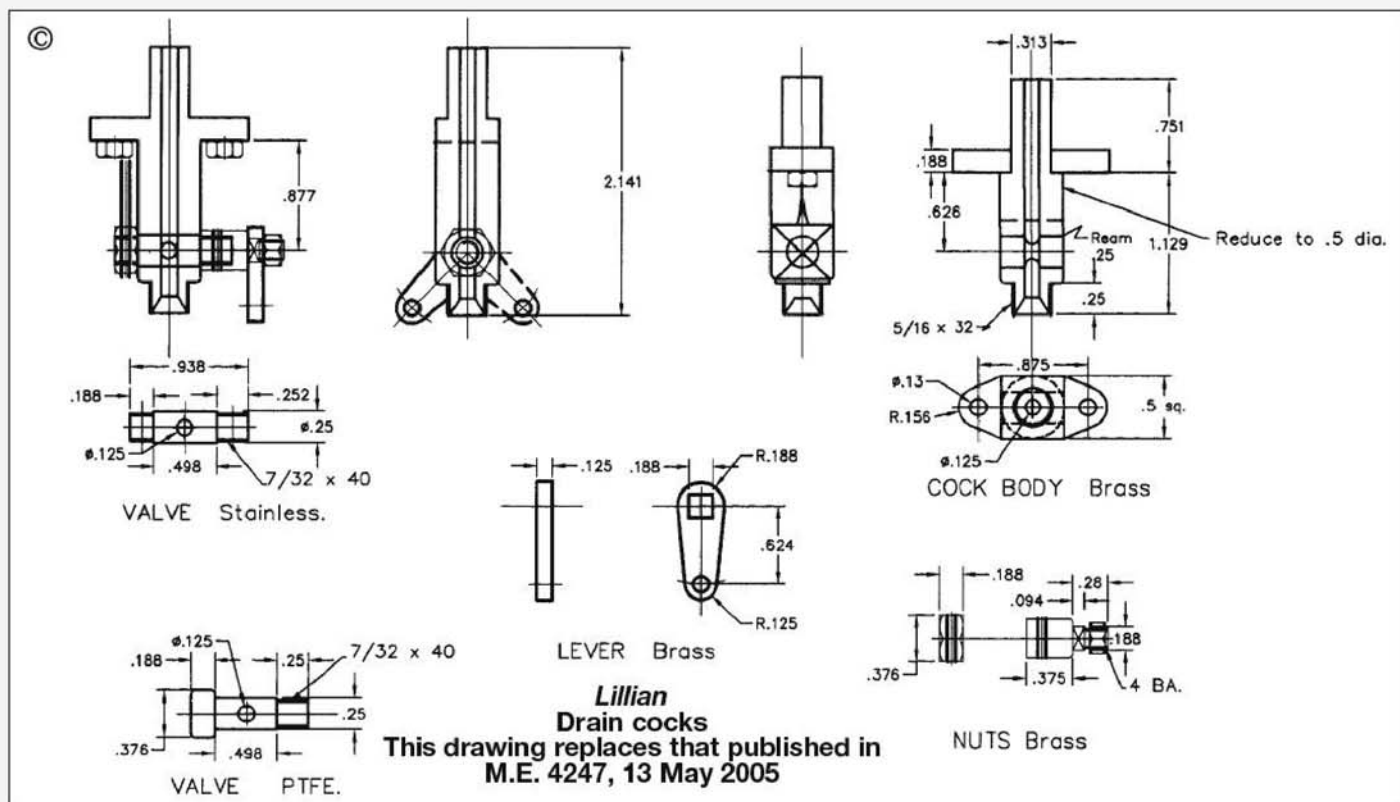
It may come as a surprise, but plain ground stainless steel will work perfectly well in a reamed hole! By that I mean that it seals okay, and because of the oil that is in the cylinder works well. I believe it was the late Laurie Joyce who used this first on his 3 1/2in. gauge King, incidentally one of the only two King models I have ever seen that really looks 'Kinglike', the other being an 0-gauge model. As the late Martin Evans once wrote, "there is something about the



A view of a hornblock laid in position in the frame. Some notes on machining these appear in M.E. 4249, 10 June 2005.



The view from the reverse side after the bolts had been fitted. Some deburring of the holes might be appropriate.



way that a King sits on the track that is very hard to recapture." Amen, say I! I have built 10 Kings all told, and have yet to succeed in this.

It is probably best to leave the holes through the valves until later, but if you drill them at this stage, make sure that you have two valves of each hand. However, mistakes can be rectified afterwards by shifting the levers round on their square bosses. Put the levers at 45deg. (two to each hand) and then drill through the assembled valves. Using the valve bodies as drilling jigs saves time, and the hole through the PTFE can, with advantage, be a few sizes below the main body orifice.

There is of course no objection to silver-brazing the levers onto the nuts, but don't do it whilst they are screwed onto the PTFE valves! And watch the drilling; if you end up without two matched pairs (of opposite hands) it won't be me who has to sort things out!

Two little connecting rods will be required to couple the levers together each side of the locomotive. The connection to the cab-operating lever I shall deal with later. A little note on pivoting these levers might not go amiss. The obvious way is to use an ordinary bolt with a couple of nuts locked together, but this is not as good as tapping one of the levers and drilling the little coupling rod to clearance size. Put the bolt through the clearance hole and into the tapped one, then put a locking nut behind the tapped one. In theory this is wrong, because the coupling rod will often rest on the thread, however in practice it works quite well. Provided you use the superheaters I shall describe, draincocks won't get too much use; unless you stop running for about 15 or more minutes. It is quite surprising how well this works.

There are of course occasions when you get a derailment, unavoidable in the long run. When – not if – this happens, draincocks are

particularly vulnerable – I know it well!

In the case of a big narrow gauge brute like *Lillian*, crossbars mounted just above rail level at front and back – tenders included – pay for themselves rapidly. The sad thing is, they rather spoil the appearance of a 'scale' model of a standard gauge locomotive, for they must be rather strong, not only to save things like draincocks but any low-hung pipe work, and brake gear. One or two of my locomotives have developed upward-curving brake cross beams, possible all of them, for my puffers are scattered far and wide. In different locations, I mean. Other items may come to mind, but preferably not 'the hard way'.

In any case I showed these items on the chassis drawings of *Lillian*. Incidentally, they can also prevent a locomotive toppling over after a derailment – very useful 750lb (approximately 341kg) wants a bit of handling.

It reminds me of driving some of my Prairies at Stoneleigh. Invariably, pulling into the departure platform over a single-slip diamond crossing resulted in complete derailment, but in the hundreds of times that this has occurred never once has 'she' failed to re-rail herself after a little sort of ballet-dance; except for the leading pony truck. This put itself back on at the next set of points, causing great amazement

among spectators. I must confess here to little bit of naughtiness. Shouts of "Stop, Stop!" were deliberately ignored, and when with a sharp click the wheels went back on – at the points – I grinned and held up the standard number of fingers!

I did once have a more serious derailment. During some shunting on the first day of the working week at Stoneleigh, it neatly cleaned off a draincock. Dismay all round. Reload locomotive into estate car, drive 50 miles to home, fit a spare draincock, reload again, 50 miles back to Stoneleigh, arriving well into the evening, giant meal, no further trouble. But I was younger then (a mere 50)!

It may be worth remembering that, broadly speaking, a steam locomotive can often be 'fixed', if only temporarily, with hammer and spanner, plus (usually) a selection of well-chosen words! Understandable (?).

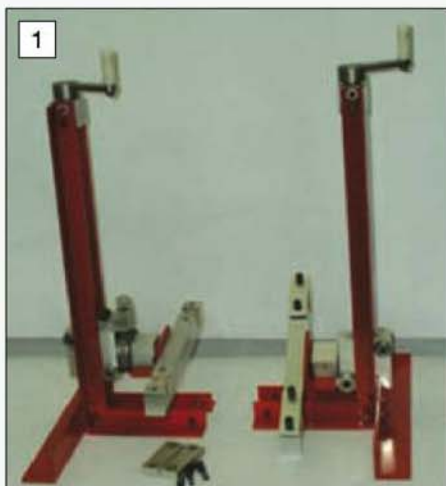
I recall an unfortunate incident on a private 7 1/4 in. gauge railway. I had been granted a narrow-gauge engine for the afternoon, but there was quite a long wait before I had to drive. I looked for a draincock lever – in vain, so I opened the regulator. Showers of dirty water followed by justifiable criticism from the railway staff. It was pointed out that the draincock lever

was actually on the cab spectacle plate top, no wonder I didn't see it! So, since this would be unreachable (and possibly inoperable) on the 'full-size' beastie, I suggest with some reason that the cab floor is a better place. My first 7 1/4 in. locomotive had draincocks operated by pliers. After the first run of the day, no further need anyway due to high superheat; obviously cylinder temperature did not fall below 100deg. Celsius. Later, rods and levers were provided. It was a great help when my 6 year-old son took over driving, with never a mistake.

●To be continued.



A pair of draincocks with PTFE valve members. Stainless steel would be a suitable alternative.



The two stand elements. They are designed to be adaptable in use and easy to store.

Colin Abrey

presents a simple design that has been proven in his own workshop.

Before I launch into the description I must confess that this is not my design. All credit for the concept and original design must go to Roy Jarman a former colleague from the Hitchin Club.

Over the years various stand designs have been published and I have seen other examples at exhibitions, but all seem to suffer from one or more limitations. The traditional stand is a large frame structure of angle or bar which, when not in use, takes up valuable workshop or storage space. Lifting a locomotive onto such a stand has to be done carefully to protect fingers and the model from damage.

So what is different about this stand? Well, the main differences can be listed as follows: -

1. Both ends are independent so locomotives of different lengths can be accommodated quite easily for servicing and repair.
2. The engine can be lifted onto a bench in the clear and then the two parts of the stand offered to it rather than trying to place a heavy locomotive within the confines of a fixed length stand.
3. With the locomotive attached to the stand it can be raised quite easily to a suitable working height and rotated for access to any part of the model.
4. It is cheap but extremely effective.

Photograph 1 shows the two units that comprise the stand and photographs 2, 3, 4 and 5 show my Simplex at various attitudes on my stand. You may think that it is a flimsy affair to

A LOCOMOTIVE BUILDING STAND

support your precious engine, but I can assure readers that it is quite stable whichever way the engine is orientated. The prototype was used to build a 5in. gauge GWR Prairie Tank while another model engineer uses it to service his 5in. gauge B1.

I have not produced full detailed drawings but have provided basic sketches only, which together with the photographs and narrative should provide the necessary detail. The sketches are dimensioned according to my version but obviously builders may wish to vary these depending on the materials available and the locomotive height. I suggest that if the uprights are extended, to give more height, then the length of the foot should be increased in proportion to

maintain lateral stability. Also I leave it to individual builders to use fixing screws that they have available, I used UNF and UNC socket cap screws in most areas simply because I had them to hand.

The basic frame (fig 1) is identical for both ends, with uprights and stabilisers of 20mm x 20mm x 3 mm MS angle while the rear 'foot', of 1 1/4in. x 1 1/4in. x 3/16in. angle 9in. long, provides lateral stability. These components were screwed together, leaving a one inch gap between the uprights, and the lower joints welded all round to ensure a solid job. The stabilisers are separated using a stretcher of 1/2in. dia. bar tapped each end for retaining screws. If you have an engine with a bogie it may be necessary to cut away a portion of

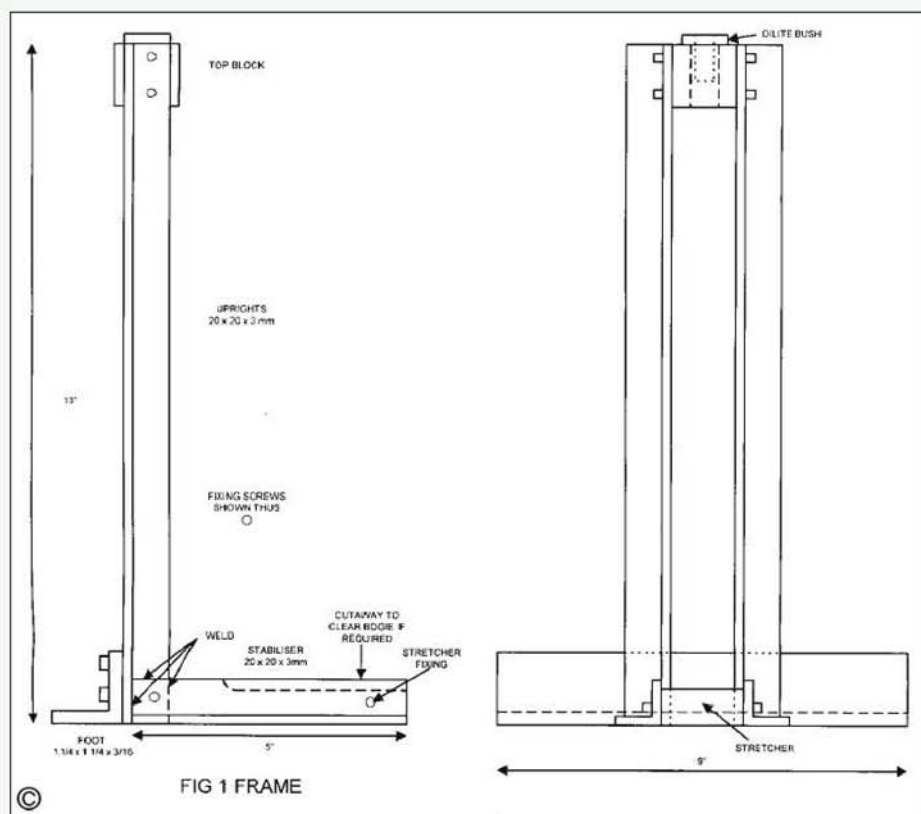
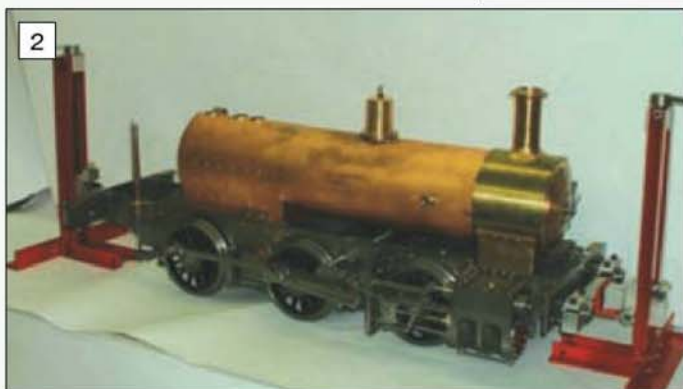


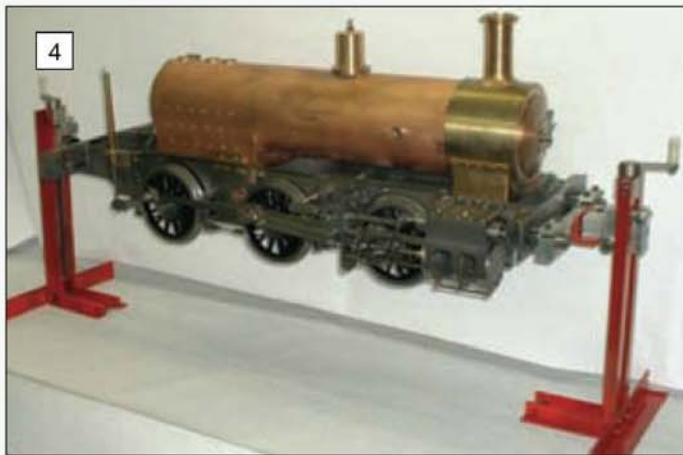
FIG 1 FRAME



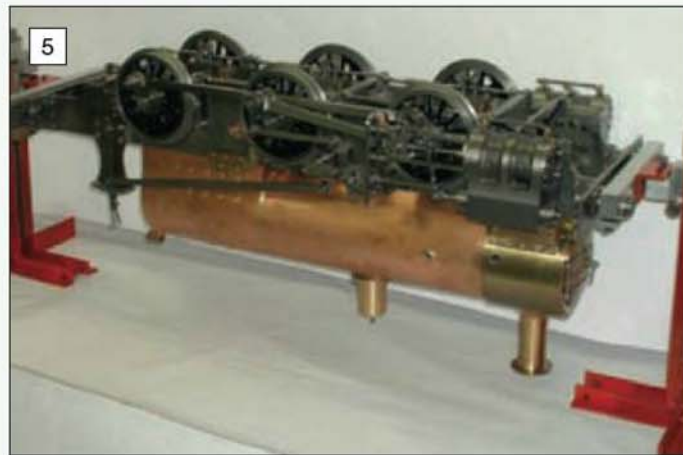
The author's Simplex shown being mounted between the two stands. This can be done with the locomotive safely standing on a bench.



Once locked into position the locomotive can be orientated to give access to which ever feature is required.



The author claims the design is stable and the jacking screws allow the working height to be readily adjusted.



By using keep plates on the bars locating the buffers the locomotive can be safely inverted for working underneath.

the stabilisers for clearance when the locomotive is down on the bench. The top block is a 1in. x 1in. x 1in. piece of aluminium alloy, drilled centrally to accept a flanged Oilite bush to suit the jacking screw. The flange of the Oilite bush provides a load-bearing surface beneath the handle, but those with heavier engines may prefer to use a proper thrust race. My jacking screws were made from round bright mild steel threaded $\frac{5}{16}$ BSF and the handle secured with a pin on a plain section at the top, but commercial 8mm studding will suffice, providing of course that you have a tap to thread the raising block and handle.

Except for the spindle length (L) both raising blocks (fig 2) are identical, a longer spindle being required at one end to accommodate the indexing device. For these blocks I used 2in. x 2in. x 1in. aluminium alloy, reduced to 0.985in. thick for clearance between the uprights, and drilled $\frac{1}{2}$ in. centrally in the horizontal plane for the spindle which is fixed with Loctite. After the spindles are in place the hole for the jacking screw is drilled centrally from the top face using a tapping drill to suit the jacking screw thread; the block is then inverted and the hole opened out to clearance size for about an inch deep. This allows a full length of thread to be cut using a standard length tap.

An important feature of this design is the use of miniature ball races positioned on the sides of the raising block. In use these bearings transfer the load to the uprights allowing the jacking screw to rotate quite freely. Suitable small ball races of about $\frac{5}{8}$ in. outer diameter are available quite cheaply at exhibitions. You may be able to see on the photographs that the races I have used are plain at the rear and flanged at the front, the reason for this is quite simply that those were the types I had available. An alternative may be to turn some

small wheels or rollers, but remember they must run freely when the stand is fully loaded.

Both ends have a support block (fig 3) of 1in. x 1in. x 1in. aluminium alloy that is drilled and reamed $\frac{1}{2}$ in. for a running fit on the raising block spindle. The outer end of the hole is counter bored $\frac{3}{4}$ in. by $\frac{1}{8}$ in. deep for a retaining washer secured to the spindle end using a countersunk screw.

For the indexing device I used a mild steel disc $\frac{1}{2}$ in. thick by $1\frac{3}{4}$ in. dia. with 16 off, $\frac{1}{4}$ in. dia. holes equally spaced around the periphery. I do not know why I chose 16 because 12 are adequate, giving increments of 30 degrees. If you decide on a different number of holes remember that multiples of four provide 90deg. indexing allowing top, bottom and each side of the locomotive to be uppermost on the stand for ease of working. I have mounted a spring-loaded plunger on top of the appropriate raising block so that it engages the holes in the disc. The disc is fixed to its support block with four countersunk screws, but before drilling the holes remember to align one of the index holes with the centre line of the block to ensure that your model is vertical when the 12 o'clock index is selected.

An alternative system would be to use a worm and wheel giving infinite but slower positioning.

We need to consider coupling each end to the locomotive chassis. My system is perhaps 'a bit over the top' as it comprises an 8in. length of 1in. x $\frac{3}{4}$ in. aluminium alloy bar with 'U' sections machined away to fit over the buffer stocks; keep plates over each 'U' serve to hold the locomotive in place when inverted. The coupling bars are attached to each support block using a 2in. length of the $1\frac{1}{4}$ in. x $1\frac{1}{4}$ in. angle using four socket cap screws in each, two into the bar and two into the support block. I advise the use of socket caps

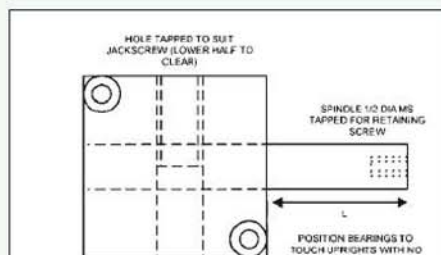


FIG. 2 RAISING BLOCK

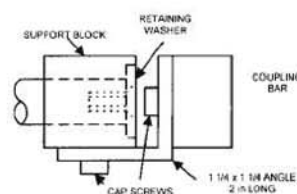


FIG. 3 SUPPORT BLOCK ASSEMBLY

here because between them they take the full weight of the locomotive; the tensile strength and shear properties of socket caps are superior to those of ordinary mild steel screws. As a minimum I would suggest 2BA (10-32 UNF) with holes tapped a deep as possible.

As the build progresses the model's centre of gravity will change somewhat making turning somewhat hazardous, however I intend to overcome this by altering the vertical position of the coupling bars to bring the model centre of gravity closer to the spindle centre line. Another change will be to cut slots in the coupling bars to accommodate the model's front hook and rear drawbar; but that is all in the future.



WORKSHOP WRINKLES

Lou Riley

quotes from his experience.

The little gadget shown in the photograph causes me to receive much ribald comment but I have the last laugh as it saves many a broken finger nail. It is a drawing pin extractor and very useful for removing stubborn pins from notice boards and the like. Mine was bent up from sheet metal that I had to hand and has served me well for many years. It is particularly useful at Christmas time when it is

time to take down the decorations. Split finger nails are not a good way to start the New Year.

Strimmer

My next door neighbour bought a replacement reel of nylon cord for his strimmer and asked if I knew a way of winding the 3m length required on to the spool. By putting the spool in the lathe chuck and running the spindle on low back gear the winding was done in a few minutes.

Unfortunately, word has got round and a steady stream of neighbours now beats a path to my door asking for the same service. I have not had a queue yet but you never know. I do not really mind as it is a tedious job winding the cord on by hand and the lathe makes a neater job.



The drawing pin extractor made by Lou Riley saves broken finger nails.



UK News

We have received notification from Alan Beard that he has been elected as Secretary of Bedford MES. Alan can be contacted at 2 Brambles, Wilstead, Bedford MK45 3ED, telephone 01234-301867 or via e-mail at alan.beard@ntlworld.com. We wish Alan every success in his new role.

The base for the new building at Bournemouth DSME is concreted and the Chairman is calling for help with the painting once the building is up. Other projects on the go are a body for the new club electric locomotive and new passenger trolleys.

Bradford MES is congratulating itself on winning the 'Best Club Stand' competition at the Harrogate exhibition this year. May we add our congratulations? It is always good for those involved in what is a lot of hard work to gain recognition of their efforts. The society made use of the security alarm system provided by Andrew Wild (reported

in *Club Chat* 4252) and "can now feel happier about the security of exhibits at shows". Andrew has applied for membership to the club and in recognition of his work on the alarm system has been given free membership for the year. The Spring Auction was very successful with lots of good bidding and even some springs for sale (think about it!). The auction even included a lathe which a lucky bidder acquired for £30. In addition to all this members have been busy working on the ground level sidings and carriage stores. Following some minor vandalism, a local retired police inspector suggested that all incidents should be reported because the police keep a log of such incidents. That seems to be a message that all clubs could take on board since the police seem to need a few incidents to happen before anything gets done these days. Malcolm Midgely and John Hawkes paid a visit to Holland recently and discovered an unusual pumping engine. The engine is a single cylinder beam

engine (3.7m bore by 3.2m stroke) but operating not the usual one beam, but eight. The eight beams operate pumps outside the engine house and these were used to drain the Haarlemmermeer Lake near Cruquius.

The latest project at the Bromsgrove SME is the raised level Gauge '1' track which is now completed. Brian Mould reports that it took "two years thinking about it and six months to build." The track has three running lines, each of 200ft. plus steaming bays, turntable and sidings. Station and other buildings will be fitted as they are completed. The society is holding an official opening of this track on the 13 August with the new track and the 16mm narrow gauge track in operation. The raised track will be "given over to the 2 1/2in gauge boys and girls." Further details can be obtained from Brian on 0121-4535733 (after 6pm please).

Another club celebrating success at Harrogate is Erewash Valley MES where member Alan Crossfield's GWR Large Prairie won 'Best in Show' and 'Best Locomotive' awards. Congratulations to Alan on

this achievement, especially so far outside GWR territory. Gordon Smith gave a talk to the society on safety valve design. The talk included several demonstrations.

The Isle of Wight MES started the season off with a busy ("unprecedented" was the word used by Chairman Reg Wrenn) Easter Saturday track and pond day and a successful rally. There were 56 visitors with four trains on the ground level track, three steam trains on the raised track, intense steam activity on the Garden railway and several boats on the pond. That sounds like the makings of a very good day to me. An interesting visitor was the *Maid of Kent* by Robin Shaw, this had a servo control for the regulator so that the driver could sit upright and avoid back ache. An unusual marine model was the electric powered fish made by Malcolm Hunt. This has a water cooled motor and can apparently leap 4ft. out of the water! That sounds like a good recipe for confusing regatta judges! The ground level track is being flattened to remove the "switch back effect" which has built up over the years. Other work includes re-

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.

AUGUST

- 5 Aylesbury (Vale of) MES, Track Night. Contact Andy Rapley: 01296-420750.
- 5-7 British Columbia SME, Trainfest Meet. Contact Sean Laurence: (604) 931-1547.
- 5 Canvey R&MEC, Evening Running. Contact Brian Baker: 01702-512752.
- 5 Maidstone MES (UK), Evening Run & Barbecue. Contact Martin Parham: 01622-630298.
- 5 North London SME, Locomotive Section Entertains at Colney Heath plus Barbecue. Contact David Harris: 01707-326518.
- 5 Portsmouth MES, General Meeting. Contact John Warren: 023-9259-5354.
- 5 Rochdale SME, Meeting. Contact Mike Foster: 01706-360849.
- 5 Romford MEC, Competition Night. Contact Colin Hunt: 01708-709302.
- 6/7 Dockland & E. London MES, Public Running. Contact P. M. Jonas: 01708-228510.
- 6 Guernsey Model Engineering Society, Track Day. Contact Dave Simon: 01481-251017.
- 6 Ickenham DSME, Public Running. Contact David Sexton: 01895-630125.
- 6/7 Leeds SME, August Rally. Contact Colin Abrey: 01132-649630.
- 6 Romford MEC, Trackside Afternoon. Contact Colin Hunt: 01708-709302.
- 6 Sutton MEC, Hosts to Gauge 1 Association. Contact Bob Wood: 0208-641-6258.
- 7 Bournemouth DSME, Nicki Memfield: Hardanger demo. Contact Dave Fynn: 01202-474599.
- 7 Bristol SME, Public Running. Contact Trevor Chambers: 0145-441-5085.
- 7 Canterbury DMES (UK), Public Running Day. Contact Mrs P. Barker: 01227-273357.
- 7 Cardiff MES, Steam-Up and Family Day. Contact Trevor Jenkins: 029-2075-5568.
- 7 Frimley & Ascot LC, Public Running. Contact Bob Dowman: 01252-835042.
- 7 Guildford MES, Driver Training Day. Contact Dave Longhurst: 01428-605424.
- 7 Hull DSME, Dove House Running Day. Contact Tony Finn: 01482-898434.
- 7 Leighton Buzzard NG Rly, Family Day. Enquiries: 01525-373888.
- 7 Malden DSME, Public Running. Contact John Mottram: 01483-473786.
- 7 National 2 1/2in. Gauge Ass'n, Locomotive Rally at Fylde SME. Contact Clive Young: 01233-626455.
- 7 Northampton SME, Public Running Day. Contact Pete Jarman: 01234-708501 (eve).
- 7 Oxford (City of) SME, Public Running. Contact Chris Kelland: 01235-770836.
- 7 Plymouth MSLs, Public Running. Contact John Brooker: 01752-671722.
- 7 South Durham SME, Running Day. Contact B. Owens: 01325-721503.
- 7 Taunton ME, Public Running. Contact Don Martin: 01460-63162.

- 7 Guild of Model Wheelwrights, Bewdley Horse Event. Contact Biddy Hepper: 01492-623274.
- 7 Westland & Yeovil DMES, Public Running. Contact Gerald Martyn: 01935-434126.
- 7 Wimborne DSME, Public Running. Contact Eric Basire: 01202-897158.
- 8 Bedford MES, Bits & Pieces. Contact Ted Jolliffe: 01234-327791.
- 8 Melton Mowbray DMES, Evening Steam-Up. Contact Phil Tansley: 0116-2673646.
- 8 Saffron Walden DSME, Club Night. Contact Jack Setterfield: 01843-596822.
- 10 Frimley & Ascot LC, Public Running. Contact Bob Dowman: 01252-835042.
- 10 High Wycombe MEC, Evening at Track. Contact Eric Stevens: 01494-438761.
- 10 Norwich DSME, Barbecue at Eaton Park. Contact Paul Reed: 01603-462925.
- 10 St. Albans DMES, Club Night. Contact Roy Verden: 01923-220590.
- 11 N. W. Leicester SME, Fish & Chip Supper. Contact John Elliott: 01455-847040.
- 11 Rugby MES, Visit to Lutterworth Railway Society. Contact David Eadon: 01788-576956.
- 11 Sutton MEC, Unfinished Projects. Contact Bob Wood: 0208-641-6258.
- 11 Wimborne DSME, Hamfest Day. Contact Eric Basire: 01202-897158.
- 11 Worthing DSME, Bits & Pieces. Contact Bob Phillips: 01903-243018.
- 12/13 Frimley & Ascot LC, Open Days. Contact Bob Dowman: 01252-835042.
- 13 Bromsgrove SME, Open Day. Contact Brian Mould: 0121-453-5733.
- 13/14 Guildford MES, OMLEC. Contact Dave Longhurst: 01428-605424.
- 13 Portsmouth MES, Efficiency & Concours d'Elegance. Contact John Warren: 023-9259-5354.
- 13 Reading SME, Public Running. Contact Brian Joslyn: 01491-873393.
- 14 Bedford MES, Public Running. Contact Ted Jolliffe: 01234-327791.
- 14 Harlington LS, Public Running. Contact Peter Tarrant: 01895-851168.
- 14 Hereford SME, Public Running. Contact Richard Donovan: 01432-760881.
- 14 Hollycombe Steam & Woodland Garden Society, Children's Day. Enquiries: 01428-724900.
- 14 Hornsby ME, Running Day. Contact Ted Gray: 9484-7583.
- 14 Plymouth MSLs, Members' Day. Contact John Brooker: 01752-671722.
- 14 Saffron Walden DSME, Running Day (public running after 2pm). Contact Jack Setterfield: 01843-596822.
- 14 St. Albans DMES, Club Running. Contact Roy Verden: 01923-220590.
- 14 Sutton MEC, Track Day. Contact Bob Wood: 0208-641-6258.
- 14 Westland & Yeovil DMES, Track Running Day. Contact Gerald Martyn: 01935-434126.
- 14 York City & DSME, Running Day. Contact Pat Martindale: 01262-676291.

preservation of the sleepers, landscaping, hedge work, arboriculture, horticulture and lawn care. The newsletter contains an item in which Gil Hughes recounts some details of his "memoirs of a misspent youth, mostly at Stratford". The Stratford in question is the East London Stratford which had one of the busiest sheds on the LNER Eastern route out of London. I too remember this from my college days when I commuted from Southend to London. A consortium of members has acquired an electric Class 08 shunter from the Sussex Miniature Locomotive Society. This has had "serious invasive surgery, a new controller, a complete re-wire and some monkey-gland treatment to the four motors". Perhaps we could have an article on the "monkey-gland treatment" for further education of the readers of this journal? The locomotive will be kept at the Broadfields track site for the use of club members. More information about the society's activities can be found on the website at www.iwmes.org.uk

The Melton Mowbray DMES

was entertained by a presentation on 'Industrial Railways' by John Scholes at the May meeting. A great number of sites and variety of engines were shown among which were "a lot of ugly ducklings by the nature of their work, but a fair scattering of swans".

Brian Patton, Chairman of the Model Engineers Society (NI) reports that following relaying of much of the ground level track over last winter it is now in excellent condition. Members are now busy constructing a turntable which as well as being useful will provide more interest for waiting passengers. Donations from Sunday public running sessions will be used to help meet the cost of a boating pool. The April meeting featured a talk

by Stewart Anderson on Loctite products and their uses. This was very well received by the members who are intending to make more use of the products in their model engineering activities.

Norwich DSME had a good write up of its activities in the local *Norwich Evening News* in April. The society is celebrating the new 30 year lease on the on the club house in Eaton Park. This will, no doubt, give members confidence to make forward plans and to continue with the development of the new ground level track. The steaming bays and level crossing are being worked on at the time of writing. The society is advertising the *East Anglian Model Exhibition* to be held on the

10/11 September at the Norwich Sports Village, Drayton High Road, Norwich. The exhibition will be open from 10am until 5:30pm each day and further details can be obtained from Geoff Johnson on 01603-810736. The Editor reports an incident to beat all the "leaves on the line and wrong sort of snow" situations. He was driving his locomotive one Sunday and had to brake sharply because a grey squirrel was sitting on the track. Said furry creature refused to move until the train got right up to it. Our tracks just aren't our own these days!

Plymouth Miniature Steam reports an inauspicious start to the public running season with a slow Sunday followed by a washout. Hopefully the better weather has improved things. A 'different' item at the March members evening was a 6ft. wing span Catalina flying boat. Other items included two Virginia locomotives and a B1. Editor, Ian Jefferson had what he described as "an interesting experience" recently when he appeared on BBC Radio Devon to describe some of the society's

In Memoriam

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

Ken Archer
Norman Crews
Tom Luxford
Len Pimblett

Saffron Walden DSME
Norwich DSME
North London SME
Wigan DMES

- | | | | |
|-------|--|-------|---|
| 15 | Model Steam Road Vehicle Soc. Roy McLellan: Full size Engine Owning. Contact Geoff Miles: 01869-247602. | 21 | Guild of Model Wheelwrights. Mid-Somerset Show, Shepton Mallett. Contact Biddy Hepper: 01492-623274. |
| 15 | Peterborough SME. Barbecue & Social Evening. Contact Tony Meek: 01778-345142. | 21 | Leicester SME. Competition Day. Contact Raymond Wallis: 0116-285-8824. |
| 16 | Chesterfield MES. J. Bagshaw: B.R. Locomotives. Contact Mike Rhodes: 01623-648676. | 21 | N. W. Leicester SME. Public Running. Contact John Elliott: 01455-847040. |
| 16 | Erewash Valley MES. Steaming Evening. Contact Jim Matthews: 01332-705259. | 21 | Oxford (City of) SME. Public Running. Contact Chris Kelland: 01235-770836. |
| 16 | Northampton SME. Running Night. Contact Pete Jarman: 01234-708501 (eve). | 21 | Plymouth MSLS. Public Running. Contact John Brooker: 01752-671722. |
| 16 | South Durham SME. Afternoon Steam-Up. Contact B. Owens: 01325-721503. | 21 | Rugby MES. Public Running. Contact David Eadon: 01788-576956. |
| 17 | Bournemouth DSME. Barbecue at Littledown. Contact Dave Fynn: 01202-474599. | 21 | Taunton ME. Public Running. Contact Don Martin: 01460-63162. |
| 17 | Hull DSME. Auction. Contact Tony Finn: 01482-898434. | 21 | Westland & Yeovil DMES. Public Running. Contact Gerald Martyn: 01935-434126. |
| 17 | MELSA. AGM & Meeting. Contact Graham Chadbone: 07-4121-4341. | 21 | Wimborne DSME. Public Running. Contact Eric Basire: 01202-897158. |
| 17 | West Wiltshire SME. Steam-Up. Contact R. Nev. Boulton: 01380-828101. | 22 | Bedford MES. Workshop Progress. Contact Ted Jolliffe: 01234-327791. |
| 18 | Cardiff MES. Forum. Contact Trevor Jenkins: 029-2075-5568. | 22 | Hornsby ME. Meeting. Contact Ted Gray: 9484-7583. |
| 18 | Leyland SME. Chat Night. Contact A. P. Bibby: 01254-812049. | 23 | Stafford DMES. Running Night. Contact Chris Dobbs: 01889-270533. |
| 18 | North London SME. Barbecue at Colney Heath. Contact David Harris: 01707-326518. | 25 | Bedford MES. School Holiday Running. Contact Ted Jolliffe: 01234-327791. |
| 18 | North Norfolk MEC. Track Evening. Contact Gordon Ford: 01263-512350. | 25 | Wimborne DSME. Steam & Chips Night. Contact Eric Basire: 01202-897158. |
| 18 | Sutton MEC. Evening Steam-Up. Contact Bob Wood: 0208-641-6258. | 25 | Worthing DSME. Tony Bentley: Matters Maritime. Contact Bob Phillips: 01903-243018. |
| 19-21 | Bristol SMEE. Bristol Model Engineering and Hobbies Exhibition at Thornbury Leisure Centre, Nr. Bristol, South Glos. 10am-6pm (Fri) 10am-6pm (Sat) 10am-5pm (Sun). Adult: £6, Child: £2.50, OAP: £5.50, Family (2+3): £14. Contact 0117-967-5878. | 27-29 | Harrow & Wembley SME. Open Weekend. Contact Dr. Roger Greenwood: 020-8427-2755. |
| 19 | Canvey R&MEC. Meeting. Contact Brian Baker: 01702-512752. | 27 | Hollycombe Steam & Woodland Garden Society. Fairground at Night. Enquiries: 01428-724900. |
| 19 | Erewash Valley MES. Steaming Evening. Contact Jim Matthews: 01332-705259. | 28 | Ammerfield Miniature Railway. Contact David Jerome: 0118-9700274. |
| 19 | Rochdale SMEE. Video Night. Contact Mike Foster: 01706-360849. | 28/29 | Bristol SMEE. Public Running. Contact Trevor Chambers: 0145-441-5085. |
| 19 | Romford MEC. Track Maintenance. Contact Colin Hunt: 01708-709302. | 28/29 | Cardiff MES. Open Days. Contact Trevor Jenkins: 029-2075-5568. |
| 19-21 | Guild of Model Wheelwrights. Bristol M.E. Show, Thornbury, Nr. Bristol. Contact Biddy Hepper: 01492-623274. | 28/29 | Claymills Pumping Engines. Open Days. Contact B. Eastough: 01283-812501. |
| 20 | Cardiff MES. Steam-Up Day and Barbecue. Contact Trevor Jenkins: 029-2075-5568. | 28/29 | Elmdon MES. August Bank Holiday. Contact Chris Giles: 0121-458-1291. |
| 20 | Chesterfield MES. Running Day. Contact Mike Rhodes: 01623-648676. | 28 | Harlington LS. Public Running. Contact Peter Tarrant: 01895-851168. |
| 20/21 | Furness MRC. Leyland MRC Exhibition. Contact Fred Firth: 01229-821192 or Colin Burns 01229-837079. | 28 | Hereford SME. Public Running. Contact Richard Donovan: 01432-760881. |
| 20 | Guild of Model Wheelwrights. Ruthin Show, Denbighshire. Contact Biddy Hepper: 01492-623274. | 28 | High Wycombe MEC. Public Running. Contact Eric Stevens: 01494-438761. |
| 20 | Hollycombe Steam & Woodland Garden Society. Fairground at Night. Enquiries: 01428-724900. | 28/29 | Leicester SME. Steam Weekend. Contact Raymond Wallis: 0116-285-8824. |
| 20 | Hornsby ME. Train Day. Contact Ted Gray: 9484-7583. | 28/29 | Malden DSME. Public Running. Contact John Mottram: 01483-473786. |
| 20 | Romford MEC. Trackside Afternoon. Contact Colin Hunt: 01708-709302. | 28 | MELSA. Sunday in the Park. Contact Graham Chadbone: 07-4121-4341. |
| 20 | York City & DSME. Practical Sheet Metal Working. Contact Pat Martindale: 01262-676291. | 29 | York City & DSME. Running Day. Contact Pat Martindale: 01262-676291. |
| 21 | Canvey R&MEC. Gala Day. Contact Brian Baker: 01702-512752. | 29 | Bedford MES. Public Running. Contact Ted Jolliffe: 01234-327791. |
| 21 | Frimley & Ascot LC. Club Running. Contact Bob Dowman: 01252-835042. | 29 | Canterbury DMES (UK). Club Night. Contact Mrs P. Barker: 01227-273357. |
| 21 | Guildford MES. Public Running. Contact Dave Longhurst: 01428-605424. | 29/30 | Frimley & Ascot LC. Public Running. Contact Bob Dowman: 01252-835042. |
| | | | Northern Mill Engine Society. Open Days. Contact John Phillp: 01257-265003. |
| | | | Oxford (City of) SME. Public Running. Contact Chris Kelland: 01235-770836. |
| | | | Portsmouth MES. Charity Day - Blind Association. Contact John Warren: 023-9259-5354. |
| | | | Saffron Walden DSME. Running Day with Barbecue (public running after 2pm). Contact Jack Setterfield: 01843-596822. |
| | | | Stockholes Farm MR. August Bank Holiday Running. Contact Ivan Smith: 01427-872723. |
| | | | Taunton ME. Public Running. Contact Don Martin: 01460-63162. |
| | | | Hull DSME. Tony Finn: Quiz. Contact Tony Finn: 01482-898434. |

activities during a 20 minute interview starting at 7:30 in the morning. Dave Witheridge describes his CO₂ engine built from a plumbing T-piece. The engine has crankshaft controlled induction and exhaust. So far it sounds normal but the really unusual aspect of the engine is that it uses the pressure under the piston to derive the power. The cylinder is open at the top and the engine runs smoothly at about 2000rpm. Details of any other unusual engines from our readers will be welcome.

Another club which has had a busy time over the winter period is **Rugby MES** where members have lifted and replaced 250 yards of track. This involved digging out the old ballast, removing 20 tons of earth and replacing the (60 tons) of ballast. This mammoth task was accomplished with the help of a team of at least ten members who were very active with the wheelbarrows and who were assisted by a small digger which was used to deepen the track bed. Apart from all this a new hydraulic table has been installed by Aubyn Mee and Simon Rolfe to make loading and unloading of 7¼in gauge locomotives easier.

Members of the **Langford & Beeleigh MRC** paid a visit to the Audley End track of the **Saffron Walden DMES** in April. It is reported that *"On arrival, the gentlemen headed for the track and the ladies headed for Audley End House so all needs were catered for"*. The new club locomotive is progressing well with the cab and motor cover nearly completed with the result that the engine is starting to look like the real thing. The pitched roof on the container is 75% complete at the time of writing. The society is holding an open day on 18 September which is open to all clubs and will include a barbecue. Details can be obtained from Secretary Jack Snetterfield at 229 Ramsgate Road, Broadstairs, Kent CT10 2EN.

The track at **St. Albans DMES** has seen two *"Maiden Voyages"* recently with the first outings of Roger Stephen's restored *Princess Marina* and Tim Hopkins' GWR pannier tank built from a Modelworks kit. Both locomotives had a run although Roger had some pump problems on the *Princess Marina*. Tim described his problem as *"the steep learning curve on how to drive a steam locomotive"*. Many will sympathise with that statement. The *Editor's Prize* for the best contribution capturing the spirit of

the society went to a member's daughter this year. The winner was Yvette Philipps (daughter of Bob) who was presented with book tokens for her efforts. The competition is designed to encourage members to contribute to the newsletter. Perhaps we ought to do something similar at this magazine?

Members of **Tonbridge MES** have been busy renewing the roofing on their coach roof. The old covering was stripped off, the underlying wood was made good where necessary and the new covering (as used by the Bluebell Line) was installed the following day. To quote the newsletter *"The strippers ended up absolutely filthy...and retired for baths before the evening meeting"*. The mind boggles; I will leave you all to draw your own conclusions. An interesting fact slipped into the newsletter is that the first hacksaw was invented in 1681. There is a description of a very interesting substance in the newsletter, magneto-rheological fluid (MR fluid). This is a mixture of carbonyl iron particles, a carrier liquid and other proprietary additives. The substance is normally a fluid but when it is subjected to a magnetic field becomes a solid. This can be made to happen thousands of times per second if required. I am sure our readers could come up with all sorts of applications for it.

Members of **Tyneside SMEE** saw some interesting items at their May 'Bits & Pieces' evening. John Bolter showed his small drill sharpening device, Peter Fedoroff had his number stamp guide for facilitating stamping numbers onto the outside rim of a cylinder. Peter Lambert has used two 20W garden lights for his milling machine. These run from a 12volt transformer. In addition there were locomotive related items from Derek Manns (*Simplex* cab and tank sides), Steve Lowe (pressed out smoke box door for *Ajax*) and Joseph Gibbons '0' gauge *Conway*). Outside, initial preparation work has started for the ground level track.

Writing from *'The Keeper's Office'* (some of our Northern readers will understand that) the Editor of the **Weymouth DMES** newsletter reports that the heavy gang have moved a large quantity of gravel onto the track bed in preparation for the concrete track base. The best effort by the gang was moving 13 tons of gravel which

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took nine people four hours and 27 cups of tea. Progress on the club room is also being made with the floor sealed and painted and the capability to make tea in large quantities.

David Hill gave a detailed and interesting presentation on *"The Crystal Palace and The Great Exhibition"* to **Wigan DMES** in April. David had a link with the Crystal Palace because his Great Grandfather, Ted Smith, won a medal playing at the palace with the *Crossfield's Perfection Soap Works Band*. What happened to all those wonderful evocative and informative company names? A comment in the newsletter questions the use of the description *"the colour of boiled carrots"* when describing how hot to get things when hardening steel. As the writer says *"When I boil carrots they are the same colour raw as they are when boiled...so why don't we just heat the metal to the colour of a carrot?"* Reader's views on the correct vegetable to use for heat treatment will be welcome.

World News

New Zealand

The April talk at **Auckland SME** was by Bob Lupton who was a railway engineer with the London Underground. Bob talked about his experiences both on that system and also Hong Kong and Singapore. Bob described the change from steam to electric power on the London system and also gave details of the control systems used. The newsletter also carries a piece on the new A1 steam locomotive being built in the UK by the A1 Steam Locomotive Trust. Details are available on the trust website at www.a1steam.com An interesting object brought to the Beginners

Night in March was the light sink, used to absorb unwanted light, produced by Graeme Murray. This was made by stacking razor blades in such a way that the incident light is reflected at an angle which prevents it escaping. It looked black to those at the meeting. After the recent correspondence in *Post Bag* about getting enough light in our workshops, it would seem things are different on the other side of the world!

The proposed boating pond at the Haswell site of **Canterbury SMEE** is expected to be enlarged following the all clear from the council. Alan Orwin gave a talk about great inventions at the March meeting and mentioned Arnold Kent (airbags for cars), Stephen Wales (blood pressure U-tube) and Felix Hoffman (aspirin).

South Africa

The **Centurion SME** has reported work in progress on several fronts. The extra tunnel project has been resurrected due to an offer of free excavation of the tunnel; progress is being made on installing the extra levers in order to operate the points from either direction and the library now has a new floor.

Reminder

Much club mail is going to old addresses no longer in use. Please change club mailing lists to read:

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Berwick House
8-10 Knoll Rise
Orpington
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BR6 0PS

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Emco Maximat Super 11 Centre Lathe, Tooling, 3ph, VGC.....	£2100.00
Emco Maximat Super 11 Centre Lathe, Tooling, 3ph, VGC.....	£2100.00
Conect Cadet Plus CNC Lathe, Used Once Only, 240 volt,	£1450.00
Pultra 1750 Bench Lathe, Drive Unit, Collets, Chucks, Tooling, 1ph, VGC.....	£1500.00
Pultra 1750 Bench Lathe, Motor, Well Tooled, Collets, 1ph, VGC.....	£1500.00
Pultra 1770 Bench Lathe c/w Handrest, Tailstock, 10 Collets, No Motor.....	£ 350.00
Denford Startum CNC Bench Lathe, 1ph, Manual.....	£1000.00
Denford Startum CNC Bench Lathe with Auto Tool Turret, 1ph.....	£1450.00
Denford Orac CNC Bench Lathe, 1ph, Manual.....	£1450.00
Boxford AUD 5" x 22" Lathe, Well Tooled, New 240 Volt Single Phase Motor, VGC.....	£1850.00
Boxford BUD 5" x 22" Lathe, PCF, Tooled, VGC, Fitted New 240 Volt Motor.....	£1650.00
Boxford AUD 4 1/2" x 18" Lathe, Tooled, New Single Phase Motor Fitted.....	£1250.00
Boxford Model A 4 1/2" x 18" Lathe, Stand, Gearbox, PCF, Tooling, Single Phase.....	£1250.00
Myford Super 7 Long Bed Bench Lathe, 1ph, Old.....	£ 600.00
Myford Super 7 Bench Lathe with Tray & Blocks, 1ph, Tooling.....	£1000.00

Colchester Triumph 2000 Gap Bed Lathe, 7 1/2" x 50", 3ph, Tooled.....	£2500.00
Colchester Chippmaster 5" x 20" Lathe, Metric, Tooled, Quiet, VGC, 3ph.....	£ 950.00
Colchester Bantam 1600 5" x 20", (Late Type) Chucks, Lever Op Collet, Coolant, OCTP, Guards, Light, Manual, 3ph, VGC.....	£2500.00
Colchester Bantam 1600 5" x 20" Tooled, Coolant, OCTP, VGC, 3ph.....	£1450.00
Colchester Bantam 800 5" x 20", Tooled, 3ph.....	£ 850.00
Colchester Bantam 800 5" x 20", Tooled, 3ph.....	£1000.00
Harrison 280 CNC Manual/CNC Training Lathe, Faults, Harrison 12" Swing Lathe, Old & Dirty But Runs Very Well, Tooled, 3ph.....	£ 650.00
Harrison M300 6" x 25" Gap Bed, Well Tooled Inc Lever Op Collet Chuck, 3ph.....	£2750.00
Harrison 11" Centre Lathe and Tooling, 3ph.....	£ 750.00
Harrison 4 1/2" x 25" Centre Lathe with Tooling, 3ph.....	£ 750.00
Pultra 1770 Cabinet Mounted Micro Lathe, Drive Unit, Well Tooled, 3ph.....	£1250.00
Acorn Capstan Lathe, 1ph, Cut Off Slide, Old.....	£ 375.00
Acorn Capstan Lathe, 1ph, Cut Off Slide, Old.....	£ 325.00

DRILLING MACHINES

Boxford Union Pillar Drills, Rack Op Table, 3ph.....	£ 325.00
Thoka Arbo No 2 6 Station Turret Drill Head, 3MT.....	£ 175.00
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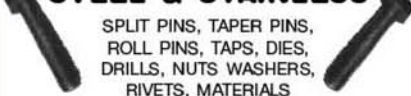
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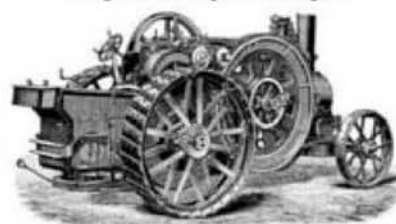
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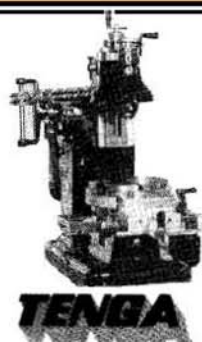
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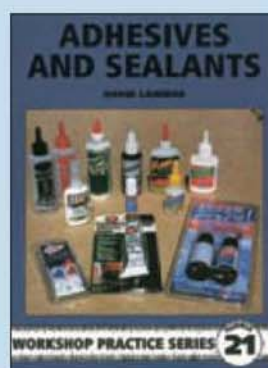
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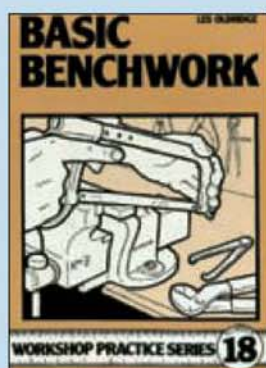
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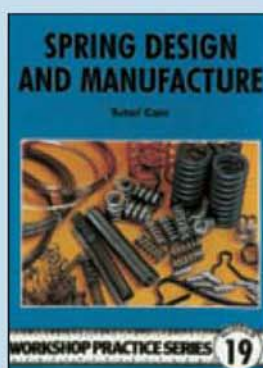
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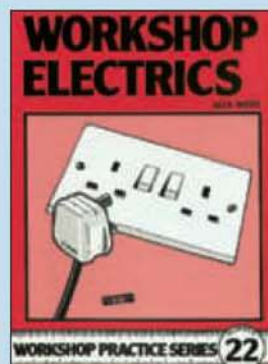
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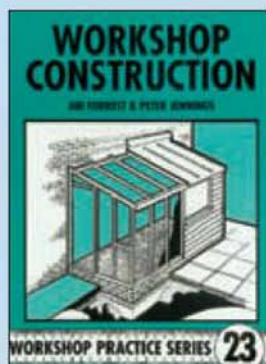
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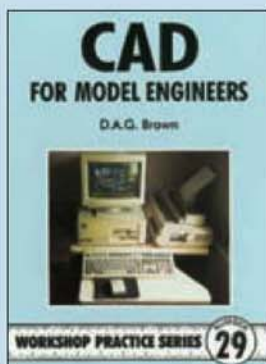
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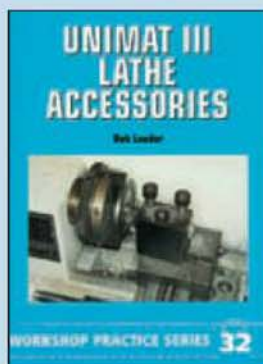
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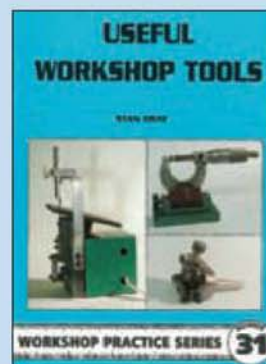
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