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Vol. 189 No. 4178

20 September - 3 October 2002

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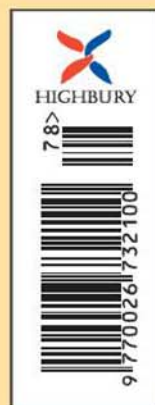
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 these components. Part XXIX.
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MODEL ENGINEER



THE MODEL ENGINEER EXHIBITION

29 - 31 DECEMBER 2002 AT SANDOWN PARK, ESHOT, SURREY

On the cover ...

Representing some nineteen years
 painstaking and patient development
 our cover photograph shows the Mk. 2
 Burnt Air engine designed and built
 by Frank Taylor and currently being
 serialised in these pages.

As well as the engine itself, Mr. Taylor
 designed and built the test equipment
 used to evaluate and document
 the performance of his engine.

Burnt air was chosen as the working fluid
 to allow the engine to operate at heater
 temperatures of 220deg.C without the
 lubricating oil tending to 'crack'.
 In this context 'burnt air' is air from which
 the oxygen content has been removed by
 a combustion process thereby avoiding
 the cost of using such working fluids as
 carbon dioxide or helium.

(Photograph by John Jolliffe)

A FERRIS WHEEL CLOCK

Planting the intermediate and escape
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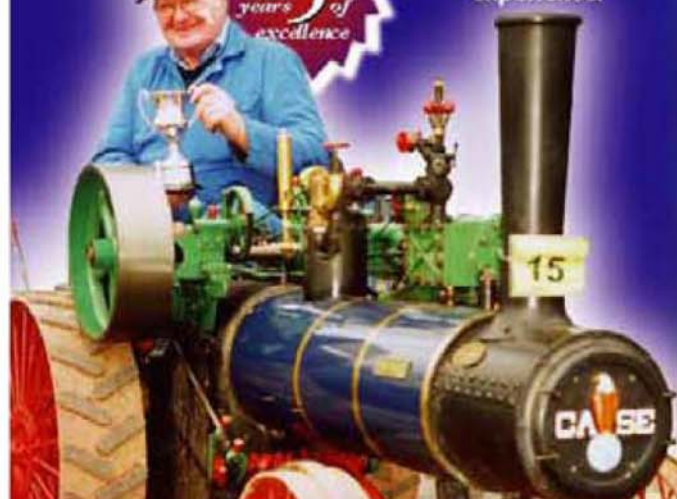
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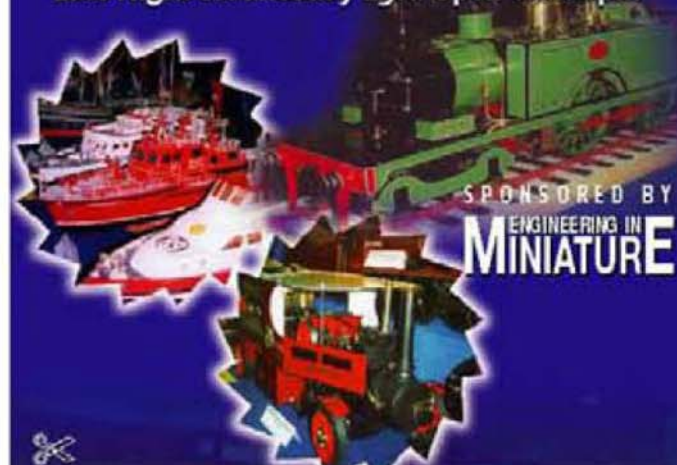
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SMOKE RINGS

With the Editors

Scrap!

A wise man once said: "He who never made a mistake never made anything." These are words to which we can all probably relate. It is a very competent craftsman indeed who never has to consign anything to the scrap bin — or perhaps one who does very little. This is particularly true in model engineering where most projects include at least one aspect that can be of an experimental nature and may require a return 'back to the drawing board' several times before it is right.

But, what do we do if a mistake occurs? We suppose that if the error happens in the privacy of our own workshops and the part is relatively small it can be discarded with a sigh and perhaps the odd expletive, before another is started. The only loss is that of the material, a little time and a small dent in our pride. However, if the scrapped part is large or complex, what then is to be done? We could always try the approach adopted by a young man working in a certain tool room.

He managed to scrap a large casting. Realising that the error would lead to a reprimand, suspension or worse, he reduced the entire casting to swarf but reported it as finished. When the time came to collect the casting from the stores it was nowhere to be found. The store man got the blame for losing it and our hero's reputation remained intact — at least with his supervisor. Apparently, proving someone has made a scrapper is a bit like proving murder; it helps to have a 'body'.

Of course, not all accidents happen to components. Sometimes machine tools can become damaged. Should such an eventuality occur then the result of our carelessness is there for all time or, at least until we and the machine part company. Should this dreadful state of affairs happen to you the following suggestion might be useful.

A certain individual managed to drill a small hole in the table of a nearly new jig borer. Realising that he would have to live with both the visual evidence of his carelessness and the leg

pulling of his work mates for many years he carefully opened up the hole to the next largest tapping drill size, tapped it and fitted a grub screw. He then got some letter stamps and stamped the word 'oil' alongside the hole.

We wonder how many people conscientiously went to squirt oil in that hole over the years and marvelled at how the level never seemed to go down. Perhaps our armed forces could learn something about camouflage from certain tool room workers!

Model Exhibition at RAF Halton

Now in its 24th year, the International Model Exhibition at RAF Halton airfield in Wendover, near Aylesbury in Buckinghamshire will be open 10am-4.30pm on Sunday 6 October.

Exhibits include model engineering, stationary engines, model railway layouts, circus and fair-ground models, aircraft models, radio controlled model boats, aircraft and cars, war games, film and TV models and plastic models.

With preservation societies, trade stands and art and craft stalls, much of the exhibition is under cover, parking is free, refreshments are available and the admission charge is £5 for adults and £2 for children and senior citizens.

Proceeds are in aid of charity, so why not support a good cause by paying them a visit and enjoying a good day out with all the family?

New model engineering society proposed for Basildon

Mr. Barrell writes to inform us that he has taken the first steps to form a Society of Model and Experimental Engineers at Basildon in Essex. He explains that to the best of his knowledge there appears to be no similar group in the immediate area but would be pleased to hear from anyone who knows differently.

Mr. Barrell has made enquiries about hiring a suitable room for a possible inaugural meeting

and suggests that a likely venue would be the Community Resource Centre at The Gore, near the town centre. This inaugural meeting would probably take place on a weekday evening in late September or October.

Anyone interested in taking up Mr. Barrell's suggestion and requiring further information is invited to contact him at 8 The Avenue, Billericay, Essex CM12 9HH.

Always pleased to learn of anything to further the interests of our hobby, we are very happy to bring Mr. Burrell's proposals to readers' attention in this column, wish the venture every success, and look forward to hearing good news about the inaugural meeting.

M.E. Index

Following our note in *M.E.* 4172, 28 June 2002, we were pleased to hear from Jo Scopes when she contacted us to say that despite domestic difficulties, her computer index is in the process of being updated and should be up to date by the time this note appears in print.

We understand that she would like to publish her index on a host website prepared to put up with her regular index updates. In the meantime, anyone who would like a copy should contact her by e-mail at jo.thoms@amsjv.com

Festival of steam models

The ever-popular annual Festival of Steam Models takes place this year at Kew Bridge Steam Museum over the weekend 5/6 October and will feature a traditional fairground theme with *The Iron Maiden*, the well-known Fowler Showman's engine, as the star attraction. This full size engine will be working in steam, providing power for traditional children's amusements.

Steam models of boats, traction engines and railway locomotives will be on display as well as the museum's unique working collection of steam powered water pumping engines. The museum's narrow gauge steam railway, operated by the Hampshire Narrow Gauge Railway Society, will be providing free rides around the site.

Visitors wishing to further their interest in steam modelling will be able to check out trade and preservation group stands offering a wide range of models, kits, specialist books and magazines, and other steam related merchandise. The first prize in a Festival Raffle will be a Mamod model steam engine.

Hot and cold food will be available in the museum café, and the museum bookshop has a wide range of books, souvenirs and gift ideas.

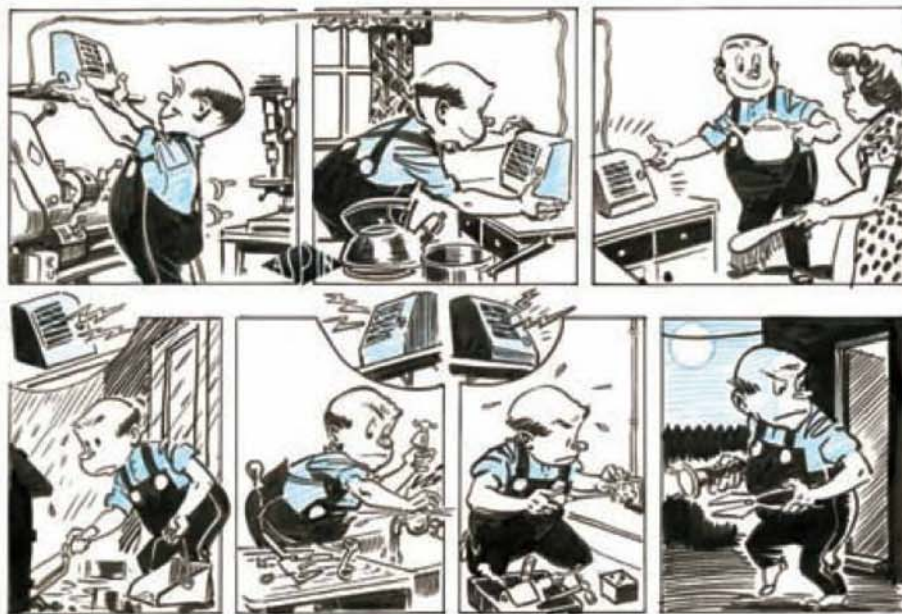
Kew Bridge Steam Museum is in Green Dragon Lane, Brentford, Middlesex, about 200 yards from the north side of Kew Bridge under the tall Victorian tower and may be reached by bus, main line rail or London Underground. The nearest motorway is the M4; leave at junction 2 and follow the signs to Kew Gardens, Brentford and Hounslow.

Admission at weekends when the engines are in steam is adults: £4.50; OAPs and students £3.50; children (5-15 years) £2; family ticket: £11.50. Please note that children under the age of 13 years must be accompanied by an adult.

For more information about this event and the Kew Bridge Steam Museum, telephone the museum on 020-8568-4757 or visit www.kbsm.org

CHUCK the MUDDLE ENGINEER

by B. TERRY ASPIN



POST BAG

Workshop (H)eating

SIRS, - In the early 1950s I was an apprentice fitter in the tool room at the Rolls-Royce factory in Derby.

The tool room had its own hardening and annealing section and when we were on night shift we used to creep in and place tins of soup or baked beans on the outlet chimney of one of the small furnaces. We had the timing judged to perfection to get the right temperature for break time when a can of hot soup with a crusty bread cob made an ideal meal on a cold night.

One night one of the fitters placed his usual tin of tomato soup on the pipe, was interrupted, and forgot the vital part of the process: to puncture the can with two holes!

Needless to say the can exploded with a loud bang, showering the soup all over the red-hot furnace. The soup immediately evaporated, of course, and the smell of tomato soup drifted down the corridors, soon to reach the nose of the night superintendent, very much to his annoyance. He never did catch the culprit involved, but made it quite clear that the practice had to cease from then on!

The smell of tomato soup hung around the corridors for a long time afterwards.

P. B. Slater, South Humberside.

Disposal value

SIRS, - Following discussions with fellow model engineers about the value of the contents of our workshops, and in view of the advancing age of the average model engineer, I feel some thought should be given to the eventual disposal of these items.

With some exceptions, I would expect that our wives or nearest relatives may not appreciate the value of the various items we have collected over the years in pursuing our hobby. A lathe and a milling machine are easily valued and it is likely that, in the event of our demise, these larger items would probably realise their market value.

However, I am more concerned about the add-on items to the major appliances in our workshops. In total, these may well have a value far in excess of that of their respective machines, e.g. collets, cutters, drills and all of the other things we are tempted to buy at exhibitions and elsewhere. If we include taps, dies and fasteners together with the many portable hand and other tools, plus possibly a cutter grinder and a scroll saw, the additional cumulative value of all these other accessories

may greatly outvalue the larger items.

Have any of the other clubs arrived at a formula for protecting the estates of members so that their survivors are not unwittingly 'ripped off' by dealers who may not be particularly scrupulous? John Colville, Northern Ireland.

Armstrong gun

SIRS, - I am obliged to Mr. Rees for his letter concerning my model of the 7in. Armstrong RBL on dwarf traversing platform (M.E. 4176, 23 August 2002)

I can assure Mr. Rees that for garrison/coast defence c1860, these guns were mounted on sliding carriages without cap-squares. The sliding carriages were merely adaptations of garrison standing carriages that, for land service, never had cap squares. Yes, very similar carriages were used in Naval service with cap-squares and, very occasionally, these found their way into land service.

If he cares to visit the Royal Armouries Artillery Museum at Fort Nelson near Fareham in Hampshire, he will see the actual gun, restored carriage and platform on which my model is based. I enclose a photograph of the gun (above) in a casemate there. There are clearly no cap-squares.

Regarding run-up, i.e. returning the gun and carriage to its firing position after recoil, two handspike levers each with a gunmetal truck, were used to raise the rear of the carriage so that the sliding carriage was converted into a four wheeled one. Thus it was run forward with ease and even required a 'preventer rope' to prevent it from striking too violently against the front of the platform. For running it back, tackles were applied. (I quote directly from *Equipment of Artillery, 1864* compiled by Major Millar VC, RA.)

Mr. Rees should note that many of Ian V. Hogg's books on artillery tend to be in the populist category and do not tell the whole story. One has to turn to the period manuals and drawings of which I now have a large collection.

D. A. Wilcox, Wiltshire.

A3 locomotive required

SIRS, - Following many years modelling in O-gauge but always with the desire to own a piece of real model engineering, I am currently looking to purchase an LNER A3 locomotive in 5in. gauge.

During recent months, I have been advertising in this magazine for an A3 locomotive but no offers



Lieut. Col. D. A. Wilcox based his model 7in. Armstrong RBL on a dwarf traversing platform on this full size version at the Royal Armouries Artillery Museum at Fort Nelson near Fareham in Hampshire.

have yet been forthcoming.

Help from anyone who can assist me in fulfilling my ambition to own such a model would be greatly appreciated.

Ian Harp-Smith, Nottinghamshire.

Pencils

SIRS, - With reference to the recent comment in *Smoke Rings* (M.E. 4173, 12 July 2002) I cannot be a practically-minded model engineer since there is no way I would allow ordinary lead pencils into an American spacecraft and probably not a Russian one either!

All it would take is for one broken pencil point to float into some densely packed circuitry and disaster might ensue. Perhaps these matters have not been left to chance and you owe the professionals a small apology. John Bauer, Ontario, Canada.

Neil Read replies:

Our piece in *Smoke Rings* was intended as a light-hearted slant on the futility of taking a 'sledge-hammer to crack a walnut'. Regrettably in this we have clearly caused offence. By way of penance, I decided to do some tests. I cut a 15mm long section of lead from my workshop pencil (of the HB variety purchased from W. H. Smith) and proceeded to test it for conductivity using a rather crude circuit built up around a torch bulb and two batteries.

My test showed that Mr. Bauer was absolutely right and the piece of lead was conductive. Small fragments would certainly be a hazard near intricate circuitry.

Curious as to whether all pencils behaved the same way, a sample of 'lead' was cut from a colouring pencil or crayon. This was a very old Harris Office Brown (Empire made!) probably dating back to my school days. This sample was not conductive — at least not according to my admittedly rather simple equipment.

May I respectfully suggest that if the British Empire could create (probably unwittingly) a non-con-

ductive pencil lead forty or fifty years ago then it should be possible for the Russians to do something similar today. I concede that we were probably wrong to use the word 'lead' to describe the type of pencil, but still think something along these lines should be cheaper and no less safe than a pen that pumps ink.

Pickle

SIRS, - Is there a reader of *Model Engineer* out there who knows where I can buy sulphuric acid of 96% concentration.

I live in Leicester but have tried all over the country without success. I have a boiler waiting to be silver-soldered and need a pickle bath. Reeves 2000, my nearest supplier, who sell copper sheet, tube and flanged plates for boilers, no longer sell sulphuric acid.

In my opinion, the model engineering suppliers are letting us down. One suggested battery acid, but at 10% concentration I would need a great deal so do not consider this to be a satisfactory answer.

I am told that EC legislation is at the root of the ban on sales of the concentrated acid which apparently can be used for making explosives. This I can understand, but why did not the various organisations which represent model engineers make known our legitimate use of this substance?

If I cannot get a suitable pickling bath it looks as if I shall have to build up the boiler in one go — or give up.

Has anyone any ideas?

G. F. Hennessey, Leicestershire.
(Many model engineers get good service from a pickling bath containing strong citric acid obtainable in crystal form from chemists or home brewing/winemaking outlets. Drain cleaners available from janitorial suppliers (see Yellow Pages) and which contain a small proportion of hydrochloric acid have also been used successfully — Ed.)

Dunchideock treacle mines

SIRS, - On browsing through my copy of *M.E.* 4166 for 5 April 2002, I stopped at John Hill's piece on *Miss Peckett*. This surely was the little engine I saw in a shed in a closed china clay mine on Dartmoor in about 1942. Nearby we found a triple expansion steam engine from a naval launch of c1900 vintage. The engine was some 4ft. high by 6ft. long and was in the open alongside a very old boiler.

To run a compound engine of that size would have required a boiler pressure of at least 100psi but, judging by the set up, a boiler inspector could never have been anywhere near it. The engine survived the war and I tried to get the Exeter Model Engineering Club to salvage it but the cost at the time ruled this out.

After studying the rare photograph and reading Mr Hill's notes about the Newton St. Cyres Cheese Quarries I thought to myself, this fellow will write about the Dunchideock treacle mines next.

I attended John Stocker School at Cowick Hill, St. Thomas in Exeter while one-armed John Stocker was still headmaster. In the mid-thirties my school mates and I were twelve years old and always out for a bit of fun. Providence sent us a young school master with a broad Yorkshire accent and we all thought that we had a right one here!

When he set us to write an essay about our surrounding area, a couple of wicked little minds thought 'Dunchideock treacle mines' which were carefully incorporated into our essays. These were read out in class, much to the amusement of our class mates who were all in on the joke.

The master said he enjoyed the parts covering the villages and moors but was puzzled by the references to treacle mines — had we seen them? We replied that we had and just to drive the point home, the next day we brought in a sample of the treacle they produced. It was actually a jar of borax borrowed from my friend's father who was a plumber, but the colour was right.

The deception was thus clinched and our master became very interested in cycling off to see these mines. We directed him to Dunchideock and suggested he should ask for final directions at the pub.

At the time, these villages had no radio, cars or buses. To get about we had to walk or travel by horse and cart. Time was set by the church clock which in turn was set to the vicar's watch. A main line driver for the GWR, my father always carried

two watches, one set to railway (Swindon) time and the other to Exeter time. It wasn't very easy to catch a train when all the towns used their own local time!

Folk in these moorland villages had an accent based on eighteenth century English. It was difficult to understand even if you came from Exeter. So a Yorkshire man seeking directions in the local pub must have given rise to some merriment. He was sent miles around the village and arrived very late back at his lodgings.

While the Dunchideock treacle mines were never mentioned again I suspect that I was on the receiving end of the cane more often. My thanks to Mr. Hill for reawakening some memories from sixty years ago.

Does Exeter MEC still exist? If so, do they still have the part-built 5in. gauge locomotive I gave them? Dennis Collings, South Australia.

Dunball treacle mine

SIRS, - I was interested to read John Hill's article on *Miss Peckett* (*M.E.* 4166, 5 April 2002) and the Clay/Hill correspondence (*M.E.* 4172, 28 June 2002) concerning treacle mines in Devon and Cornwall. We also had a treacle mine in Somerset. The story of the Dunball treacle mine, and how it came out in 2lb. tins, was often told.

Nobody could remember how the story originated. Like the pig shearing matches held at Butcombe, it was thought to be a bit of nonsense — useful when testing the credulity of 'incomers'.

However, I discovered that there really had been a treacle mine at Dunball. It was not a 'mine' in the real sense, but a borehole pumping out a thickish saline mud from which salt was obtained. The name for the 'saline mud' was *treacle*!

Maybe there was a salt industry at Dunchideock and Wheal Clidgy? I have read of the term 'treacle' being used in the production of salt by this method in East Anglia so it would seem that its use is not just a local one.

John Chapman, Somerset.

Drawings and dimensions

SIRS, - Anthony Mount's letter concerning drawings and dimensions (*M.E.* 4174, 26 July 2002) interested me for several reasons but particularly with regard to the topic of metrication. It is the expression of such thoughts which provides stimulus for future discussion.

The draughting aspects of Mr. Mount's letter were of interest to me as I served a five-year apprenticeship

as a ship draughtsman. During this period I obtained qualifications in naval architecture. Subsequently, I was employed in a variety of engineering disciplines before finishing my full-time employment with eight years teaching of technology (now craft, design and technology) to students in secondary schools.

During my time in teaching I was always careful to observe the requirement placed upon us to teach metric units. However, whenever I asked a pupil for the size of something I frequently received an answer in fractions of an inch. This occurred during the 1980s, long after the UK was supposed to have embraced metric units.

Another issue was the requirement to return to our 'grass roots' or first principles and use first angle projection (otherwise 'English projection') for technical drawings. This was after we had been persuaded to adopt third angle ('American') projection in the aircraft and other defence industries as a result of our membership of NATO, of which the USA is a senior partner.

At the time we adopted third angle projection, we also adopted the Unified system of screw threads. The Americans are more fiercely loyal to the British imperial system than we are ourselves and, to this day, they always quote the swept volume of their engines in cubic inches; I have seen dimensions given in 1/128in. on sheet metal drawings. Even so, some anomalies exist and there are, for example, 42 US gallons to a barrel of oil compared to approximately 35 imperial gallons.

During the course of my professional career I have been required to change from one standard to another and back again many times. My first assignment when starting a three-year spell in contract design was to re-arrange the alignment of a one metre diameter duct on a piece of German designed equipment. The error was almost certainly attributable to a mix up in metric dimensioning.

In the last year of this period of my life, c1968, I was employed in the design of satellites and ground-handling equipment. One of these

projects required me to produce the installation drawings for the European consortium in first angle projection with metric dimensions and the manufacturing drawings (for the UK manufacturers) in third angle projection with imperial dimensions.

My personal view is that the standard to which we work is irrelevant.

The single area of annoyance to which I will admit is that over the years I have been required to acquire taps, dies and spanners in the three main systems (imperial, unified and metric). During this period I wonder how many nuts have been ruined by the use of 13mm spanners on 1/2in. hexagons or 1/2in. AF spanners on 12mm hexagons. However, we did manage to struggle through two world wars with the various allies using different systems!

I understand that British Standard Pipe threads are now the adopted standard for this class of thread in the EU.

With respect to relative fits, apart from the frequent necessity to ensure interchangeability; too great an interference can result in over-stressing the parts.

These days I can accept the *status quo* on measurement standards and nothing much concerns me.

R. E. Ellwood, Hertfordshire.

Flash steam

SIRS, - Steam enthusiasts here in the Colonies have been influenced by the book *Experimental Flash Steam* which is substantially about the one metre hydroplanes described in these pages in years past.

I am in receipt of a letter dated 20 February 2002 from J. N. Walton in the Isle of Man in which he says that Edgar T. Westbury was an expert on the subject.

I am interested in anything with which anyone can help us on this subject. I would like to buy some of these boats with their engines, as the latter were highly developed.

Tom Kimmel, Steam Automobile Club of America Inc., PO Box 247, Berrien Springs, MI 49103, USA.

e-mail: sacapres@steamautomobile.com
website: www.steamautomobile.com

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



A simple plug gauge and ring were quickly turned up to illustrate the points made in this article. The plug was turned to a diameter of 1.076 inch.



The ring was turned to a snug fit on the plug gauge and is seen here with the plug fitted into its bore.

WHY WON'T IT FIT?

Neil Read

explains some of the causes and effects of the troublesome phenomenon known as 'lobate'.

There are times in the life of an engineer when the powers of deduction of one of the great fictional detectives like Hercule Poirot are needed. For me, such an occasion cropped up about a year ago, and the facts of the 'case' may be of interest to readers.

I was approached by an acquaintance who, regrettably, was in a spot of bother. It seems that he was building a device, about the exact purpose of which he was rather reticent. However, this mechanism had a $\frac{3}{4}$ in. dia. shaft running in a phosphor bronze bush. Since he lacked the facilities to machine the parts himself, he had approached a lathe owning friend to machine the bush. The shaft was to be a piece of precision ground shafting of unknown provenance that he happened to have by him.

His engineering friend measured up the shaft and turned up a reamed bush. The outer diameter of this bush was machined to be a running fit in the housing so that it could be fitted using Loctite. This friend then went off on his, no doubt well-deserved, annual fortnight's holiday leaving our hero to fit the bush and complete that aspect of the mechanism. The bush was duly fitted into

the housing and my acquaintance attempted to fit the shaft. To his horror, the shaft was not a running fit in the bush but was in fact quite tight.

What could have happened? Had the bush been machined incorrectly or had it shrunk during or after fitting? After worrying about it for a few days and nearly driving his wife mad he decided to approach me. Could I help? Well, I said I would try and so the parts were delivered to my workshop. A quick check with a micrometer showed that the shaft measured up at 0.750in. within a 'tenth' or two. The bush was reamed to approximately 0.751in. dia. and was a nice running fit on a piece of good quality $\frac{3}{4}$ in. dia. silver-steel. So why would the shaft not fit the hole in the required way? The shaft was mounted in the chuck of my Harrison lathe and set to run as true as possible. A dial indicator graduated in 0.0001in. increments applied to the outer diameter of the shaft then revealed the truth — the shaft was lobed. I cannot remember by how much, but it must have been 0.001in. or so.

Lobate (more correctly termed 'low frequency out-of-round') is a phenomenon sometimes encountered in engineering. It takes the form of a small odd number (3, 5, 7) of fairly regularly spaced undulations which can occur on the outer diameter or bore of a part. Such surfaces can have the rather curious characteristic of being of constant diameter but variable radius. I became aware of this phenomenon while still a very young man. I

needed a $\frac{5}{16}$ in. dia. hole in a piece of steel to take a piece of $\frac{5}{16}$ in. dia. rod. My drill was probably badly sharpened and my 'drill press' was an electric pistol drill held in a makeshift vertical stand. The combination of a poor drill, a compliant set up and incorrect drilling speed resulted in a spectacularly tri-lobed hole which, despite being drilled with a $\frac{5}{16}$ in. dia. drill would not accept my piece of $\frac{5}{16}$ in. dia. steel. I finished up opening up the hole with a rat-tail file!

Problems with low frequency out-of-round can occur on ground surfaces, as was the case with my acquaintance's shaft, but can be much more difficult to spot because of their small magnitude. Because ground mild steel and silver-steel are now quite common materials in the amateur's workshop I thought that some notes on the nature of this phenomenon and its causes may be of interest to readers.

Small change

First, let us consider the nature of low frequency out-of-round in more detail. Please note that during the course of this article I shall refer mainly to odd orders of out of round (3, 5, 7). Faults like ovality (2 lobes) are generally easier to spot with the measuring instruments likely to be available to the amateur and also have different causes. It helps to illustrate these things if you have a model — something you can see and touch. Well, the chances are that UK based readers have an



Although the coin is 1.076in. dia. it will not fit in the bore of the ring but rests in the chamfer formed between the bore and the face.



The coin will fit the bore of the ring if inserted in the manner shown. It was actually a snug fit showing that the ring was bored close to nominal size.

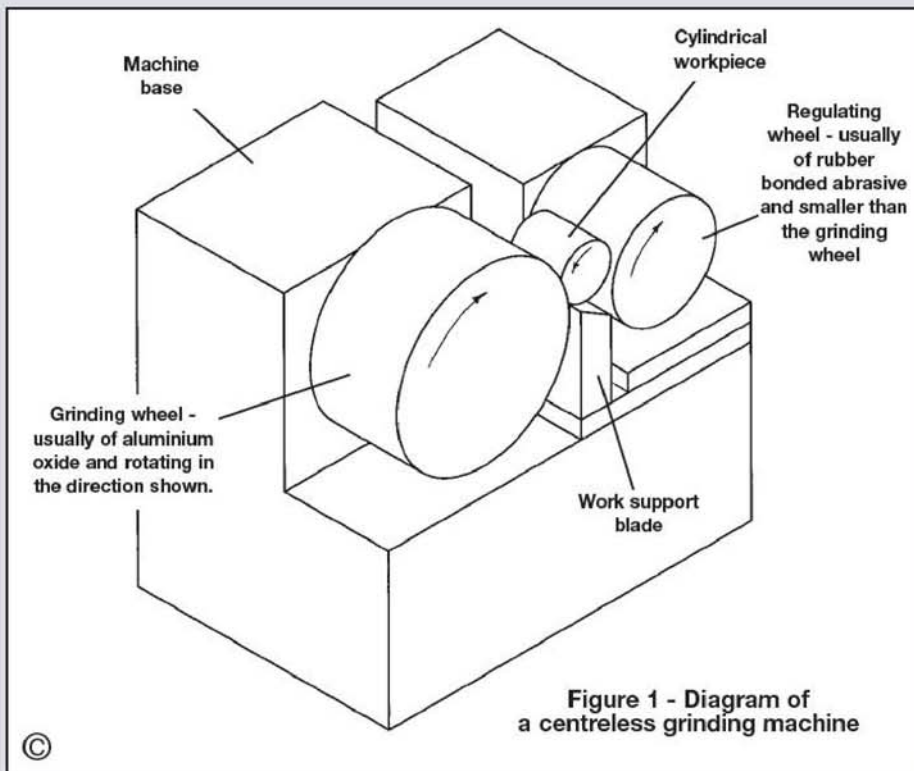


Figure 1 - Diagram of a centreless grinding machine

example of a lobed component in their pockets right now. Have a rummage through your small change and sort out a reasonably new and clean 50 pence coin. A 20 pence coin will also do if you are hard up!

Take your 50p coin and measure across from one of the corners to the opposite curved side. You will probably find that it measures up at around 1.076 inch. However, note that you get the same reading no matter where you take your measurement. Your micrometer or vernier calliper can be positioned anywhere along the curved side and it will register the same diameter. The coin is obviously not round, you can feel the bumps, but your measuring instrument says it is. This illustrates one of the great truths about low frequency out-of-round. You cannot always detect it with a calliper-measuring device. In fact, you can only make a proper assessment of it by rotating the part by means of a true running spindle.

Some will tell you that you can measure it by rotating the part in a V-block. This is only partly correct. The position with V-blocks is as follows:

- 1: V-blocks can give interpretable measurements only when the lobing on the part is regular.
- 2: It is rare for lobing on a workpiece to be truly regular.
- 3: Until you have checked the part the correct way (on a true running spindle) you cannot know whether or not the lobing is regular, or how many lobes there are.
- 4: For every regular lobing pattern and every V-block angle one must use a special multiplier to derive the true out-of-round value from the measured value.
- 5: Without exception, every V-block angle is blind to certain commonly occurring regular lobing patterns.

Implications

Having got that off my chest, let us move on to consider some of the practical implications of low frequency out-of-round. Before you put your 50p piece back in your pocket, try the following test. Make up a little plug gauge with a diameter of 1.076 inch. Turn up a ring to a nice snug fit on

the plug gauge (photo 1). You will find that although your 1.076in. dia. plug gauge fits the ring (photo 2) your 1.076in. dia. coin will not—at least not in the way you would like. (photos 3 and 4). This, of course, is the problem that my acquaintance experienced with his shaft and which I experienced with my $5/16$ in. dia. hole. Parts with lobate might not fit other parts even though they measure up to the correct size.

So, where does this leave the model engineer working away in the privacy of his workshop? The most likely source of problems from lobate is the drilling machine. The textbooks will tell you that you should never open up an existing hole with a two-flute drill. Drill manufacturers make three-flute drills for that purpose. However, I have yet to see anyone with a set of three flute drills, so we all break the rules and use our two-flute drills.

Sometimes, when carrying out this operation, the drill will start to chatter or cause the work to gyrate. If you persevere with the operation you are

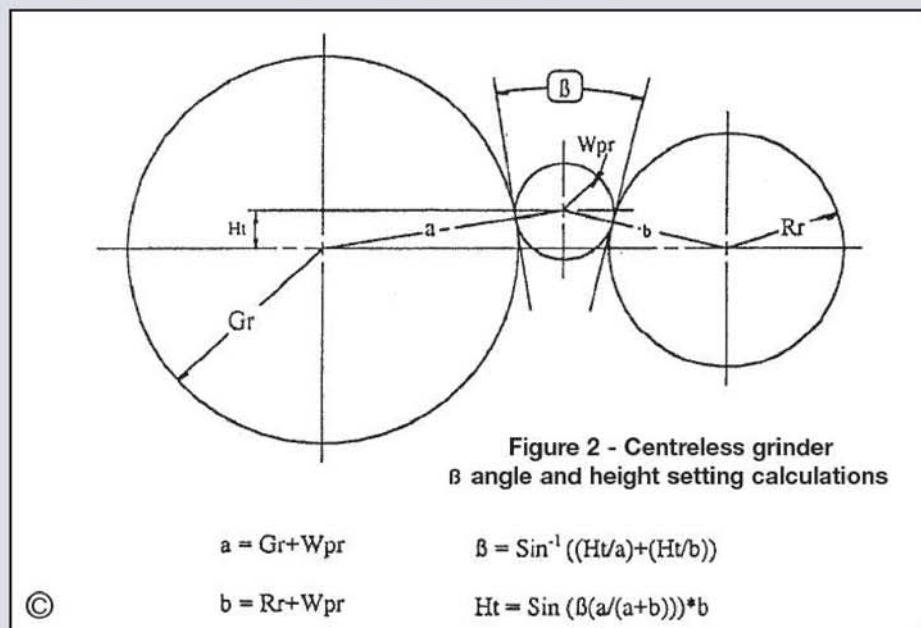
likely to break the drill or produce the sort of hole I made as a youngster. If this problem begins to manifest itself, stop the drilling machine and place a small square of emery cloth, abrasive side down, over the hole (photos 5 and 6). Apply the drill to the cloth back and as it breaks through it will pick up in the hole and cut cleanly (photos 7 and 8). I was shown this dodge by an elderly fitter many years ago and it hasn't let me down yet. Perhaps someone out there can explain to us why it works?

Bell mouthed chuck jaws

Careless use of chucks can cause distortion and a 3-jaw chuck will put three bumps in the bore of, say, a thin ring if gripped too hard. However, you can also introduce out-of-round on the workpiece if your chuck is worn and suffering from what is commonly known as bell-mouthed jaws. A chuck in this condition will not grip bars along their entire length and, as the cutting tool is applied, the workpiece may well start to wobble slightly in the chuck. The amount of wobble will be more when the forces are pushing the bar between two jaws rather than when it is directly supported by one of the jaws. Hence the finished workpiece may well end up with three lobes. If your chuck is in this condition it is well worth putting it right and several letters outlining how have appeared in *Post Bag* in recent months.

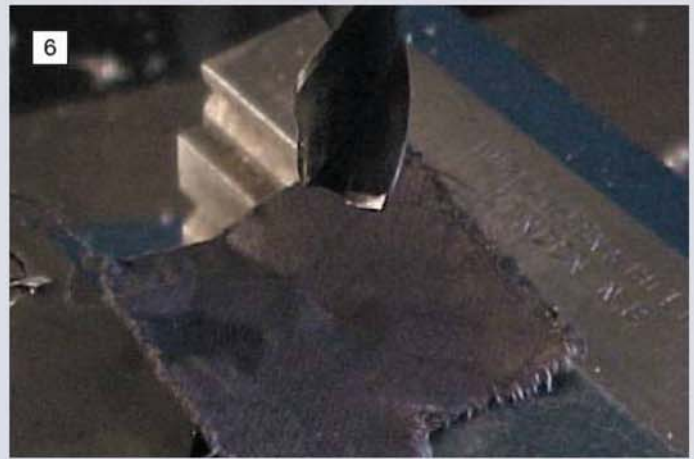
Centreless grinding

Be aware that not all 'precision' ground steel is perfectly round. If obtained from a reliable source it almost certainly will be, but know what to look for if you hit problems. Most precision ground stock is produced on centreless grinding machines. Centreless grinding is one of the darlings of production engineers as it is an extremely versatile and relatively inexpensive process. Centreless grinding can be used for operations as diverse as grinding straight or tapered shafts, grinding anti-friction bearing rings, finishing automotive parts like steering gear ball joints and finishing the bowls used in 10-pin bowling alleys, to grinding the artificial corks now used in wine bottles.





5
A 5/16in. dia. hole has been drilled in a scrap of mild steel bar. It is planned to open up this hole to 1 1/32in. without any special precautions.



6
Before drilling with the larger drill, a square of emery cloth, abrasive side down, is placed over the hole. Worn emery cloth is perfectly adequate.

These machines can be used in 'through feed' mode for long shafts or 'plunge' mode for form grinding complex shapes onto relatively short items. If correctly set, the process is fast, precise and accurate. If not correctly set then it can be a real headache. In short, when it's good it's very good, but when it's bad it's horrid!

Figure 1 shows the layout of a typical centreless grinder. I have chosen to use a diagram to illustrate the machine as a photograph wouldn't be particularly helpful. It would tend to show acres of guarding and other features like wheel dressers that would contribute nothing to the present discussion. However, please be aware that the diagram is a simplified one and that production grinders of this type are adequately guarded and rather more complex than shown.

I don't know how the centreless grinding process evolved but it was certainly in use in pretty much its present form by the 1920s. It is possible that it developed from earlier techniques used to finish the outer diameters of gun barrels. The points to notice are the position of the workpiece in relation to the grinding wheel and the regulating wheel. As the grinding wheel cuts into the work it tends to spin it up to the same speed. This effect is resisted by the regulating wheel, which is usually made of a rubber bonded abrasive and regulates the speed of the work — hence its name. The regulating wheel removes no stock but bites into the work and stops the latter running up to grinding wheel speed.

It was soon found that the work blade needed to have an angled top — 30deg. from the horizontal

being the best choice. This gives good rounding-up capability and enables a relatively rough and uneven part to go into the machine and come out smooth and round, the shape being generated by the geometry of the set up conditions alone. For best results the workpiece is usually above a line drawn through the centres of the grinding wheel and regulating wheel. The amount above is fairly critical and was traditionally established by trial and error. It was found that the height of the workpiece above the centre line of the wheels depended upon the workpiece diameter but was more critical for small parts than big ones. Good setters knew what to look out for and could get things right by virtue of their experience.

Of course, the trial and error approach to setting cried out for an analytical approach and much work was done during the 1960s and 70s to optimise the set up conditions. This resulted in the concept of the β angle being introduced and is as defined in fig 2. It is basically the angle subtended by the tangents drawn through the contact points between the grinding wheel and workpiece and the regulating wheel and the workpiece. For best results β needs to be set to approximately 6-8 degrees. Any larger and you will promote high frequency out-of-round on the work (chatter), any smaller and there will be an increased risk of our old friend lobe.

Other conditions of stability are possible but are not so reliable as those given. Grinding wheel to work speed ratio should be held to approximately 130:1. If the work goes faster then it may

produce chatter and if slower (you've guessed it) lobe. There are a number of other setting which are important on a machine of this type but those specified above are the main contributors to good roundness. It goes without saying that the grinding wheel must be trued, sharp and balanced and the regulating wheel true running.

You can see that setting a centreless grinder is a balancing act. Get it right and the process is a good servant. Get it wrong and it will make bad work. I realise that the average model engineer is unlikely ever to be required to set his own centreless grinder, but having a knowledge of some of the engineering practices going on around him or her might be useful. After all, like my acquaintance, you may one day encounter a shaft that won't go into a reamed hole and might want to know the reason.

Rogue piece

I regret that I don't know what became of the piece of ground shafting that prompted me to play detective. It was rapidly taken from me and the owner scurried off to find something more suitable. In my experience such pieces of material have a nasty habit of turning up at club 'bring and buy' sales. It is not for using, it is for buying and selling and may change hands several times before someone takes pity on it and turns it into something useful. If you happen to see a piece of 3/4in. dia. ground bar at your club sale then hesitate before you buy it — it may be the 'rogue' piece referred to in this article. 



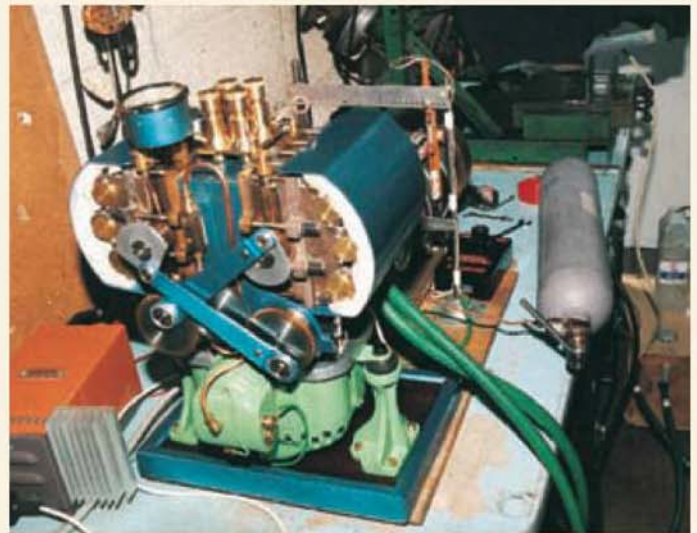
7
The emery cloth starts the drill centrally in the hole and both lips of the drill are cutting evenly. The vice/work is/are clamped before finishing the hole.



8
The finished 1 1/32in. dia. hole is clean and true without lobes or chatter. The bright ring round the hole is caused by the initial rotation of the emery cloth.



The author testing his engine in his workshop. The engine is the Mk. 2 version, the description of which commences in this issue.



The Mk. 2 engine on its test bed with some of the instrumentation built by the author to develop its potential.

A BURNT AIR ENGINE

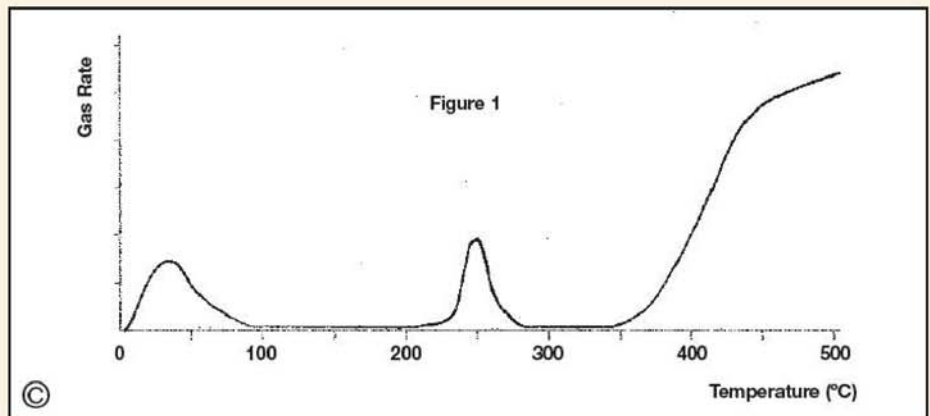
Frank Taylor

begins work on his Mk. 2 engine with the crankshaft and crankcase.

●Part II continued from page 171
(M.E. 4176, 23 August 2002)

After being struck down by the failure of the Mk. 1 engine, Mk. 2 suffered a slow and shaky start. However, all fancies were left behind and the real thinking began. All I needed was a good set of displacers to match the cylinders. The following ideas were floated:

- 1: I have never liked the idea of putting hot gas into a cold cylinder, which seems to be the usual practice, so this would be avoided if possible.
- 2: It would be very nice to have a fully rotary type of displacer but if not, a semi-rotary displacer would be used. This could provide good turbulence and heat exchange. If mounted above the cylinders it would be easy to provide both heater and cooler with direct access to the cylinder.
- 3: Electric heating and water-cooling would be retained as it offers ease of measurement and control.
- 4: The cylinder would run at a temperature approximately halfway between that of the heater and cooler and the maximum temperature of the heater would not exceed 220deg. Celsius.
- 5: Oil would get into the displacers and the bearings in the displacers would need lubrication. The consequences of this could be very dangerous and thus would prevent the use of air as a working medium. I did not like the idea of buying carbon dioxide or helium and chose to burn the oxygen out of a quantity of air and bottle it. There would also be additional safety by working the heater at a relatively low temperature; the background to this may be found interesting. It appears under the next heading.
- 6: After a lot of my up-a-bit, down-a-bit mathematics, a figure of 2.3 was arrived at for the compression ratio.



That was about as far as it was thought through in the beginning; the rest was worked out as I went along.

Oils and hydrocarbons

May I say at the outset that I am not suggesting anyone should try out the experiment described below. The results are given here as they are relevant to my decisions.

A small quantity of lubricating oil, cooking oil or polythene is placed in a retort with precise thermostatic temperature control and the gaseous products from that retort piped away so that they bubble under water. If the temperature is raised slowly in small increments and the bubbles of gas observed, one will observe that the volume of gas approximates to the graph shown in fig 1.

Immediately heat is applied, a few bubbles of gas will be evolved due to expansion of the air. At a temperature of approximately 100deg. C, these die away and nothing seems to be happening. At around 240deg. C there is a fairly fast but short-lived delivery of gas. The hydrocarbon is oxidising and consuming the oxygen in the air. Again nothing seems to be happening.

At 400-450deg.C, gas delivery begins again and increases as the temperature rises and will probably be accompanied by light fraction liquids which float on the water. These are volatile and inflammable so *please do not try it out*. The bond structure of the hydrocarbon is breaking

down and this is known as *cracking*.

If the method previously described is repeated, but with the retort filled with burnt air instead of normal air, the second peak of gas does not occur.

Gaskets, O-rings and the like can work at somewhat higher temperatures in the absence of oxygen, and the dangers of ignition are eliminated. This aspect means that my engine would not meet the safety rules for Model Engineer Exhibition Competition however, in my opinion, it meets the spirit of the rules which wisely legislate against hazards.

Crankshaft

It seems that most engine constructors start by machining the crankshaft. Why this should be I have no idea, but I started in the same way. The shaft is made of EN8 steel or whatever is the modern equivalent. This is a tough material but it machines just like free cutting mild steel. When K. R. Whiston was trading he was always waxing lyrical about EN8 and I thought it was just that he had a lot to sell. In time I learned that all that he said was true; alas, it's too late now to buy up a good stock from this source.

Photograph 8 shows the nearly complete crankshaft. Each crank is individually balanced as near as I can calculate. The end discs containing the drilled crank centres will be removed leaving only the shaft centres when all the finishing is complete.



8
The finished crankshaft for the Mk. 2 version of the engine. The chosen material was EN8, a tough steel but one which is easy to machine.



9
Drilling an oil way through the crankshaft web to link up with an axial hole drilled through the non-drive end of the crankshaft.



10
Using an extension drill to axially drill the crank pin nearest the drive side of the crankshaft. Redundant holes were plugged with grub screws.



11
Drilling the oil way in the thick central web of the crankshaft at a pre-determined angle on the vertical slide.

An enquiry in *Post Bag* some time ago enquired how high pressure oil was delivered to the big end bearings of a crankshaft. In this engine, oil at 40psi is fed to the non-drive end main bearing which has an internal groove aligned with a hole in the shaft journal. Oil enters the crankshaft and travels its entire length to the drive end main bearing, visiting the big ends on the way.

The following photos show how the shaft was drilled. Photograph 9 illustrates how first the non-drive end main bearing journal (foreground) was drilled to halfway through the crank web. The nearest crank journal was also drilled to the next web. This hole can be seen in the photograph.

Drilling the web edgewise, shown here, connects the two previous holes together. The holes were tapped and plugged. This process continues.

Photograph 10 shows how an extension drill was needed to drill the drive end crank. Photograph 11 shows how drilling of the thick centre web was done at an angle, previously calculated and set on the vertical slide.

Aluminium castings

The making of the main and sump castings was described in *M.E.* 3778 and 3819 (6 June 1986 and 19 February 1988 respectively). At the end of this activity I had two sets of castings, one to

use and one as a spare in case of mishap.

Photograph 12 shows the crankcase castings arranged to display top and bottom views. Photograph 13 shows the sump arranged in a similar manner. Note the large square protrusion at the bottom of the sump provided to make holding for machining easy.

Before describing any assembly or construction I think it is always a good idea to show what is to be constructed and for this reason I offer the following two photos. Photograph 14 shows most of the work on the crankcase completed. The assembly is standing upside down on its four cylinders and the four connecting rods fixed to the two yokes are visible.



12
The crankcase castings (one to use and one spare) prior to machining and arranged to show the inner and outer surfaces.



13
The two sump castings. One (left) is showed machined and the spare (right) in the 'as cast' condition. Note the square protrusion for fixturing.

14



The crankcase assembly shown upside down and in virtually complete form. The protuberance in the foreground is the oil management system casting.

15



A close up of the big end and yoke assembly. The connecting rod to yoke bearings are hardened steel running in hard bronze bushes.

At the centre point of the yokes are four aluminium alloy blocks which will eventually run in harden steel slides in the sump casting. The oil management casting is fixed in place and can be seen in the foreground. On the gasket face close to this casting there is a black O-ring seal for the suction line running from the sump to the oil pump. The pipe fitting (immediate foreground) carries away the spillway oil (oil released by the pressure regulator) to lubricate the drive shaft axial seal.

Photograph 15 gives a good view of the big end and the geometry of the yoke.

The connecting-rod-to-yoke bearings are hardened steel running in hard bronze. These bearings have very little rotational work to do as the connecting rod almost goes straight up and down which is a feature of this type of drive. The $\frac{3}{8}$ in. thick case and the multitude of screws were built for high pressures but this has turned out to be a bit of over-kill. However, as it is a casting and homemade at that, better to be on the safe side.

Machining the crankcase

At this point I had no milling machine and all the work had to be done in the lathe. It is a salutary exercise to have done some of the work this way, providing as it does, a better understanding of the problems of others with limited equipment.

Photographs 16 and 17 show the gasket face, which forms one of the datum faces, being fly-cut. I had previously decided that the casting could be machined on the lathe but it would be a close thing. Photograph 17 shows just how close, with the casting hanging over the end of the cross-slide. The 10in. dia. faceplate was used and the fly-cutter had to turn in the gap. This was when I first realised the value of that lovely long cross-slide and, as time went on, this was to repeat again and again.

Photograph 18 shows a boring operation on

the crankcase. It was no accident that the crankcase was at centre height, which made this operation easy. When first setting up the casting there it had to be positioned so that all future machining would fall within the bounds of the metal and no reliance placed on casting squareness or parallelism. Failure in this respect would mean that sooner or later one is trying to cut fresh air. I know this for sure because I have done it!

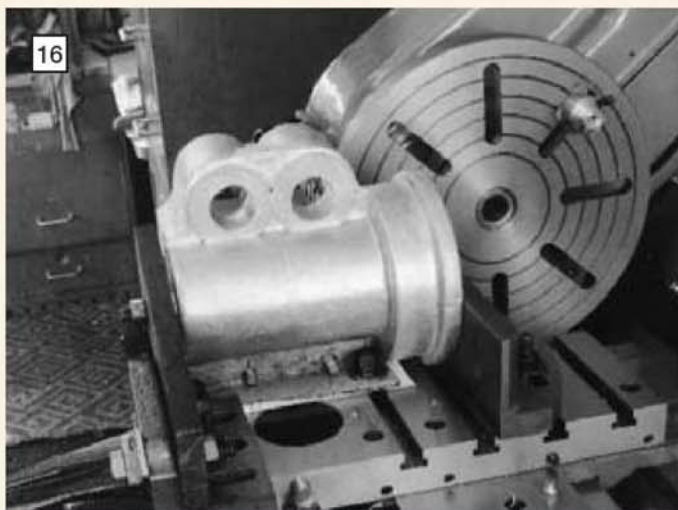
Fortunately for me it was on a relatively simple casting. The boring head to be seen was made

from another old lathe slide, half a Fiat car universal joint plus an extension for the tool. The head has a wonderful range but it does tie up my 7in. dia. face plate. As for my head (the one without hair), it is screwed on with a Whitworth thread. The old lathe slide had a metric thread so I divided up the dial into $\frac{1}{40}$ mm increments and think of them as thousandths of an inch until I get close to size.

Here the large hole for the main bearing housing is being bored out. This housing is large enough to allow the crankshaft to be inserted from this end and to allow the boring head to reach through the crankcase and bore the far end main bearing seat in line. After this the flywheel housing gasket face was cut, thus forming another datum face.

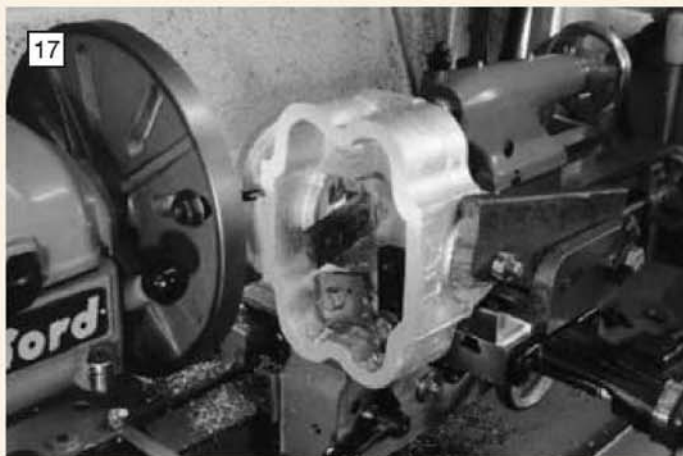
●To be continued.

16



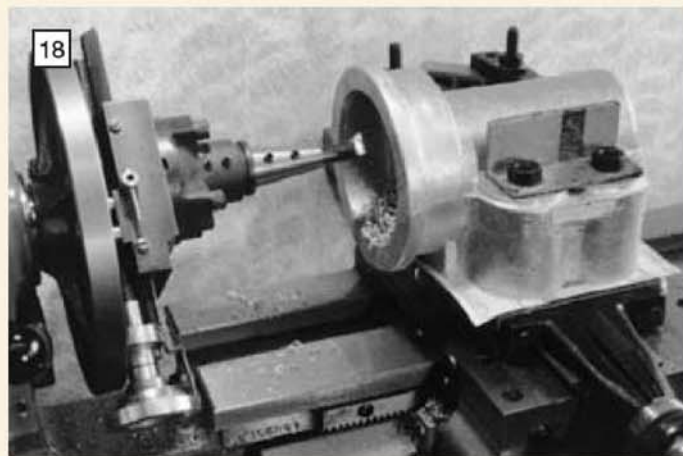
Fly-cutting the gasket face of the crankcase. The work piece is mounted on the cross slide of the lathe and the cutting tool on the 10in. face plate.

17



Another view of the fly-cutting operation on the crankcase but this time from the other side. Note the work fixturing arrangements.

18



Boring the hole for the main bearing housing. The boring head is a homemade device mounted on the 7in. dia. lathe face plate.

A green hand-cranked mechanical device, possibly a small pump or generator, mounted on a wooden base with wheels and a black handle. The device has a green cylindrical top, a silver-colored crank handle, and a large silver-colored flywheel. It is mounted on a wooden base with two large, dark, circular wheels. A black handle is attached to the side of the device.

●Part II continued from page 187
(M.E. 4176, 23 August 2002)

Anyone with experience of machining aluminium alloys will be aware that they can be awkward materials owing to the way they build up on the edges of cutting tools. The only way to avoid this is to use a really sharp tool and an appropriate cutting fluid. Most modellers have discovered that white spirit or paraffin are suitable, but as already observed, the use of such substances require all due precautions to be taken to guard against the accompanying hazards of fume and fire.

Three holes pass right through from one side to the other; these were made while the casting was set up for machining the large diameter hole. It would not have been possible to drill them from the other. Neither was it practical to use a standard centre drill to start the holes, so a length of bar stock was drilled to accept a centre drill which was secured in place using retaining compound (**photo 9**). An ordinary drill was used to make the holes (**photo 10**).





3
A hole on one side of the crankcase gives access to the crankshaft and main bearing.

There was also a small slot designed to retain oil around the crankshaft bearing. The obvious way to cut this would be by using an extra long series slot drill, something which few potential builders are likely to have to hand. It would not be difficult to make a suitable single point cutter from a piece of silver-steel, or alternatively to extend a $\frac{1}{8}$ in. dia. slot cutter in a similar manner as was done with the centre drill. However, some may see this as rather a waste of an expensive slot drill, so I decided to cut my slot by simply drilling a small hole and then converting it into a



4
A view of the timing side of the crankcase casting. All the castings were of excellent quality.

slot by the careful use of a sharp cold chisel. This method may not have provided the neatest result, but it is effective and is out of sight.

The casting was turned over to machine the inside diameter of the smaller of the two holes (photo 11). It was again necessary to retain the set-up while the flat step inside, to which the cam and followers are bolted, was milled. This operation was straightforward enough, but it is worth pointing out that the use of a long series cutter will improve visibility; a standard length cutter makes it difficult to see what's going on.

This recess needs to be very flat and so the cutter feed rate should not be too fast. The rest of this circular recess also needed to be cleaned up and just a touch of material removed in order to bring it to the correct depth. Here again, if one is available, a boring head can be used, but it is a very time consuming operation; it is just as well to use an ordinary milling cutter to hack out as much material as possible. The end result was a bit of a mess so, to obtain a nice flat surface, I made a small grinding disk fitted with a piece of abrasive paper held in place using double sided adhesive tape. The outer diameter matched that of the recess, and it was simply a case of lowering the disk into the hole and letting the abrasive do the work.

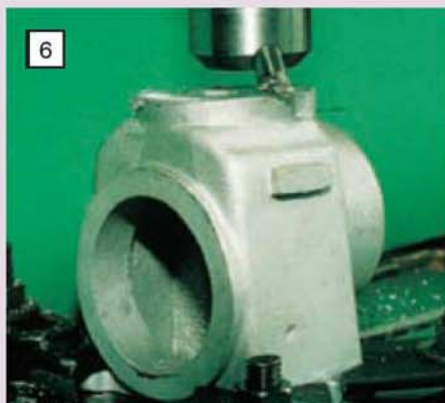
Two further holes, tapped 7BA, are required within the rectangle; these should not cause any difficulty as there is room to use ordinary drills and taps.

Finally, before putting the casting away to get on with another part, the two $\frac{3}{16}$ in. dia. holes in the top that are used as tappet guides were drilled at this stage. None of the other holes were made, as they can be matched from other parts later.

● *To be continued.*



5
The crankcase casting is clamped to an angle plate to machine the base flat by fly-cutting.



6
With the crankcase casting clamped to the table, the machined top will be parallel to the base.



7
Without disturbing the previous set-up, the hole in the crankcase top was then bored.



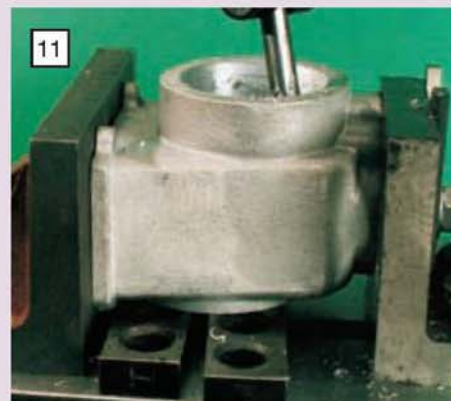
8
The large crankcase access hole was bored with the casting again clamped to an angle plate.



9
The special extended centre drill made by Loctiting a standard centre drill into a length of silver-steel.



10
After spotting, the three holes were drilled using standard drills which were long enough to reach.



11
The timing gear cavity was bored using a similar set-up as previously.

Keith Wilson

continues with further details
of boiler fittings.

●Part XXX continued from page 191
(M.E. 4176, 23 August 2002)

Our water gauge may look a bit tricky or complicated at first, but the number of bits is roughly the same as the older version, and the overall result is neater. The only snag is that not being a precision product, $\frac{1}{4}$ in. gauge glass can be over $\frac{9}{32}$ in. diameter. Suppliers can however generally be persuaded to supply some 'miked' lengths between 0.245 and 0.260in. diameter, and this works very nicely.

The glass is inserted through the top fitting (as if this isn't obvious) and is best lubricated by saliva before inserting. It is an advantage to round off the downward edge (use a fine grindstone or slipstone) to aid insertion through the O-rings.

The main part can be turned from $\frac{7}{8}$ in. dia. brass bar, or built up as shewn; it is a matter of personal choice as to the relative values of turning much brass to waste, or the slight extra work of silver-brazing two bits together. Since there are several other bits to silver-braze, the choice is yours. In my case, having four sets to make, the thought of using up a couple of feet of 1in. brass proved less attractive than a bit of simple mass-production.

To get the mounting holes correctly spaced, a simple jig will serve also to locate the necessary tapped holes in the backhead bushes; it can be made from a strip of $1 \times \frac{1}{8}$ in. steel about 4in. long. Incidentally, the full-size gauges were attached with 5 studs; the trouble is, one on each portion would be semi-hidden behind the fittings themselves. Access for dealing with these nuts is bad enough as it is; there's no point in extra complications.

The two caps which hold the O-ring seals are soft-soldered onto their bits. If plumber's solder is used, this doesn't soften or lose strength seriously until the temperature corresponding to 150psi. is reached. It would be theoretically possible to machine this assembly (the bosses holding the seals) from solid, but recollecting that the $\frac{1}{16}$ in. deep slot would have to be machined with a special boring tool that would in turn pass through a hole a fraction over $\frac{1}{4}$ in. diameter, the idea may lose some of its charm!

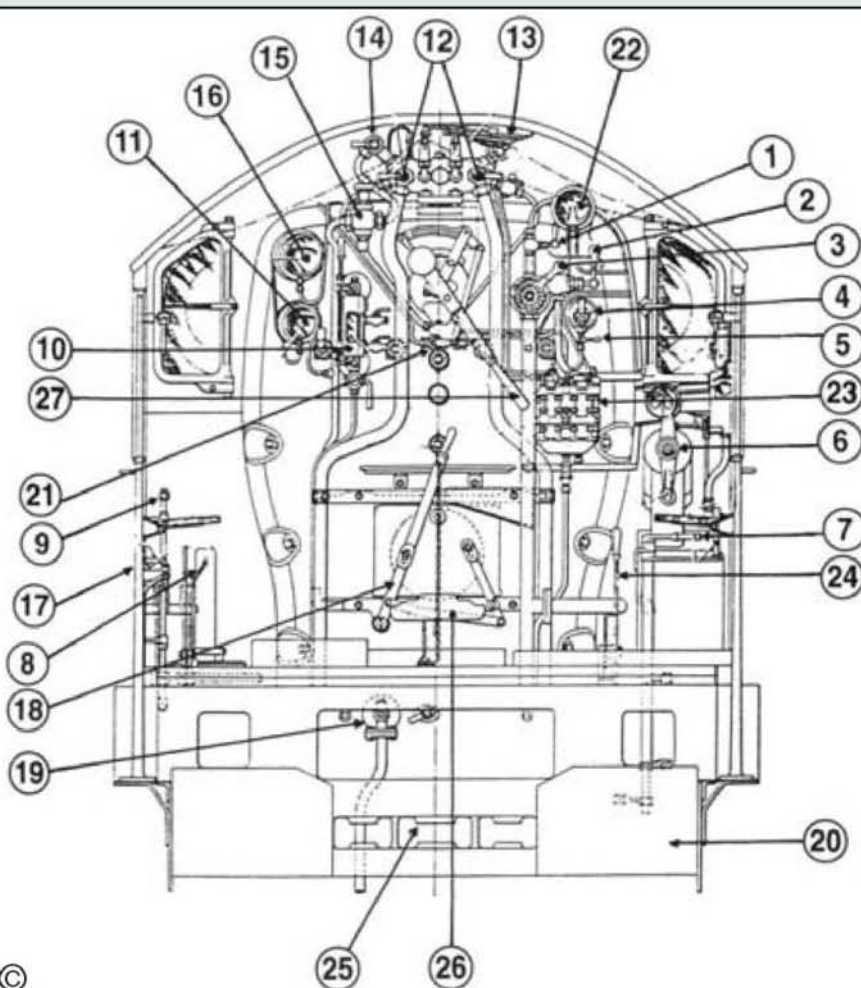
Blastpipe and jets

The blasting on this locomotive (apart from that arising when you or I have made an error) is sturdy, a useful attribute when cleaning tubes and smokeboxes generally. The main part is a casting, and needs very little machining. Only the top and the base need facing, exact length not critical. It's not very easy to mount in the lathe, but mounting small-end first in the 4-jaw chuck may help. A temporary bush to accommodate the 'revolving' centre in the tailstock will help, but treat it carefully and take light cuts; it would the very deuce to re-set. A possible way of dealing with the other end is either to use the 4-jaw chuck again or clamp it to the faceplate.

Treat decimal dimensions with a pinch of proverbial salt. Bolt it to the top of saddle casting with 4 off 2BA studs and nuts — domed brass

SAINT CHRISTOPHER

A GWR LOCOMOTIVE for $7\frac{1}{4}$ in. gauge



Layout of a Great Western 'King' class footplate

- | | | |
|-----------------------------|-------------------------------------|---|
| 1: Small ejector | 10: Water gauge | 19: Blowdown valve |
| 2: Large ejector | 11: Carriage warming pressure gauge | 20: Intermediate buffing gear |
| 3: Vacuum brake | 12: Injector steam spindles | 21: Lubricator jigger valve for regulator |
| 4: Blower valve | 13: Lubricator condensing coil | 22: Vacuum brake gauge |
| 5: Lubricator warming cock | 14: Carriage warming cock | 23: Lubricator |
| 6: Reverser | 15: Carriage warming regulator | 24: Cylinder drain cocks |
| 7: Sanding gear | 16: Steam pressure gauge | 25: Drag box |
| 8: Damper controls | 17: Slacking pipe control | 26: Firebox door flap plate |
| 9: Exhaust injector control | 18: Firebox door handle | 27: Regulator handle |

nuts on bronze studs are recommended; removal is then less of a problem, although fairly rare.

More interesting items are the blast nozzle and jets, which are mainly plain lathe jobs. Although I have not shewn it here, a good plan is to make the actual nozzle somewhat larger than shewn, tap it $\frac{3}{8}$ in. x 32TPI, and have three or four spare inserts with different bores. On testing the locomotive, choose the biggest that will make steaming easy. By making the threaded portion of these spares

fairly long, a certain amount of vertical adjustment is possible. A double taper is suggested, narrowing to a choke and then expanding again. Useful.

In theory, the little jets could be drilled into the body instead of being separate screwed-in items, but there are certain advantages with separate jets. As you will find out, a thick oily sludge soon builds up in this area and a primus pricker is far easier to use when you can see where to start. As an additional check, the holes are No. 72, which is

Use care when silver-brazing this unit together, the bits are thin and could easily melt, which would not exactly aid peace of mind or language. Bolt to column with brass domed nuts and studs. Connect to the hollow stay with a $3/16$ in. pipe. Although short, a certain amount of fluid friction is set up by a $5/32$ in. pipe, which might at first



Standard Handle —

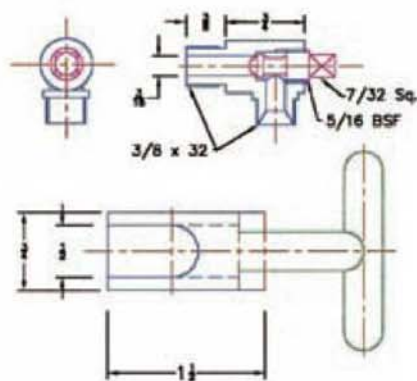


Otherwise As Pipe Type

These dummies are side by side on 7/8in. centres. In full size, they were usually held by their steam pipes, but occasionally with a stem going down to the whistle shield — a piece of metal bent to guide escaping steam up over the cab roof.



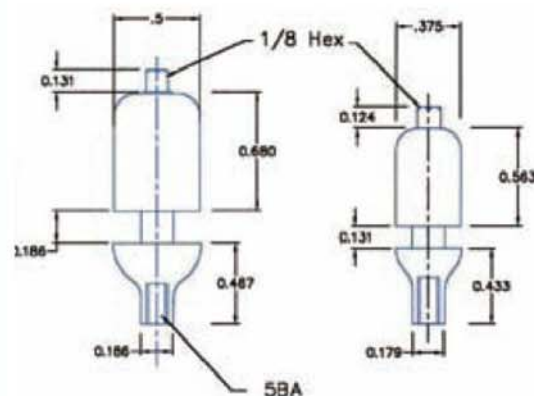
Tricky to install for there is not too much room, these items are very simple but useful. Not only must they clear the frames, but also avoid



© **BLOWDOWN VALVE AND KEY**

controlled by a chain. Its purpose was to aid the fireman in keeping up pressure, for during firing it could be easily pulled open and pushed shut (by the shovel) between successive shovelfuls of coal when a bout of firing was in progress, the main doors could be shut.

Much depended on how well the engine



© **DUMMY WHISTLES**

Firedoors

Dear old Curly never liked this type of firedoor; I fear this may well have been because he didn't think of the cure for jamming on stray bits of coal himself. However, someone else — I know not who — thought of a cure, that of cutting away part of the runners.

Another good way is to invert the lower guides, that is to put the slot on the bottom of the doors and have the guide runner as a single strip with no groove. I haven't used this method yet, but see no reason why it shouldn't work.

The two runners are slitting-saw jobs, presenting no great difficulty. Use brass or steel, it doesn't seem to make much difference but brass levers aren't over-strong and ham-fisted operation may fracture the large one.

The profile of these items is fascinating, for us it is a case of copying a forging probably pressed into a die — I know not. The easiest way of making the joint 'twixt levers, runners and link is to use 3/32in. rivets, preferably drilled through the end (using something like No. 60 drill) and fitted with a washer and split pin. I don't know the minimum size of split cotter available, but it isn't exactly difficult to hammer a bit of 10A fuse wire flat and bend it to shape.

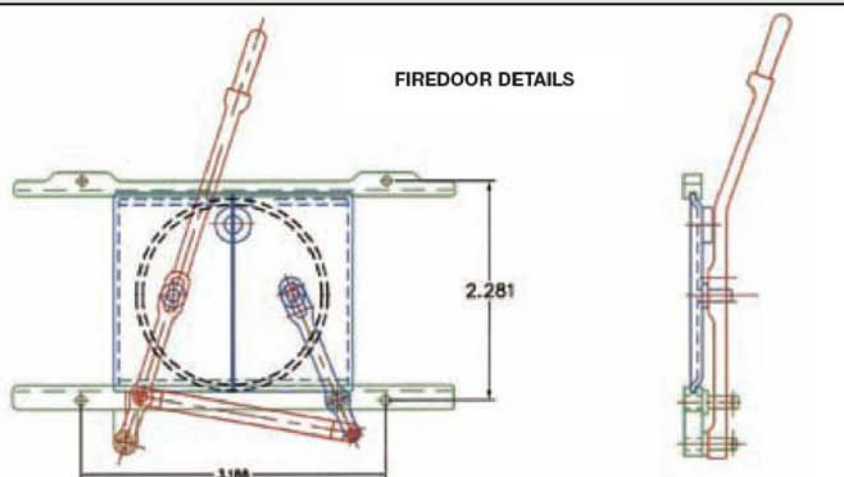
The doors themselves are knocked up from 18swg metal over a former. It makes sense to make this former about 1/4in. wider than needed and part the doors later, trimming them to size accordingly. The central pins and pivot pins should be stainless, silver-brazed into the doors and runners.

The full-size doors were cast iron, hollow, with an opening on the 'away' side at the bottom, and the side nearest the boiler at the top. This permitted — nay encouraged — a flow of cooling air through into the firebox, for a supply of air over the fire aids proper combustion. The little boss, half in each door. Is in fact surrounding a sighting hole.

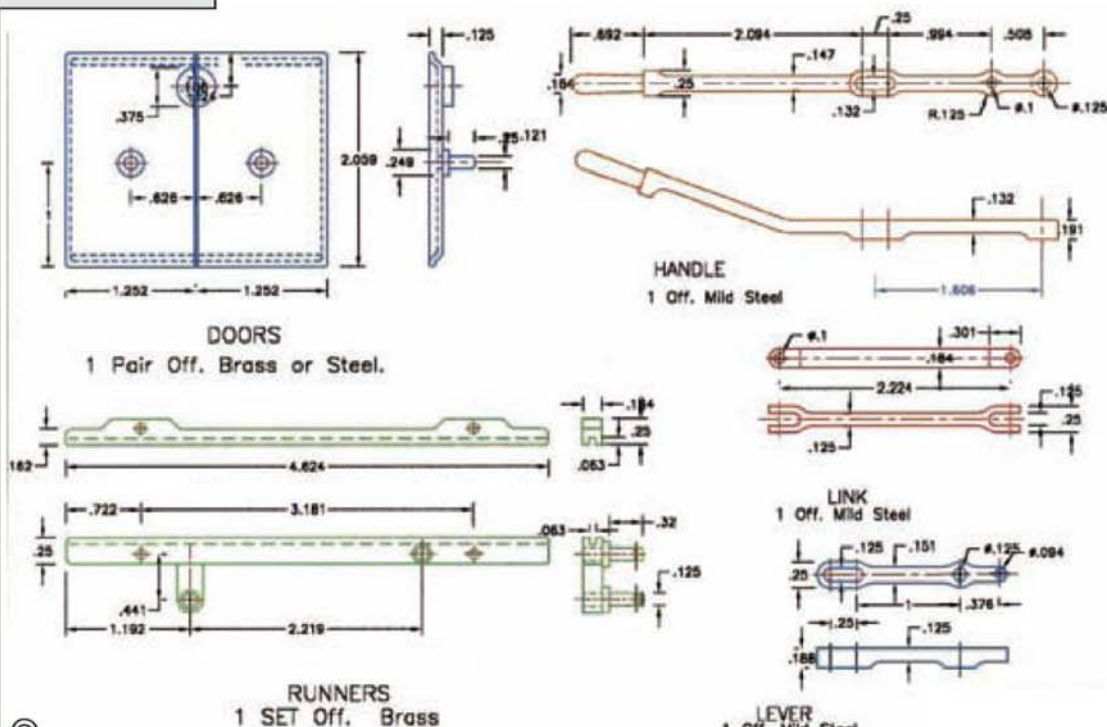
There was an inner door, fairly thin, not fitting the doorhole completely, hinged at the bottom and

were employed, one firing, and the other dealing with injectors and doors. I was on that train, and recollections of the experience are still as green as ever. I would mention that the published logs of the journeys were toned down in places by about 10 miles per hour!

●To be continued.



FIREDOOR DETAILS



©

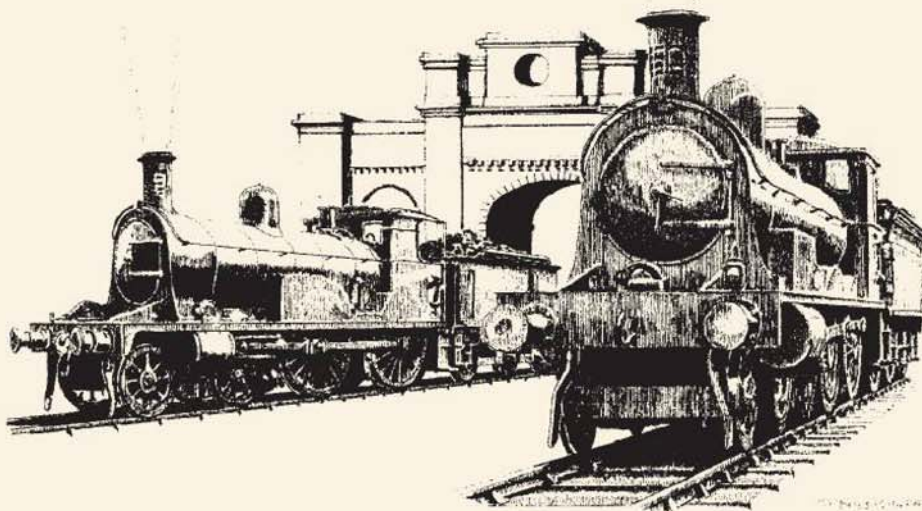
Neville Evans

returns to the smokebox doors and wingplates, and suggests a novel method for making the door hinges before considering the blastpipes and taking another brief look at *Penrhos Grange*.

● *Part IX continued from page 78 (M.E. 4174, 26 July 2002)*

The smokebox door is quite straightforward and the same design of door was carried by both classes of locomotive as built by the Highland Railway. There is however a rather curious anomaly, in that some locomotives, mostly I think 'Lochs', have a large ring on the wing plate, onto which the smokebox door abuts. I include photographs of both types on the locomotives in HR days. As far as the 'Big Goods' is concerned, the LMS seem to have used any sort of door that would fit, without dramatically altering the appearance of the locomotives, apart from the obvious details of hinge length and width. The shorter hinges were certainly used on No. 103, the engine preserved in Glasgow Museum of Transport and Technology. I believe that these were of the Caledonian pattern. At about the same time we see that snap headed rivets were applied to the smokebox edges. I suppose they must have been cheaper than the flush type, although the LNER seemed to be able to use flush rivets almost to the end. Incidentally, I heard the other day from an unimpeachable (though secret) source that GWR actually meant 'Gresley Was Right'. You didn't hear it from me though!

The first problem we encounter is that of shaping the door itself. Keith Wilson suggests you make up a former from steel plate and use it as a guide



THE HIGHLAND RAILWAY JONES 'BIG GOODS' & LOCH 4-4-0 LOCOMOTIVES IN 5in. GAUGE

so that the tool is moved automatically across the work as it is traversed. While I am sure that this is very effective, particularly in the larger scales, I have always contented myself with measuring the angles of the door on the outside and using a series of angular offsets at something like 1deg. intervals, finishing off firstly with a scraper held at right angles to the work, and then smoothish files. I recently tried a diamond impregnated file that I bought at an exhibition. There are three different grades of stone, and I have found that it can remove metal at an astonishing rate without getting clogged up. I also find it useful for lapping lathe tools and general sharpening.

If you cut an accurate former from card or thin plywood, you can offer it up to the door at intervals as a guide.

Smokebox door hinges

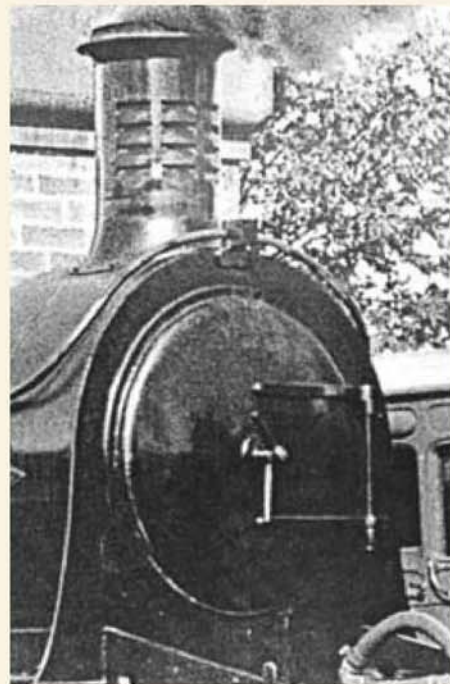
I have always considered that the door hinges are one of the most difficult parts of an engine to get to look right. If they are made to scale they are normally rather flimsy, before they are riveted to the smokebox door. They have to be bent in two planes in order to fit properly, and if you get them even slightly wrong, they look awful. Deryck Goodall, as usual, came up with a bright idea. I have drawn the hinges as machined from a piece of $\frac{3}{16}$ in. steel plate. The $\frac{3}{32}$ in. hole is drilled first, and the block is roughed out as shown. I finished the $\frac{3}{16}$ in. boss on mine and then cut two $\frac{3}{16}$ in. slots in the smokebox door, using a slot drill. I'm sure that everyone has been warned of the dangers of trying to cut an accurate slot with an end mill. Suffice it to say that it will come out oversize.

The door was set on a flat fire brick, the two hinges were inserted and the whole lot was silver-soldered up, using an absolute minimum of filler. I then mounted it back in the lathe, using the spigot as before, and very carefully turned down the hinges, leaving them just over $\frac{3}{64}$ in.

proud of the door. The next operation was to clean up the face of the hinge with smooth files, finishing with fine emery cloth and 'Loybloss'. These invaluable items are a remnant from my motor cycling days. They are hard rubber blocks, which are impregnated with an abrasive. They come in three grades, coarse, medium and fine, and do a wonderful job on steel or indeed any other metal. Buy them from a vintage motor bike emporium or somesuch. They seem to give an ideal finish to con-rods and other such items that mustn't be too shiny.



Smokebox door details of HR No. 17928, one of the Jones 'Big Goods' locomotives.



Smokebox door details of a Highland Railway 'Loch' class locomotive.

The wing plates are made of $\frac{1}{32}$ in. brass, or steel. It would seem, though I am open to correction, that wing plates were meant to brace the running boards/platforms/footplates, call them what you will. They certainly gave the locomotives the air of having outside cylinders when viewed from the front. They were gradually taken off the Highland locomotives that interest us, as they were rebuilt with different boilers. The plates are held onto the footplate with thin $\frac{7}{32}$ in. angle irons. I would think that one of these 'metal centres' that we see in model shops, holding a large selection of mainly brass sections, would hold something that is very close to the ideal.

Blast pipes and nozzles

The blastpipes for both locos are bolted to the floor of the smokebox, which of course is the horizontal stay that sits above the cylinders. The exhaust pipe from the cylinders is pushed up through the $\frac{1}{2}$ in. hole in the stay and the joint between the blastpipe and the stay is sealed with an O-ring. Note that with the 'Loch', which has cylinders parallel to the frames, the whole exhaust assembly is straight and vertical. The 'Big Goods' however has inclined cylinders and therefore there has to be a kink in the exhaust pipe, just beneath the stay. It's all pretty obvious from the drawing. As it is impossible to give accurate measurements for the lower exhaust pipe assembly, I've had to leave the final fitting to the discretion of the builder. When you are satisfied that it all fits, silver-solder the three pieces together.

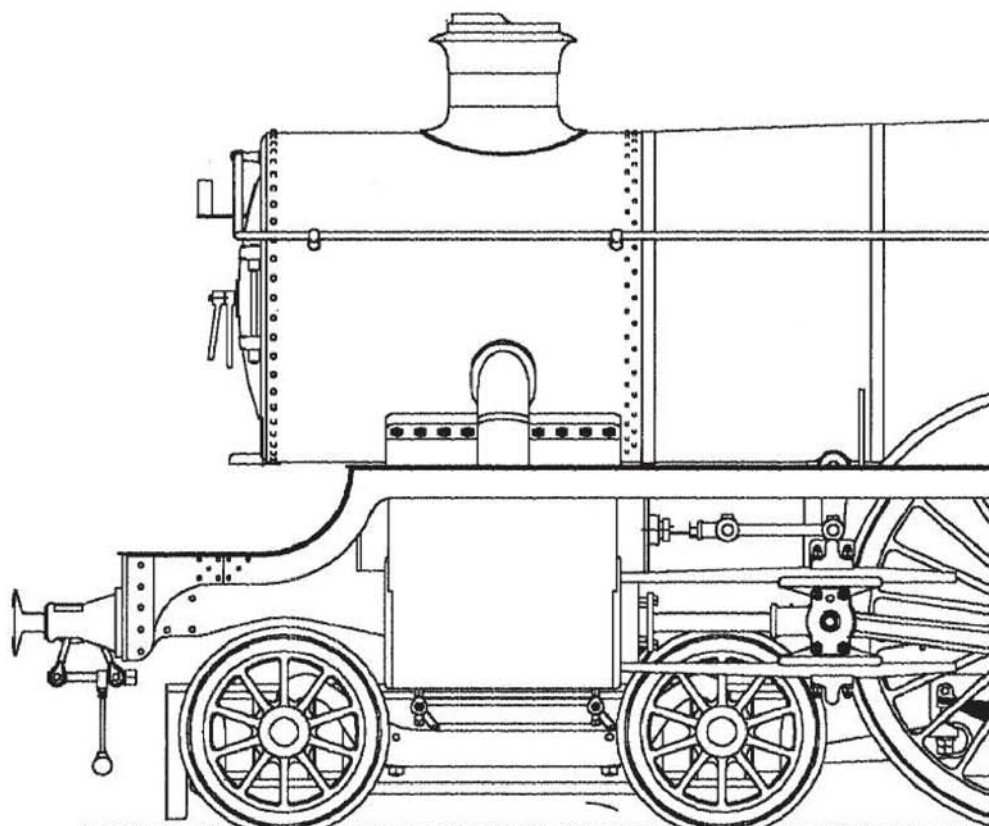
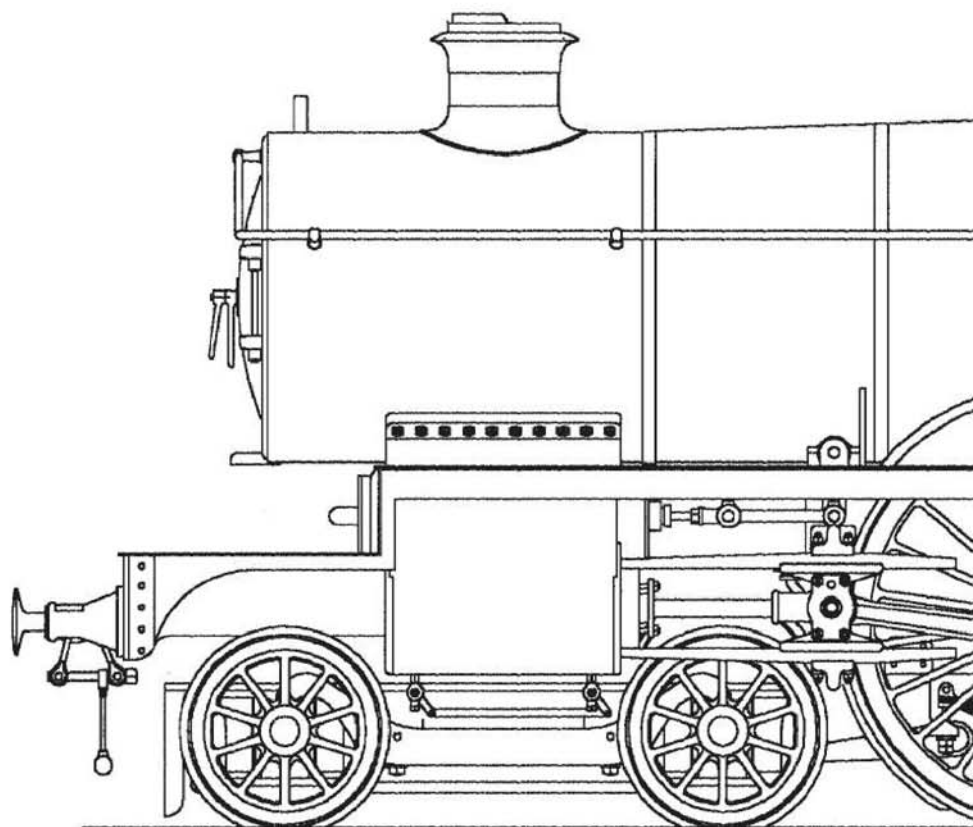
While on the subject of stays, Bob Raffan, who is making great progress with a 'Big Goods', has pointed out that I've used an obsolete drawing of the horizontal stay, which was wrongly captioned. I include a copy of the correct thing with the usual apologies.

Penrhos Grange

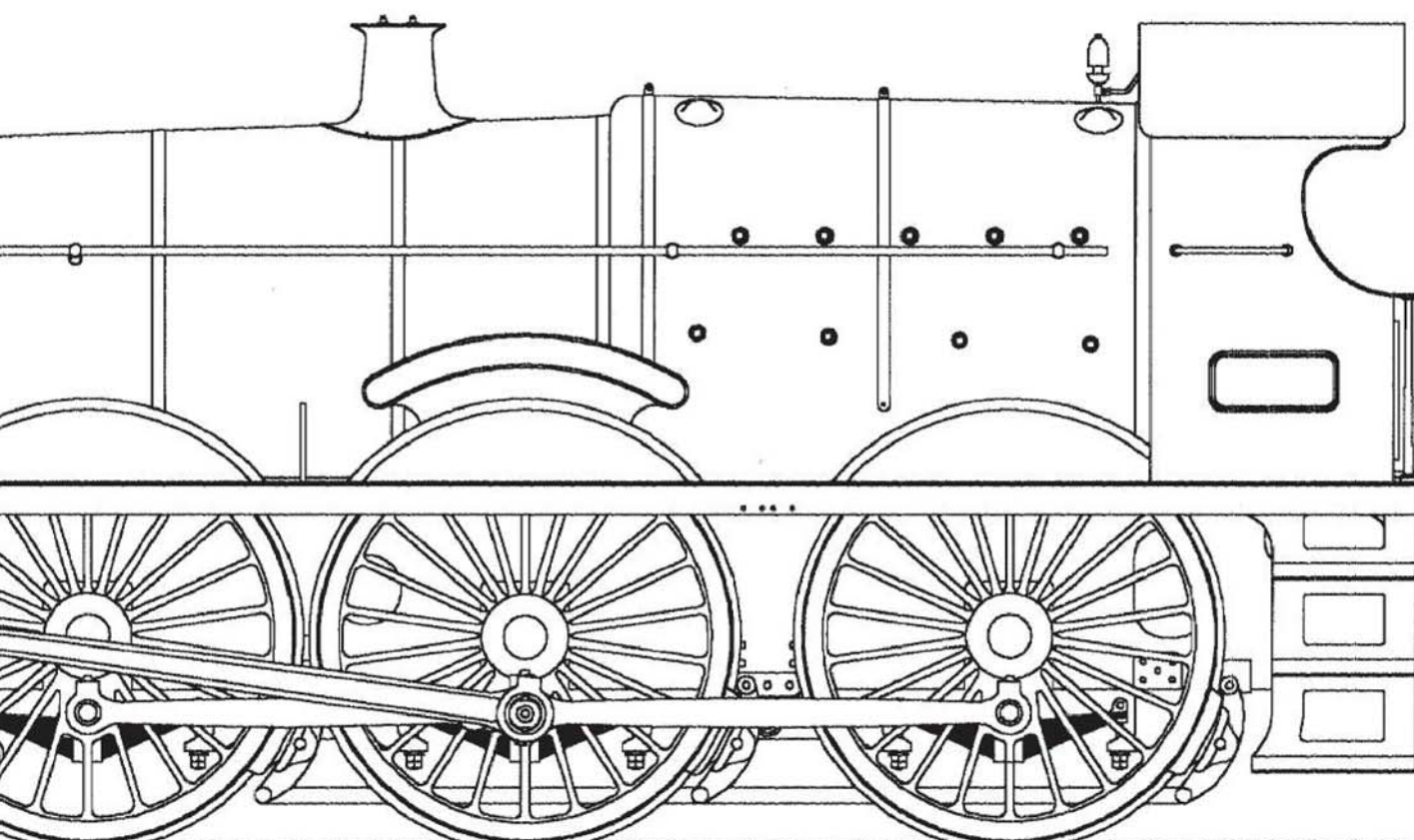
I visited the Bristol club exhibition the other day (time of writing), and as ever was delighted by what I saw. Among the many exhibits were no less than 8 examples of *Torquay Manor* in various stages of construction from bare chassis to finished locomotive. This, and the fact that I've already been bombarded with requests for further details of the 'Grange', leads me to think that it might be as popular as Martin Evans' superb design. The object of the exercise is that prospective builders arm themselves with a set of drawings of *Torquay Manor*, and/or the relevant copies of *Model Engineer* and either use Martin's details complete by way of stays, valve gears, cylinders, etc. or use the slightly amended version that I shall be offering.

While at the exhibition I noticed a small firm that specialises in the manufacture of connecting and side rods, cut on a CNC machine. It struck me that as the GWR 2-cylinder 4-6-0s all used similar rods, and as authentic GWR conrods are very difficult to make, that if the manufacturing technique was slightly changed and if the price was right, there would be a large market for these items. Watch the adverts in the nearest future.

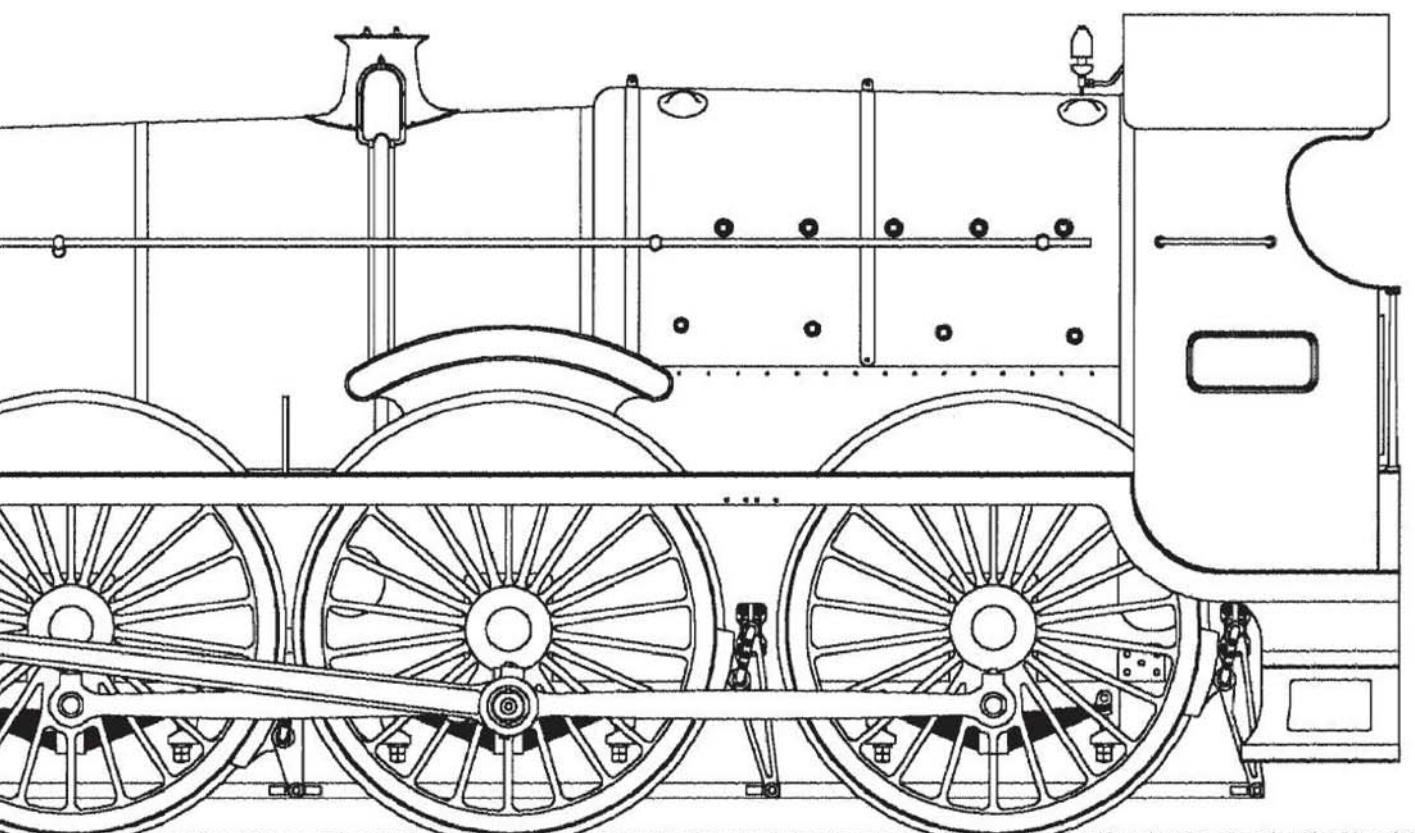
Here for comparison are general arrangement drawings of *Lady of the Lake* one of the early 4-6-0s, and *Titley Court*, one of the last batch of 2900s. These later locos were built with super-heater and top feed and were so different from



©



LADY OF THE LAKE



TITLEY COURT



Smokebox door details of HR No. 103, the Jones 'Big Goods' locomotive preserved and on display in Glasgow Museum of Transport & Technology.



WOM Models in Somerset (call 01458-831565), displayed some examples of their CNC rods at the recent Bristol SMEE ME & Hobbies Exhibition.

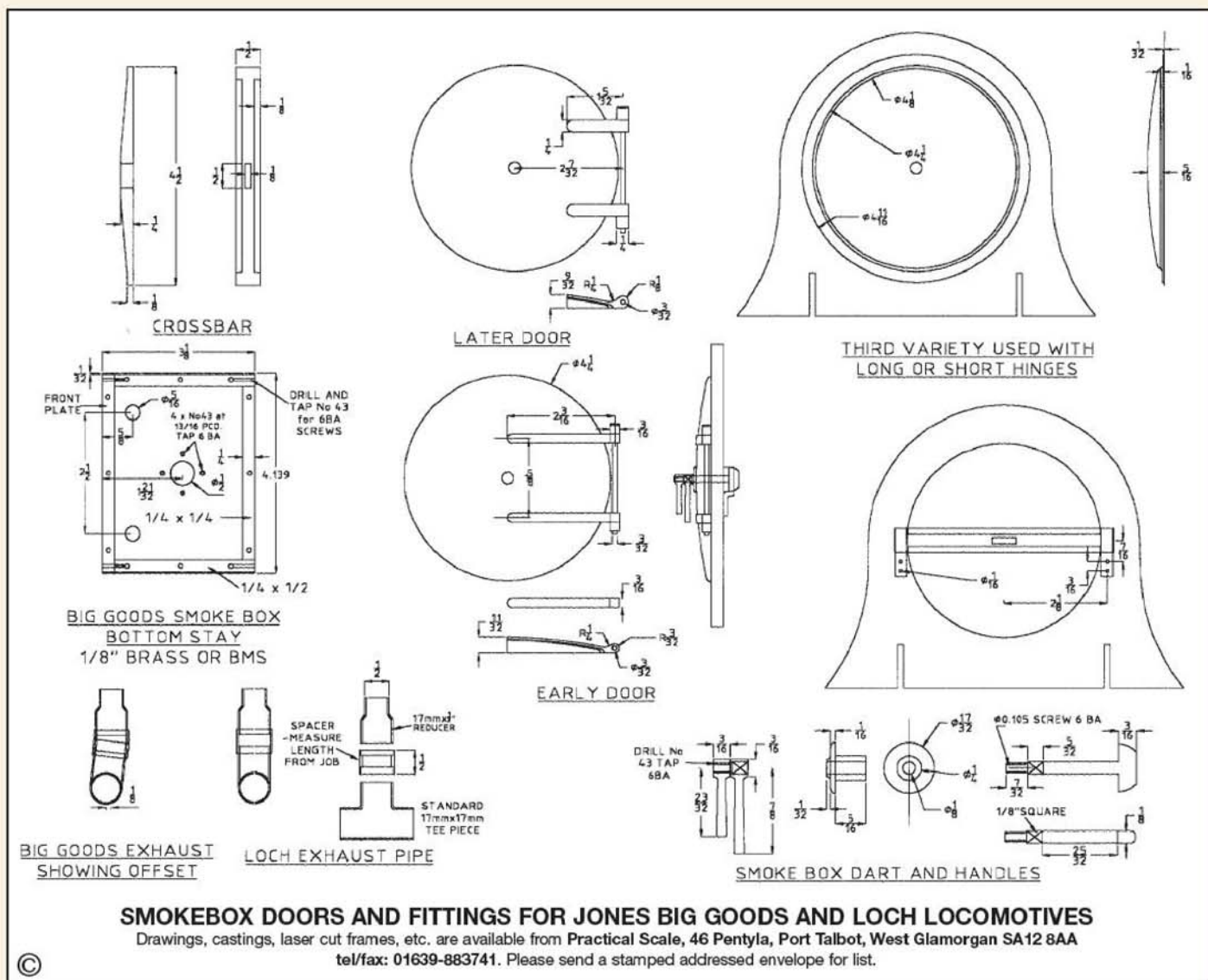
the earlier 2900s that the GWR actually noted them as a separate class when they were built. A quick comparison of the two drawings will show that although the basic design is similar, there are many detail changes. Incidentally, before the War, Deryck's father in law used to fire a 'Saint' every day from Cardiff, to Paddington and return, followed by a trip to Hereford and back. That was

a normal day's work. During the Easter weekend, they would take eighteen coaches crammed with passengers, out of Paddington, slip two at Reading, three or four for Bristol, and take 12 through the Severn tunnel. What other British engine could emulate that feat?

To finish I must say that I received an e-mail from Keith Wilson just now, welcoming me to the

GWR clan, and offering me his entire enormous wealth of drawings and knowledge. A few weeks ago I received a similar letter from Martin Evans noting his approval of my efforts so far. I find it very satisfying and a great honour to be accepted as a fellow contributor by these kind and generous people.

●To be continued.



SAVAGE'S *LITTLE SAMSON* in 3in, 4in. (and other) Scales

Martin Wallis

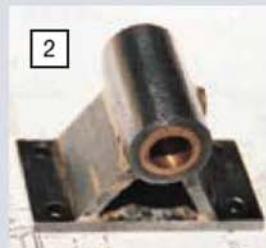
discusses the top work.

●Part XXIX continued from page 185
(M.E. 4176, 23 August 2002)

The seemingly generally accepted collective noun for the connecting rod, eccentric rods, expansion link, crosshead, etc. is the motion. Another term I have heard, particularly with older engine men, is the top work. It is the motion or top work that is next on the list. Our *Little Samson* is now really looking like an engine with the boiler, hornplates and shafts, wheels, backtank, front end and cylinder all complete. Once the motion is made, all that is left are the gear guards, gear selectors, lagging, canopy, and name plates, together with sundry extras such as the tool box and feed water heater, if fitted.

Valve guide bracket

The last part of the trunk guide assembly is the valve spindle guide bracket. A casting was considered but a fabrication is probably quicker and certainly neater. The bracket is shown in **photo 1**. The valve rod is thus well supported 'outboard', ensuring alignment with the hole where it enters the cylinder. I mention this, as another road steam design, examples of which I have seen at exhibitions, seems to omit this guide. The expansion link is certainly closer to the cylinder, which will reduce the tendency of the valve spindle to whip, but it does not seem an ideal arrangement.



Above: a view of the bracket after hard soldering. The bronze bush has been fitted but the backplate has yet to be cut away to complete it.

Left: the valve spindle guide bracket attached to the trunk guide.

Stan Nipper has kindly supplemented my drawing with an addition detailing the angles and method of fabrication. Care needs to be taken to fit the valve guide onto the trunk guide so that the two axes are parallel. Once fitted, some builders may like to fit two small dowel pins so the bracket may subsequently be removed and refitted with precision.

With the trunk guide bolted to the cylinder, a piece of silver-steel, a good fit in the guide bracket and with a turned point on one end is slid

in and tapped with a hammer to mark the entry point of the valve spindle in the cylinder. The cylinder may then be drilled for the valve spindle and counterbored for the gland.

Piston and rod

Much has been written on pistons and rods and I propose here to do little more than summarise some of the more important points. I submit that the following points are worthy of consideration:

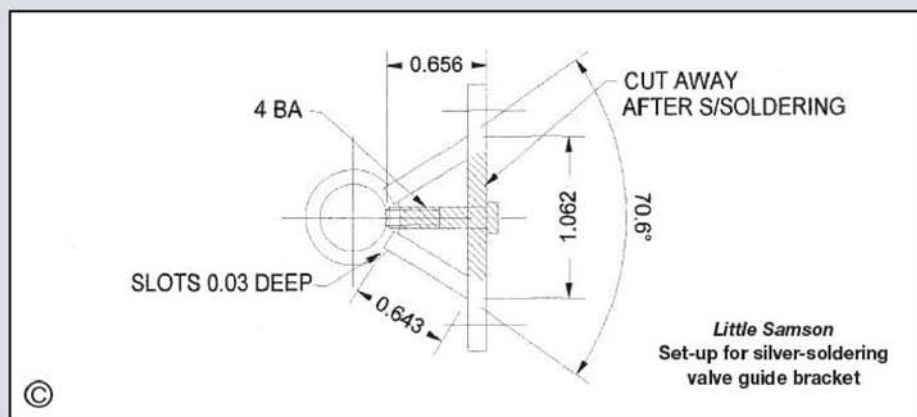
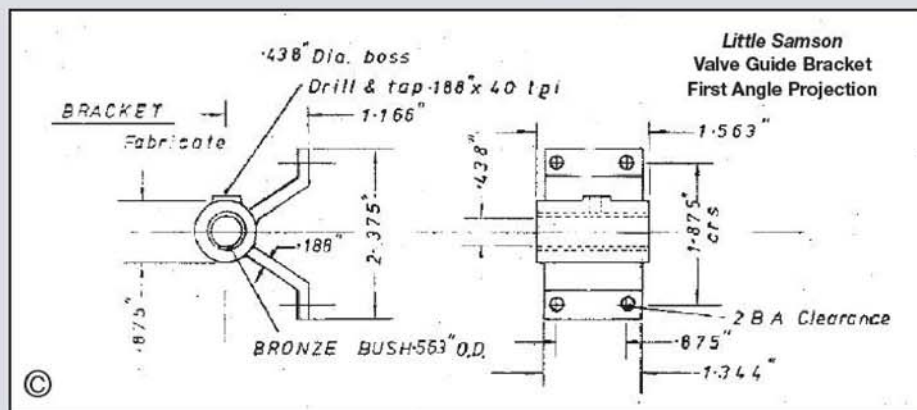
- 1: Choice of material, including the rings.
- 2: Mutual concentricity of piston and rod.
- 3: Availability, when fitted, of adjustment to set equal clearances between piston and cylinder covers at each end of the stroke.

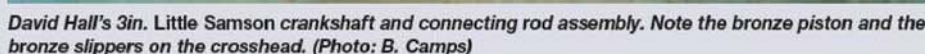
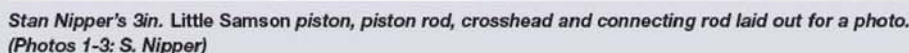
Materials

I have specified a cast iron piston and cast iron piston rings, which is the time assured method of doing things. Cast iron is one of few materials which works well against itself, a property known and exploited for many hundreds of years. However, modern materials, in the form of stainless steel, have been substituted for the wrought iron piston rod, which is a great improvement.

Critics of cast iron will observe that when laid up over long periods, a model with cast iron pistons may 'rust up' if there is not adequate oil. The piston could become immovable in the bore. This I have experienced (other peoples' models, I hasten to add) and have had to remove the covers and introduce a proprietary release agent such as WD40. However, I have never experienced this with my own models. At the end of each running season I always give it a good dose of cylinder oil on its last steaming, and once cool eject any condensate by pulling it over several times with the drain cocks open.

Bronze is the obvious alternative. What I believe to be universally accepted is that if the bore is of cast iron the piston rings should be of the same material. Commercial piston rings are invariably of cast iron, although doubtless there are exceptions. I guess builders who prefer bronze pistons would opt for bronze rings but would have to make them themselves.





Should a bronze or gunmetal cylinder liner be fitted, the situation is entirely different. A bronze piston should be fitted and either bronze rings could be fitted or an O-ring substituted. In the smaller scales cast gunmetal cylinders and O-rings are a good combination. Never fit an O-ring in an iron bore, it will surely be shredded in double quick time.

Concentricity

Clearly the piston must be concentric on its piston rod. Any method chosen must hold it securely and be arranged so that it cannot move inadvertently in use. One accepted method is to thread

the end of the piston rod (usually a 32tpi or other fine thread), thread the piston, and screw the two together. Tight threads may do the trick, otherwise high temperature Loctite might be used. The piston rod is then held in a collet (for accuracy) and the circumference of the piston skimmed true.

Two other methods both rely on a nut to secure the piston. Remember that a recess will be needed in the cover to accommodate the nut. First the piston is reamed a size smaller than the rod, the end of the piston rod is then carefully turned down until the piston is a push fit, and then fitted up to the shoulder and held there by the nut. The

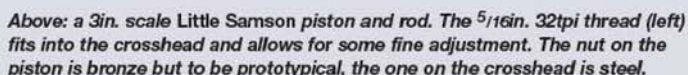
second method is exactly similar, except that a taper is substituted, the nut pulling the piston hard onto the taper. This last is the method chosen for our *Little Samson*, although any of the above would work if carefully done. I believe the method is clear from the illustrations.

Adjustment

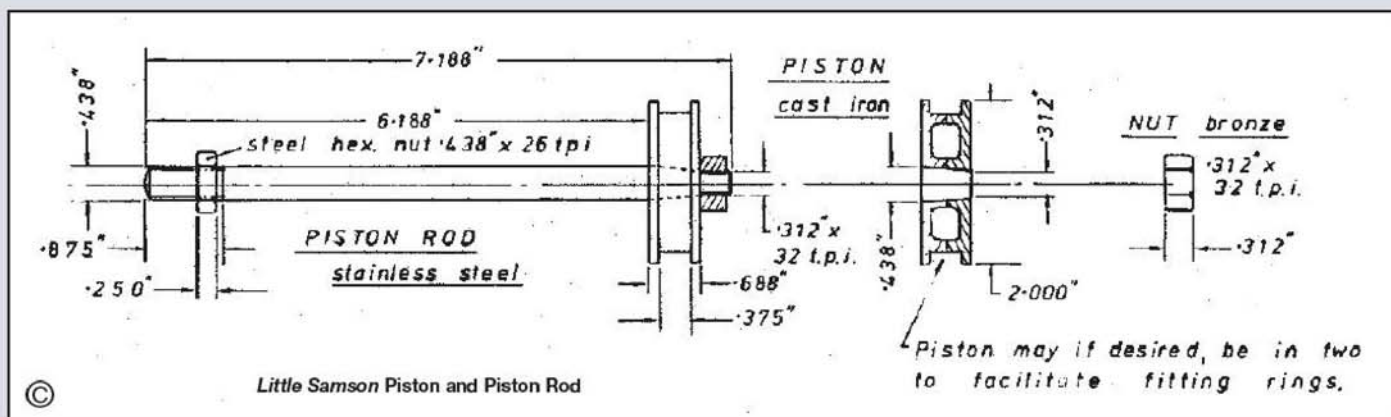
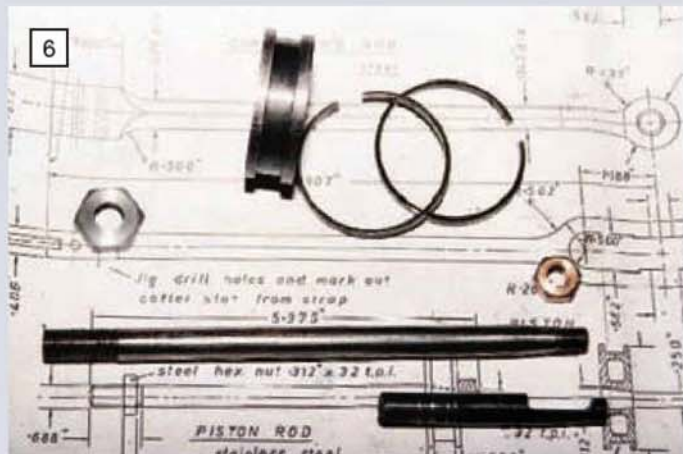
Once correctly installed the piston should sweep up and down the bore leaving approximately equal clearances against the covers at each end. These clearances should not be great as they represent 'dead' space and will affect economy. To be strictly correct, when the engine is cold the clearance at the crankshaft end needs to be a little greater since when hot, the boiler will expand and the cylinder will end up further away from the crankshaft.

The adjustment need not be at the piston end of the piston rod. On our *Little Samson*, the piston rod threads into the crosshead and is held fast by means of a locknut. On the *Little Samson* works drawings, the crosshead is detailed with a 1 1/8 in. fine thread (that is to say 1.125 in.) for fitting the piston rod. As a wise precaution, a locknut is detailed on the piston rod. Savages might also have added a small cross drilling through the crosshead and piston rod, to make absolutely certain nothing could ever come undone, but such was not shown on the drawing and would have certainly weakened the rod.

Many full-size engines use a taper and cotter to fit the crosshead to the piston rod and a taper and nut for the piston at the other end. So, you would think that with two taper fits there is no

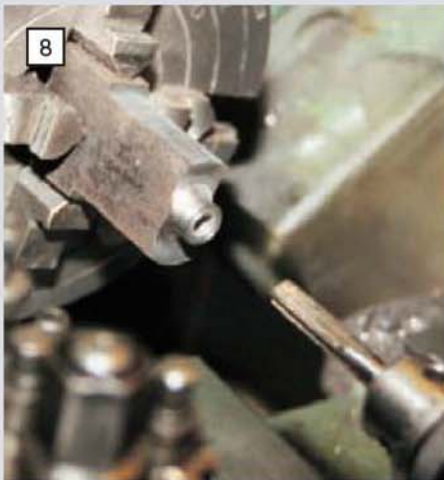
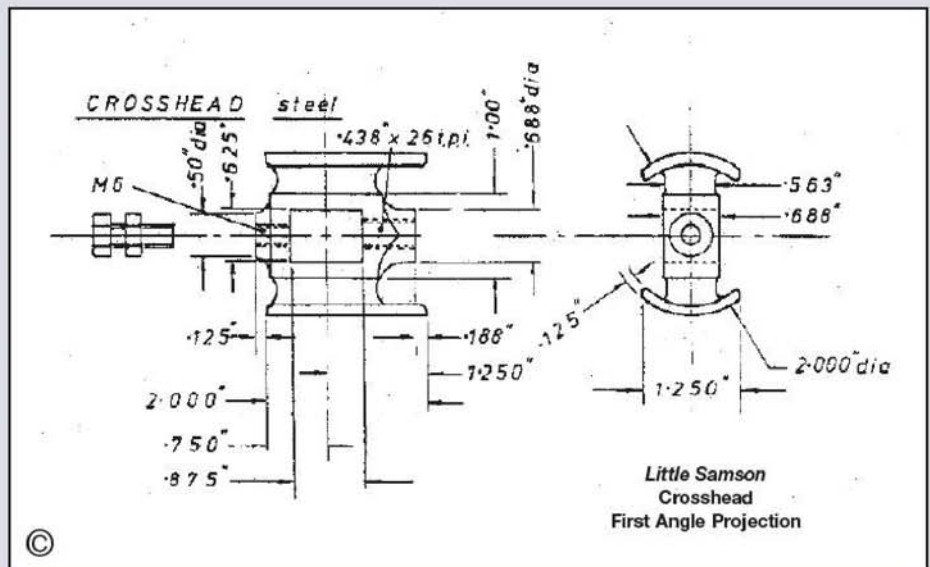


Right: note the taper on the end of the piston rod and the home-made taper reamer below it. The reamer is basically a 'D' bit and was machined at the same setting as the taper on the rod. It is made from silver-steel and is hardened and tempered. (Photos 5-6: S. Nipper)

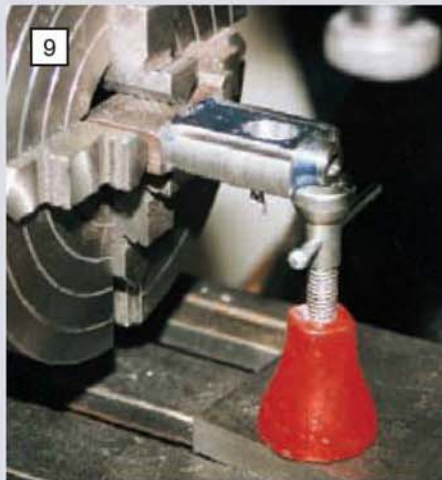




The tapered bore in the piston is formed using a taper reamer. The casting is supplied with a chucking spigot so that the bore and the outside diameter, including the piston ring grooves, may be machined at the same setting.



The central section of Stan's 3in. crosshead is in the lathe and is about to have the 32tpi thread installed.



The result from photo 8 undisturbed and still in the 4-jaw chuck is transferred to the dividing head to have the sides machined and the square slot machined.



Above: the central crosshead piece is then slid into a tube and secured with a couple of screws ready to be silver-soldered.
(Photos 7-10: S. Nipper)

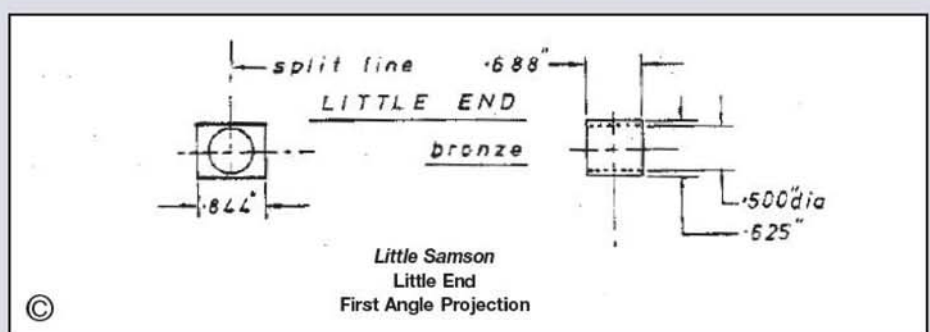
adjustment to get equal clearances between piston and covers. Well there is, as someone found out quite by accident.

Knock, knock

Both full-size engines and models occasionally develop annoying knocks and rattles in the motion, due either to worn parts or something becoming loose. These may be located by ear, eye, and touch. Careful observation and listening may narrow such noises down to 'big end at forward dead centre' or suchlike. A good alternative is to place a finger on all the rods in turn and you will be able to feel the knock as well as hear it.

I am sure safety inspectors would shudder at the thought of climbing up on to the footboard of an engine and reaching in to touch the rods in turn as it all goes around, and they would be quite right. Obviously such actions are undertaken at minimum revs. and great care and forethought is applied before reaching in.

Anyway, in this case, the big end was diagnosed as being loose; it was stripped down and the brasses closed up. Another packing piece was added between the bearing brass and the strap (together with all those fitted on previous adjustments) as the taper cotter was out of travel when all was reassembled. Mysteriously the knock remained. There was some bafflement for a while until it was realised that the piston was now



hitting on the front cover. Half the packing pieces were removed and fitted on the other side of the big end and all was at last as sweet as a nut.

Hollow piston

The works drawings show a piston in two halves, an arrangement which has been adopted on the model. There are two advantages: the piston rings are easier to fit and the piston may be made hollow. Hollowing a piston will significantly reduce its mass and thus the weight of iron that is propelled up and down the bore. Full-size road steam makers went to different lengths to attempt to balance the reciprocating masses. Some fitted balance weights on the crankshafts, others cast a small weight inside the flywheel, while others

made no attempt at all. Our *Little Samson* seems to come into the 'no attempt at all' category, apart from the hollow piston.

Making the piston in two halves certainly complicates matters and, to the best of my knowledge, none of the *Little Samson* builders have considered it worthwhile. However, on my half-size Fowler, I certainly considered it worthwhile to hollow the pistons and estimate they weigh less than half that of equivalent solid pistons.

Crosshead

Happily for us, the Savage drawings show a crosshead without the usual adjustable slippers where it runs against the trunk guide. The only adjustment is in the little end brasses; so they can



John Freeborn's set-up for cutting the radii in the ends of his 4in. scale crosshead by using a ball nosed cutter and a rotary table. The crosshead was cut from the solid.



The completed 4in. crosshead is fitted into the connecting rod fork. (Photos 11-12: P. Kybert)

drawings do not specify a material but I am certain it would have been ferrous, either cast or wrought iron. The bearing surfaces top and bottom are large and, as far as we are concerned, should last for ever.

Stan and David have both fabricated their 3in. crossheads and John cut his 4in. example from the solid. Stan's sequence of events is shown in photos 8, 9 and 10. Once machined, the central portion was silver-soldered into the outside ring, the sides of which were subsequently cut away. The square hole for the little end brasses was cut out before soldering up, as it was easier to hold. Even with a small cutter, the corners of the hole will need to be cleaned out with a square file.

In the smaller scales, the split little end brasses will certainly be a fiddle to make. It might well be as well to just fit a simple parallel bush working on the assumption they cannot be seen when assembled and that it is easy enough to

make another one if required. If a round bush is to be substituted, the adjusting bolt and locknut should still be made, as they are a distinctive feature. Remember that the larger-than-usual fork in the end of the connecting rod is specifically to clear the little end adjusting bolt and nut, so you ought to fit one.

Next time we will take a look at connecting rod construction. The connecting rod is one of the parts of an engine that tends to catch the eye so it is well worth taking a little more trouble over. *Little Samson* builders seem to agree and have responded in the photographic department accordingly. I have 47 pictures of connecting rods in varying degrees of undress from which to choose perhaps a dozen. As ever the *Little Samson* series would be sunk without the wonderful work of the 'advance party'. My grateful thanks to all concerned.

● *To be continued.*

A FERRIS WHEEL CLOCK

Richard Stephen describes the planting of the intermediate and escape wheels before dealing with the pendulum and back cock.

● *Part VII continued from page 176 (M.E. 4176, 23 August 2002)*

The intermediate and escape wheels can now be planted in the train. The pivots on the two arbors still require to be reduced in length. The bushes should already have been correctly sized to take the pivots. Screw the end caps in place. The pivots are now ground to length using a carborundum grinding disc in the Dremel mini-drill. Hold the arbor in a collet or 3-jaw chuck in the lathe and grind a point on the end of the pivot, reducing the length at the same time.

The length of the arbors was made about 0.40mm less than the separation of the plates. Grind back the pivot until the shoulder is about 0.20mm clear of the surface of the bush. Now grind back the pivot at the other end of the arbor. Keep trying the arbor between the plates. You should aim to have just a slight amount of end shake when the plates are firmly assembled. If you grind too much off the end of a pivot, remove it and replace it with a new length of drill rod softening the Loctite with a little gentle heating.



Some of the items referred to in the accompanying text are visible in this photograph. Note particularly the pallet arbor end cap, back cock, pendulum support and pendulum suspension spring.

The pinions and wheels can be fixed to the arbors using Loctite Screwlock. This will facilitate the removal of any wheel or pinion should this be necessary. The wheels and pinions will eventually be secured using Loctite high strength retainer.

It is now time to test the train. Before you assemble the train, the 3mm holes in the plates where the 3mm ball races have been fitted, i.e. at the Ferris wheel arbor and the centre arbor,

should now be enlarged to 3.5mm. Assemble all the wheels including the Ferris wheel. If everything has gone correctly, the escape wheel should turn freely when one ball is placed in a slot at the '9 o'clock' position. If the train will not turn freely with just one ball there is too much friction somewhere in the train. Starting with the escape wheel, progressively remove wheels until the source of the friction is located.

The prototype train turned very freely even when a single ball was placed in a slot at the '11 o'clock' position.

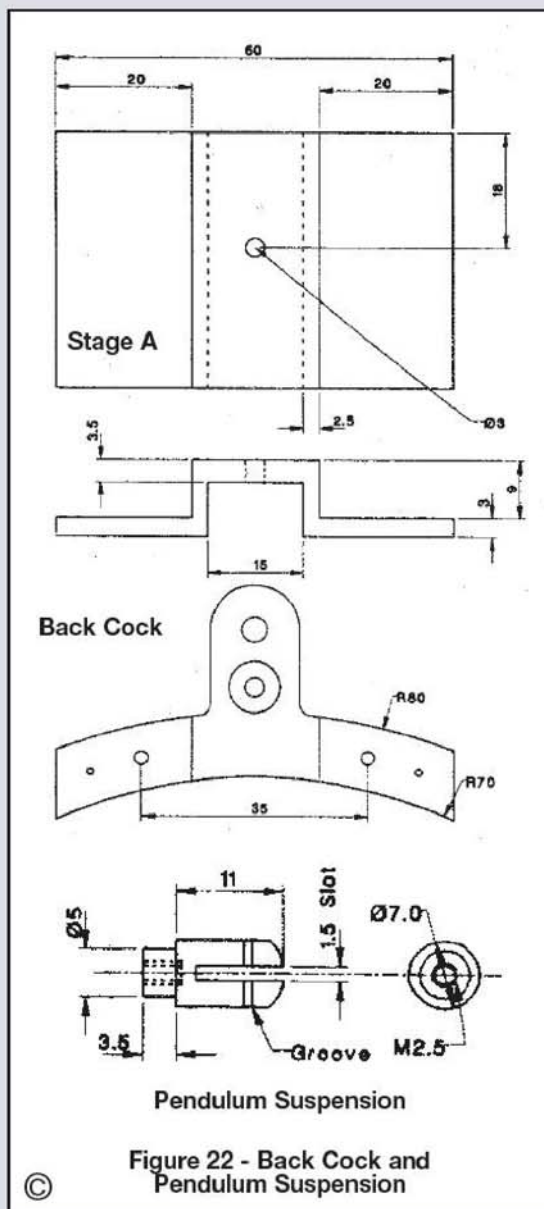
Back cock

The dimensions of the back cock are shown in fig 22. It is best made from a solid brass block but it could be fabricated using scraps of 3mm engraving brass silver-soldered together. Personally, I find fabricating unsatisfactory as the silver-solder eventually tarnishes to leave a dark mark. The cock has a rather complicated form, the shaping of which, without access to CNC equipment, will have to be done by hand. The diagrams in fig 22 illustrate the steps I took making the cock. Unfortunately, there is no easy way to make it!

When you have completed stage A, the hole for the bush should be drilled and reamed 3.0mm. Assemble the back plate, middle bar and the pillars. Make sure the screws are tight. To fit the back cock in its correct position you require a 60mm length of 3mm dia. silver-steel rod. Check that the rod is perfectly straight by testing that it runs perfectly truly in the lathe. Pass the rod through the 3mm dia. holes in both plates. Check that you can turn the rod easily with your fingers. Now pass the rod through the 3mm hole in the back cock. Clamp the cock to the back plate with toolmaker's clamps. The centre line of the cock should line up with the centre line of the back plate. Check again that you can turn the 3mm rod easily with your fingers. If it is at all stiff, carefully adjust the position of the cock until the rod turns easily. The back cock is now correctly aligned with the holes drilled for the pallet arbor. Using the back plate as a template mark out the shape of the cock with a scriber.

The holes for the screws and the 1mm register pins can now be drilled using the scribed lines as a guide for their positions (see fig 22). With the holes drilled, reposition the cock and clamp it to the back plate. Check that the 3mm silver-steel rod still turns easily. Leave the cock clamped in place and disassemble the plates. Drill the holes in the back plate for the register pins. Insert the register pins in the cock. Reassemble the plates. Position the cock using the register pins and clamp with toolmaker's clamps.

Check once more that the 3mm dia. silver-steel rod still turns easily. Disassemble the plates and drill and tap the holes for the 2.5mm screws. Finally check



©

Figure 22 - Back Cock and Pendulum Suspension

that the scribed lines are still correct. The cock can now be finished off using a piercing saw and files, referring to fig 22 as a guide for the shape. When the cock is finally profiled, the recess for the end cap can be drilled using the 8mm dia. counterbore, and the end cap fitted in place. The hole for the pendulum support is drilled 8mm vertically above the pivot hole in the cock.

The dimensions of the pendulum support are also shown in fig 22. This should present no difficulties and when made can be screwed in place on the back cock.

Fitting the pallet arbor

With the back cock in position, the pallet arbor can now be made. Measure the separation between the middle bar and the back cock. Make the length of the arbor 0.40mm less than the measured value. The pallet arbor is best made from 2mm dia. blue steel or equivalent. If you have none, use silver-steel. If you use blue steel the temper will have to be drawn from the ends in order to drill the holes for the high speed steel pivots. The collar can be made of mild steel and fixed in place with Loctite.

Follow the procedure previously described for grinding the pivots to length. Fit the pallets onto the arbor using Loctite Screwlock. Assemble the plates, back cock, escape wheel and pallets. If everything has gone according to plan, the escapement should function correctly.

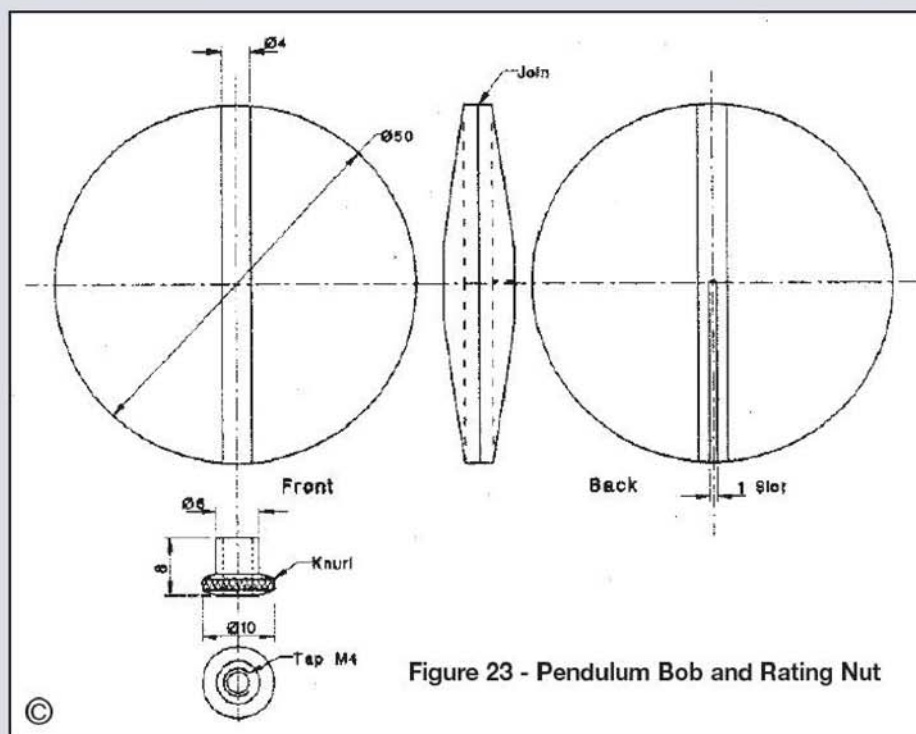
Pendulum bob

The pendulum rod for this clock is made of carbon fibre and steel. No particular attempt has been made to compensate the pendulum for temperature effects. The temperature in most modern houses is relatively constant, which minimises temperature effects. Any

reader who wishes to accurately compensate his pendulum should contact me (by telephone on 01572-770416 or by e-mail at dickstephn@aol.com) and I will explain how to do so using a carbon fibre rod.

The bob is prevented from rotating on the pendulum rod by a 1mm peg which slides in an internal groove in the bob (see fig 23). The only problem encountered when making the bob is cutting this internal groove. After trying several techniques with limited success I evolved the simple, if slightly unorthodox method which follows.

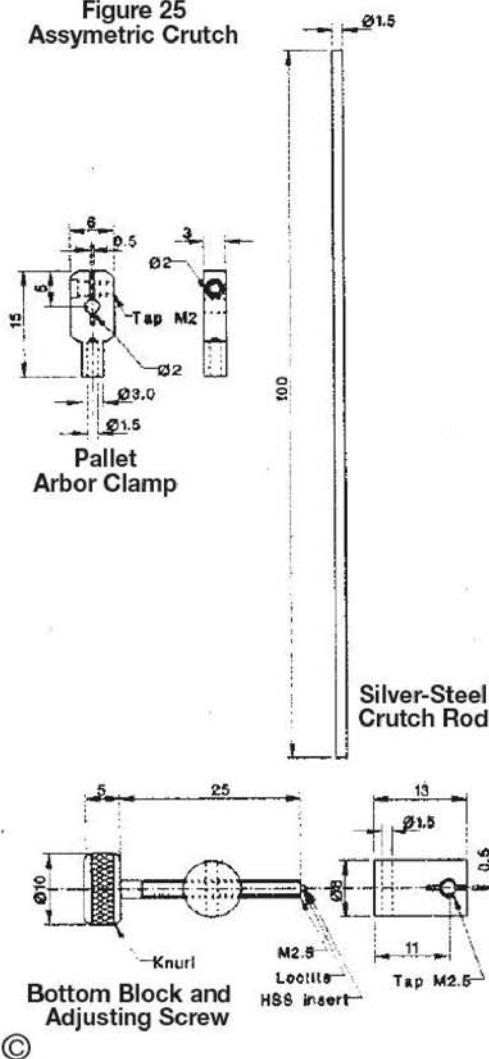
A length of 50mm diameter brass bar is required for the bob.



©

Figure 23 - Pendulum Bob and Rating Nut

Figure 24 - Pendulum Rod Details



Suspension Spring Block

Suspension Spring
Pallet Arbor
Clamp
Loctite

100

Top Section

Bend

Loctite

Crutch Plate

Bottom Block & Adjusting Screw

Bob

Rating Nut

Bottom Section

Figure 26
Pendulum and Crutch Assembly



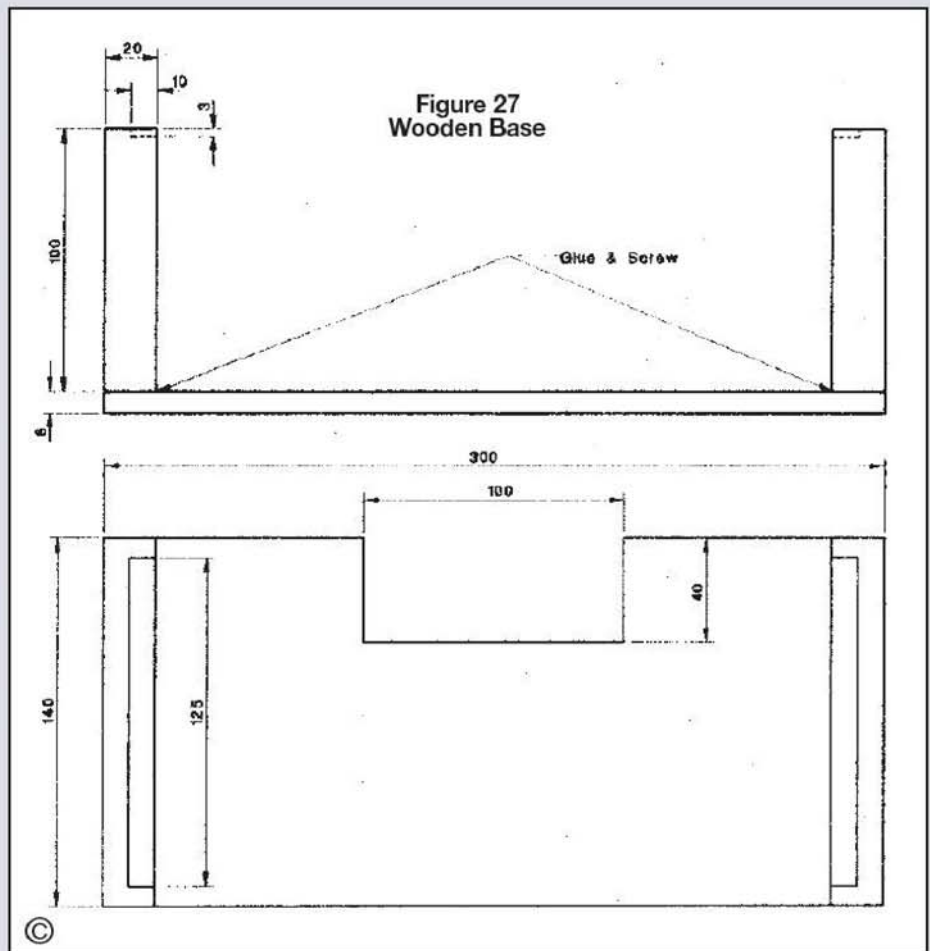
A view of the rear of the clock showing the carbon fibre pendulum rod and pendulum crutch assembly.

into the block. The block was still too thick for the slot in the support. The thickness was carefully reduced by filing both sides until the spring block fitted snugly in the slot in the support. On no account must the spring block be able to rock sideways in the slot—if it does you should begin again.

The suspension spring is fixed to the suspension spring block at its lower end. The dimensions of this part are given in fig 24. The top section of the pendulum rod screws into the suspension spring block and is made from a piece of 4mm dia. mild steel rod. The dimensions are given in fig 24. The 2mm grooved spigot is fixed into the end of the carbon fibre rod using epoxy resin adhesive. The bottom steel section shown in fig 24 is threaded 4mm for the rating nut. To prevent the bob from rotating on the rod a 1mm peg is set in the lower section. This peg slides in the groove cut in the bob.

The last component is the crutch plate which should be made from silver-steel. Cut off a 15mm length of 8mm rod. Drill and ream a 4mm hole about 3mm from one end. Face off the end of the rod and reduce the thickness between the edge of the hole and the face to 1mm. Slightly chamfer the edge and polish the face finishing with 1200 wet and dry paper. Now reduce the other end leaving about 5mm between the hole and the face. Drill and tap a 2mm thread in the end. The excess material can be machined away as shown in fig 24. Now harden and leave in a glass hard state, clean and polish.

The pendulum rod can now be assembled. Using epoxy resin, first glue only the lower section into place in the carbon fibre rod. The bob should be able to slide freely on the rod. Screw the top section into the suspension spring block. Slide the bob onto the rod as far as it will go. Apply



some slow setting epoxy resin to the spigot of the top section and inside the carbon fibre rod. Insert the spigot into the end of the carbon fibre rod. Lay the pendulum bob on a flat surface and rotate the spigot until the suspension spring lies at right angles to the plane of the bob. Allow the epoxy resin to set before moving the pendulum.

Crutch

The crutch is illustrated in fig 25. Its construction should present few difficulties. The pallet arbor clamp and the bottom block are made of mild steel, the rod is made from a length of 1.5mm dia. silver-steel rod, and the knurled adjusting screw from brass. The polished domed end of the adjusting screw that rests on the crutch plate on the pendulum rod is made from a piece of 1.5mm dia. high speed steel drill rod. The parts are fixed together with Loctite.

Testing the movement

The movement is now ready for testing and should be assembled. At this point you will notice that the pendulum extends below the feet. This was quite intentional. The reason for this was to reduce the height through which the balls needed to be lifted. As it is, the ball lift has to raise thirteen 15mm steel balls each weighing 16 grams (total weight nearly 11lb.)

The pendulum in the finished clock swings in a recess in the base. The base houses the batteries, electronics and the motor that drives the ball lift. To test the movement, a base will have to be made on which to mount it. Figure 27 shows a suitable design for a test base. This base has a dual purpose as, when used as drawn, the movement and base plate can be located in the recesses in the uprights. This will be useful later when, for example, testing the ball lift. Since we have not

yet made the base plate, the test base can be inverted with the plywood uppermost and the movement screwed to it for testing.

The test base can be made from a piece of 8mm plywood and the side supports any available 20mm thick wood board. Mill out the recesses dimensioned 125 x 10 x 3mm and shown on the bottom of the side supports. For our initial trials, the movement needs to be firmly screwed to the plywood board. To mark the positions of the screw holes, three lengths of 4mm dia. steel, threaded rod 10mm long will be required. Turn a sharp point on the end of each piece of rod. Screw one into each foot with the point outermost. Position the movement so that the pendulum can swing in the recess in the base and press down firmly. The dimples in the surface should be easily visible.

Drill the holes for the 4mm screws. The three pointed lengths of threaded rod will be needed later to mark the positions of the screw holes in the brass base plate on which the movement is mounted. Secure the movement to the base with the three 4mm screws. Attach the pendulum. The crutch plate on the pendulum rod will have to be moved to its correct position. The domed high-speed steel point on the crutch adjusting screw has to rest at 90deg. to the face of the crutch plate. If it does not rest at 90deg. the pendulum will be caused to swing in a figure of eight pattern. To set the pendulum in beat simply turn the adjusting screw until the tick is perfectly even.

Place eight balls in the slots on the left of the Ferris wheel. If the escape wheel turned with one ball in a slot at the '9 o'clock' position the movement should run. My prototype ran immediately and has continued to do so ever since.

●To be continued.

CLAMPS & CLAMPING

Peter Spenlove-Spenlove
discusses making and using these
vital pieces of workshop kit so often
taken for granted.

●Part II continued from page 181
(M.E. 4176 23 August 2002)

Most model engineers make their own strap or plate clamps using offcuts of rectangular steel bar, black or bright as available, and usually as and when needed. A clearance hole for the bolt or stud is drilled through closer to one end than the other. More usefully, a slot is milled from the centre towards one end. This is a job for an end mill or slot drill with the job held in the machine vice. The slot should be an easy clearance on the clamp bolt and does not therefore require great accuracy. Two holes may be drilled to define the ends of the slot and the metal between them milled away in stages. Following generous deburring of all edges you now have a plain strap clamp.

Unless the owner of big industrial machines, the average model engineer will need an assortment of T-bolts, nuts, etc., ranging from $\frac{1}{4}$ - $\frac{3}{8}$ in. for Myford T-slots and small rotary tables to $\frac{3}{8}$ - $\frac{1}{2}$ in. for milling machines and large rotary tables. Similarly, the strap clamps might range from $\frac{1}{4}$ x 1in. to $\frac{1}{2}$ x 2in. mild steel. Some of mine have been made from $\frac{1}{2}$ x $\frac{1}{2}$ in. Duralumin offcuts. Some are very short while others are quite long; almost all were made from scrap offcuts.

As described so far, the full width of the work end of the clamp presses onto the work, but it may be that a full width space is not available, so the clamp end must be sawn, filed and re-shaped to fit the work. The clamp nuts go into a hole or recess, etc. If the clamp bears on a finished surface, such as a cylinder bore, suitable protective packing must be added to prevent local marking or crushing, not forgetting to set the strap at the very slight angle down towards the work as explained later.

I include a page from a catalogue showing typical shapes of forged strap clamps, some of which can be copied in mild steel or aluminium alloy.

Concerning T-bolt, etc. heads, the stem (and thread) of a T-bolt can be any size up to the full

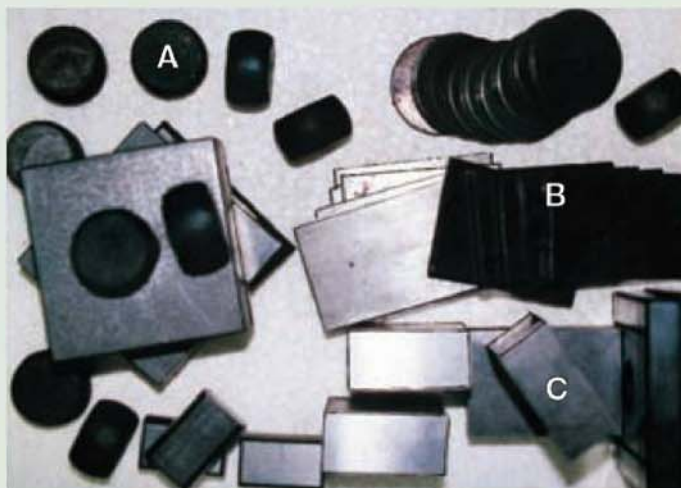
width of the T-slot, or even larger if two flats are milled or filed next to the head. However, the thread in a T-nut must be at least $\frac{1}{16}$ in. (1.5mm) smaller than the width of the T-slot. If the thread in the nut is too large, the T-nut will be weak and may distort. Such a weak nut could break out of the T-slot by fracturing the sides on smaller machines; go easy on the spanner.

You may ask "What size should T-nuts and T-bolt heads be?" Industrial machine T-slots are made to standard sizes and cutter manufacturers make T-slot cutters to suit. In our smaller world there is a great range of both imperial and metric equipment for which I would prefer to actually measure the slot, make a dimensioned sketch and mill a strip for four to six T-nuts some 0.010-0.015in. less than the slot. I once made some to a closer fit which, while they slid along a perfectly clean T-slot, jammed up in use because of burrs and tiny bits of swarf in the slot. If the T-nut sticks while clamping the work, you are tempted to tap it (or the T-bolt) into the right place and all your packings fall away or the work slips out of position.

I have a milling head which mounts on the boring table of my lathe using three $\frac{5}{16}$ in. BSF bolts

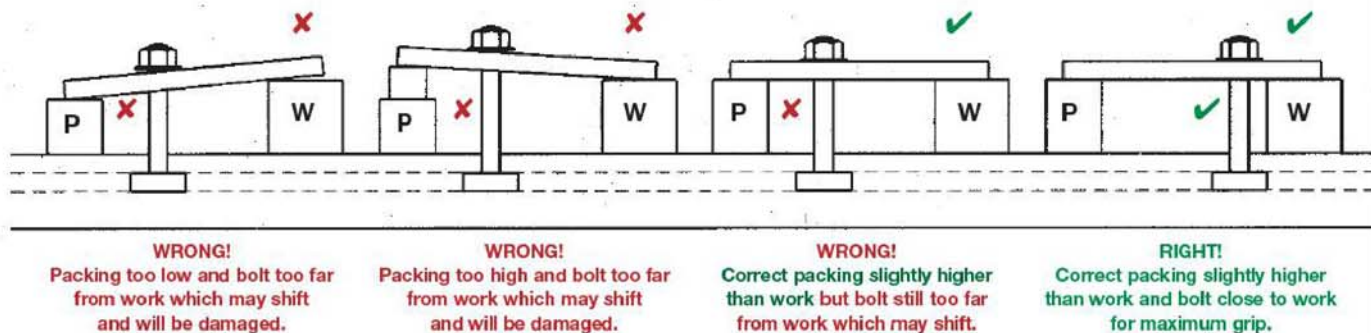


A selection of well used, old and very battered plain $1\frac{1}{2}$ x $\frac{1}{2}$ in. strap clamps with $\frac{1}{2}$ in. T-bolts.



A miscellaneous collection of assorted packings: all flat and free of burrs.
A: Scrap 1in. dia. hot forged steel blanks.
B: Thin flat packing material, various thicknesses.
C: Bright steel blocks, four of each size required for convenience.

THE USE OF PLATE CLAMPS



The diagrams show a plate clamp in use to secure workpiece (W) for machining. The clamp is held using a T-bolt, nut and washer and is packed up using packing (P). The writer has often seen all of these arrangements in use in professional workshops!

Note that although one plate clamp is shown, work should be secured by the use of at least two to prevent movement under cutting forces.



Adjustable step pattern



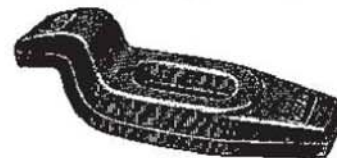
Finger pattern; single end



Finger pattern; double end



'U' pattern



Goose neck pattern

INDUSTRIAL CLAMPS

Industrial machines are likely to feature large T-slots. The forged clamps shown here are likely to be available from used machine tool merchants. Usually relatively large, seek out smaller clamps which are neither cracked nor bent. Check any T-nuts you may find for damaged threads and that studding is available to suit.

to hold it down. Instead of using three T-nuts which are difficult to align with the bolts, especially the middle one, I milled a T-nut to suit the entire length of the T-slot but didn't separate it into the usual nut pieces. It was then drilled and tapped to match the boring head bolts. This long T-nut is easy to use and imposes less local strain on the cross-slide. Each bolt is trimmed to suit its T-nut and stops $1/32$ in. (1mm) short of the bottom of the slot when fully home.

I have seen milled T-nut blank lengths advertised in these pages in the past. If square or rectangular bright mild steel is not available readily, these lengths, if the right size for your machine, could be useful. Just drill, tap and split it into a batch of T-nuts.

At a pinch, a cheap square nut can form a light duty T-nut to hold down a simple swarf or cutting deflector at the end of a milling machine table.

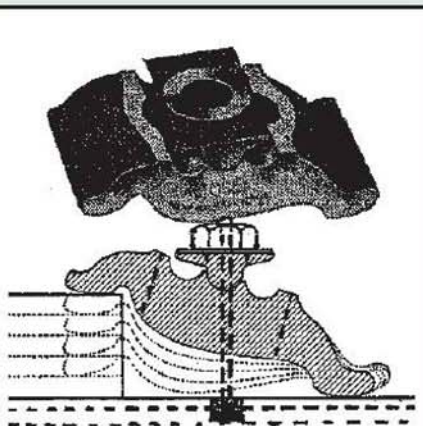
There are several wrong ways and one right way to use flat bar strap clamps. They are often used incorrectly, even in jobbing shops, until the machinist learns the correct technique after an expensive job slips away from under the cutter. Even then, some are likely to wrongly assume that the cutter was at fault and may not consider reviewing their clamping technique!

The clamp should grip the workpiece by the use of a nut and a washer fitted to a clamp bolt towards one end of the clamp. The outer end of the clamp is supported on packing block(s). It is generally and wrongly considered that the packing should be the same height as the workpiece to bring the clamp level. The error in this is that even heavy clamps bend very slightly when tight and then press on the very edge of the workpiece and packing block.

Another error is the use of packing which is too low, causing the clamp to slope down from the workpiece. Not only will the edge of the workpiece be damaged, but the work could slip out. For best grip, the strap should slope very slightly, almost imperceptibly, down towards the workpiece.

The T-bolt/stud, washer and nut should be placed as close to the work as possible, hence the slotted strap. The clamping force provided by the nut is shared between the workpiece and the packing at the outer end according to the distances. It's all to do with leverage. The nearer the bolt to the work, the greater the force on the workpiece. If the nut is nearer the packing, it will be the packing and not the work which is gripped firmly. Properly arranged, the strain on the T-slot, threads and strap is minimised, resulting in less risk of damage or accident.

All this means a selection of packing material to augment your collection of bolts and straps. To avoid the need for an extensive range, collect a few blocks with good flat faces and add a quantity of flat and burr free thin sheet metal squares. It is better to put the blocks on top of the thinner



SELF SETTING CLAMP

(from a 1934 Buck & Hickman catalogue)
Radiused ends remove the need for packing unless the work is very high. Used with T-nut, studding, washer and nut, note the special self-setting washer below the clamp nut which should be set as close to the work as possible

packings; if used the other way round, the thin material may be distorted, rendering it useless for further work. Source of thin packing include:

- a local sheet metal fabricator of boxes, ducting, etc., might guillotine a collection of pieces about 2in. (50mm) square for you.
- a firm making sheet metal pressings often punch big holes in the work. The pieces from the 'hole' are likely to be scrap to them but useful to us. Distortion can be removed by annealing the material and squeezing it flat between two pieces of bright mild steel.
- large old obsolete coins, i.e. UK penny pieces.

However, I don't advise the use of tinplate; it's too thin and you may cut yourself on its sharp edges while setting up the pile of packing during clamping. Useful thicknesses are 1mm, 18swg, 16swg and $1/8$ in. as available.

A very useful alternative to sheet metal packings is to drill and tap the back end of the strap clamp for a short knurled or hexagon headed set screw with a slightly rounded tip. This then is used as a jack screw directly on the packing block. This is favoured by industrial users who have no time to waste sorting out pieces of packing — which are probably in use by another machine operator anyway! Another advantage is that the work end of the strap can be set to sit better on a cast workpiece which might be somewhat uneven.

Instead of a plain washer and nut, 'deluxe' versions of this clamp will have a hollow spherical face on a thick washer and a matching spherical faced nut which allows the clamp to align itself and causes less strain on the T-bolt, stud or nut. Some don't bother to make a special washer; the

rounded end of the nut will suffice up to $1/2$ in. (12mm) threads for model engineering work.

If you are concerned about the work shifting, add more clamps. Using short T-bolts, clamp strips of metal onto the machine table up against the work to act as a stop fence. Take light cuts and use a sharp cutter and cutting fluid. Avoid power feed so that if the cutter starts to fail you can feel by way of the handwheel any extra feed pressure and be warned of potential trouble.

Plain (unthreaded) shank end mills have a habit of coming out of the collet when under severe load. This is a gradual process and may not be noticed during power feed. That is why most end mills and similar cutters have threads to fit into special chucks. Watch out for this when milling your T-nut strip in steel if you use plain shank cutters.

I once made a strip of T-nuts, milling one side then the other at the same index setting. By rushing the work, the finished cut was a good 30 thou. lower at one end of the second side. I had to even out the error by doing both sides again at a new index reading. With the work hidden by 'suds' and swarf, it was not evident that the cutter was gradually creeping out.

Second-hand machines often have burrs in the slot due to previous owners using converted hexagon headed bolts or bent T-nuts. These may be removed by running a flat file down the sides of the T-slot. Note that the T-nut shouldn't show above the surface of the machine table or you won't be able to use it to fix a stop or a fence directly onto the table to locate the work.

The length of a T-nut should be about 2-2 $1/2$ times the thread diameter. Or, if you tap your T-nut to take studs much smaller than the width of the table slot, make the length twice the width of the slot. The heads of T-bolts should also about twice the thread diameter.

Most T-slots are set deep into the machine table surface to prevent pull-out breakage. Some lathes have been designed with a light boring table/cross-slide to give users the ability to machine large work in which case the T-slots are rather shallow, so go easy when clamping work on it. If you are facing a chunk of steel using a flycutter in the chuck, the intermittent cut may cause the work to shift gradually. Don't be tempted to overtighten the T-bolts (Myford T-bolts are $3/8$ in. BSW and quite strong). Instead put a piece of typing paper, i.e. non-glossy, under the work before clamping it down.

If it still slips, stick a couple of small pieces of new very fine grade wet-or-dry abrasive paper together with office paper adhesive, sparingly applied to the paper side. The two grit sides will grip the machine surface and the work and will usually prevent movement when clamped normally. You may have to allow for the paper thickness when marking out.



THE BEAST FROM DOWN-UNDER

Keith Watson

**in Western Australia describes
the construction of a half size
Wallis and Stevens steam tractor.**

The story starts last February in sunny Down-Under land when I was approached by a fellow who wanted a larger size traction engine, something along the lines of a 6in. Wallis. As many will know, these little engines are not as big as the Fowlers, Burrells and Marshalls, and they were designed to haul the lighter loads around the roads of Britain when the Heavy Motor Car Act came into being. These little steam tractors still have all the same qualities as the big engines but the design was simpler and lighter. I simplified it even further, hence this little Wallis is about the same size as a 4in. traction engine, but much easier to build.

Stuart Martin, whom this story is all about, has made many engines from a simple steam engine to some quite complex affairs including one which has four strokes per crankshaft revolution. He has built beam engines, a steam hammer, several little single-cylinder gas engines, and a model of *Evening Star*, even casting his own driving wheels. He has also made an amazing electric boiler. However, all of Stuart's models can be placed on the kitchen table, so this time he wanted to do something different.

On seeing the drawings, Stuart became very interested and realised that this was not only something he could make, but also that he could customise it to suit his own requirements. For instance, Wallis used only ten spokes in the hind wheels but Stuart wanted 12. He also increased the wheelbase and the wheel width, giving the engine a larger appearance. I was impressed when I saw Stuart, who had never built a large model before, turn his hand to making the crankshaft, making the larger valve gear and machining the cylinder. He chose to have the flywheel machined

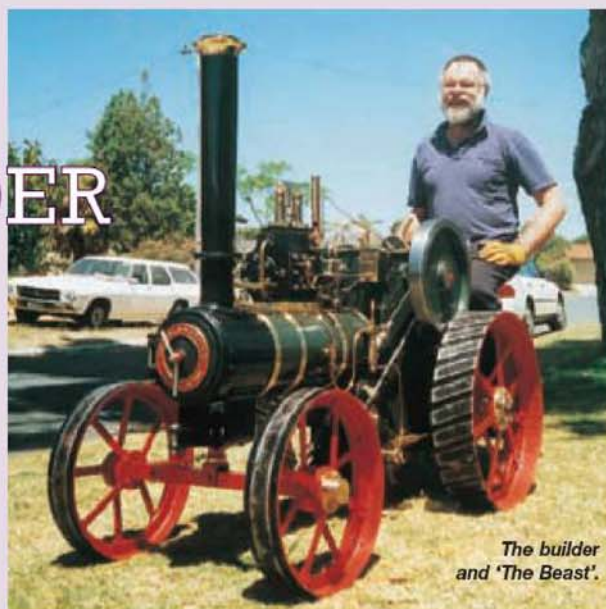
by a local company as it wasn't worth buying a larger lathe to do just one or two jobs.

One of his variations was to alter the roller chains I specified to a lower ratio from 8:1 to 11:1. This gave the engine more power and a smoother start off and cost him no more whereas to use gear drives would have been very expensive and difficult to change.

Stuart is an avid reader of *Model Engineer* and has had his own foundry for quite some time. He uses shell moulding and has used wooden patterns when he should have used aluminium which in consequence have suffered from the heat. That said, I have been much impressed with the range of items he has cast, including a brass name plate for the smokebox door, new wheel hubs, a very neat steam throttle valve and quadrant, plus some nice little wheel valve handles.

His use of brass and rivets give this engine lots of appeal. His ability with fabrication surprised me, not only with the larger components, but a beautifully made brass mechanical lubricator which works perfectly. One part which had him worried was the steering worm as he had been given a 20 tooth worm wheel but couldn't cut the worm, so he fabricated one! He machined a boss to the correct root diameter wrapped a length of 8 gauge wire around it, spaced it and brazed the ends. Then he silver-soldered the wire to the boss, the result was real Australian ingenuity. I have never seen such a job done before; it is the easiest steering worm I've ever turned. Purists may turn up their noses, but the finished engine has to be seen to be appreciated.

Stuart has built the standard 8in. steel Briggs boiler which in this case has 19 x 3/4in. tubes all expanded into the 1/2in. tube plates and beaded over at the firebox end. The boiler is complete



The builder
and 'The Beast'.

with a 2in. screwed inspection plug which can be seen just ahead of the motion bracket on the right-hand side. To cover this up he has cast his own neat brass cover and fixes it with tiny wing nuts. When the day's steaming is over it's a simple matter to remove the cover and, with a purpose made ring spanner, to remove the 2in. BSP plug and look inside the boiler. If the steel boiler is to be left dry, the plug can be left out to allow the boiler to dry out while it's still hot, thereby eliminating the corrosion which continues when the boiler is out of use.

The boiler has a Bailey and McKay steam pressure gauge and a three-cock water gauge fitted with a proper brass and glass protector. The firebox has a sliding door and is easy to fire even though the door is located below the second shaft. It steams well on our local fuel and, with only a couple of inches of coal on the grate, the engine will run with a full load. If the firebox is filled much higher, the safety valves will simply blow off all the time. Make an injector? Many of us shy away at the thought but not Stuart who simply looks up his *M.E.s*, made some reamers according to the advice and, believe it or not, made an injector which worked almost immediately.

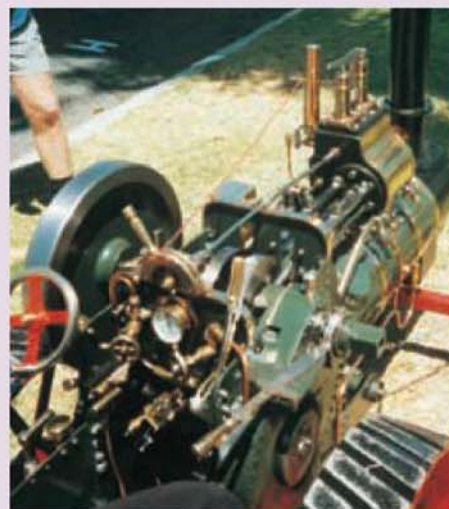
Anyone requiring more information about this engine is welcome to e-mail me at watosteam@smartchat.net.au or to write me at 10 Scarp Terrace, Willetton, Western Australia 6155.



The 6in. Wallis poses alongside Stuart's first traction engine model, a 1in. Minnie.



Left hand side detail of the Wallis steam tractor showing the pump and fabricated steering worm.



'The works' of Stuart Martin's 6in Wallis & Stevens steam tractor with a steel Briggs boiler.

CLUB CHAT

With Stan Bray

UK News

Building activities at the school at which their track is situated has led to some disruption of normal Chesterfield DMES activities. Their access road and hard standing have been affected, resulting in clouds of dust settling around the site on dry days and a sea of sticky mud appearing when it is wet. Members hope that the contractors will return the ground to its original state, at the very least, when their work is finished. Meanwhile, they just have to cope with situation. This year marks the 70th anniversary of the society but as yet we have no information regarding any celebration of this event.

A large attendance at the Romney Marsh MES open weekend was particularly notable for the number of steam locomotives present. While most societies find that steam power is outnumbered by non-steam models nowadays, only one electric-powered model was to be seen during the entire weekend. With plenty of activity on the garden gauge layout it was noticeable that radio control of locomotives appears to be on the increase. It is estimated that some 250 visitors attended during the weekend, including a small party on a visit to a Gala Day organised by the Romney Hythe and Dymchurch Railway. Although several meetings have been adversely affected by rain, special events have generally been blessed with good weather, including the annual midsummer gathering and barbecue which was held on a bright sunny day, attracted an attendance of about 150, and encouraged a number of members to steam their locomotives.

A popular autumn North London and South Hertfordshire area event is the annual St. Albans DMES exhibition which this year moves to Francis Bacon School in Drakes Drive, St. Albans and will take place over the weekend 28/29 September. We are promised an excellent selection of models covering a broad range of model engineering interests together with many covering other modelling disciplines. With support from other societies and traders, the notorious society sales stand will offer its usual collection of bargains; we understand that some visitors attend the exhibition mainly to visit this stall! Members and their guests recently filled a coach to visit the Bluebell Railway where they were able to enjoy a visit to the locomotive,

carriage and wagon works as well as a roast pheasant luncheon.

The cost of alterations

necessary to bring their railway to conform with HSE regulations has obliged Staines SME to increase the fares charged for rides. Unfortunately, poor weather has meant that the anticipated increase in revenue has not yet materialised. To comply with their insurer's requirements, from 2003 all steam locomotives used to haul members of the public are to be fitted with spark arresters, a sensible precaution in the present day litigious climate, no matter how minor the issue. We wonder whether this ruling will include gas and spirit fired models! Gas firing is popular in America and Germany and with no problem from spark emissions, those who have no desire to fit arresters may see this as a possible way forward. A new section of station platform has been laid inside the club track; an aid to safety, passengers alighting from trains can now put both feet at the same level on firm ground on each side of the track, making it easier to get off.

Awards at the annual Taunton ME trophy night were made as follows: the *Logan Trowel* to Ian Grinter and Tom Dominey; the *Jack Gardener Trophy* to Ian Grinter; the *Foden Tankard (pour encourager les autres)* to John Hockett; the *Bits and Pieces Cup* to Andy Cooke and the *Stationary Engine Award* to Alex Hadfield.

The annual Bradford MES pop-pop boat competition attracted a lower entry than usual this year, the adults seemingly having more or less given up as they don't seem able to compete with the expertise demonstrated by the juniors. The winner was Chris Eddison who beat his brother Daniel by 0.1 second. Part of a social evening, the event is enjoyed by many members and their families, and the tracks were in use by several being introduced to the intricacies of driving locomotives. Society members who have been supporting the technology department of a local school have been surprised and delighted at the interest shown by the pupils. Generally speaking and not unnaturally, the youngsters' interests were basically different to those of the average model engineer and the most popular occupation was building hovercraft for radio control operation. A few 15 year-olds were assisted in building a large (12kg) robot to compete in the televised robotic competition. They beat all comers in the Suffolk heats and go on

to the next round in Essex. Despite beating the overall winner in two straight contests, they did not win overall but still received a handsome cash prize. The members of the society concerned have so much enjoyed helping the youngsters, and are so impressed with their keen and pleasant attitudes, that they have offered to continue when the school returns after the summer holiday, feeling that they are definitely helping the youngsters develop an interest in engineering and associated matters.

A total of 26 locomotives were to be seen on the track during a fine and warm Wigan DMES Open Day at which the new pavilion was in use. The society is temporarily without the services of its Secretary John Chamberlain who has been in hospital for heart surgery from which we are happy to report he is making a good recovery. To give him plenty of time to recuperate, Bob Connor has stepped into the gap; letters to the club should be addressed to Bob at 76 Bentham Road, Standish WN6 09D.

A 'Steam Train Rides Here on Sunday' banner at the entrance to the Northampton SME track in Delapré Park for the week prior to public running sessions has resulted in an increasing number of passengers. It pays to advertise! In the interests of safety, a rule has been introduced that no-one is to work at the site alone but must be accompanied by another person. The only exception to this rule is if the person concerned has a mobile 'phone with them. Proposals have also been made concerning safe working practices in the club workshop.

A number of enthusiasts for the gauge, and members of the National 2 1/2in. Gauge Ass'n attended the official opening in August of the 2 1/2in. gauge track now incorporated into the Fylde SME railway. This marks a milestone in the history of the club and fills a gap in the North West where 2 1/2in. gauge tracks are few and far between. It has been decided to go ahead with the construction of a ramp to allow locomotives to be loaded and unloaded safely from motor vehicles; it will connect to a lifting turntable and will then give direct access to the steaming bays.

News from Tyneside SMEE indicates that rapid progress has been made with the new track. This is due both to the method of organising the construction, and to the efforts of the dedicated band that has been carrying out the work. A talk on model racing yachts by Jim Fewster, Secretary of the Model

Boat Club in Exhibition Park, attracted a good audience of society members. Due to other commitments, Malcolm Halliday, who has been club Secretary since 1995, during which period he has covered a number of other posts as well, has decided to stand down, but will continue as Programme Secretary. Ian Spencer, a former Chairman of the society will now take over as Secretary and Malcolm's many other jobs shared out among others.

'Just in time' is a commonly used expression to describe a modern concept by which an industrial company carries the minimum of stock and orders material from a supplier who undertakes to deliver it 'just in time' to be used for the contract. There are some who have been heard to employ other descriptions, such as just too late — but that's another story! All that said, members of Hereford SME were just in time when it came to completing their track extension, the Jubilee Loop, and an additional siding. The work was completed and in use for their open day in June, which was attended by a number of members from other local societies. The result was a much slicker operation than previously, with the minimum of delays and more trains operating simultaneously. Work is now progressing on a new signalling system which is expected to be ready just in time for the autumn rally of the Southern Federation of Model Engineering Societies in September.

World News

Australia

Despite the very cold winter weather during June and July, a large number of members attended the track meetings of the Steam Locomotive Society of Victoria, and there has also been plenty of support from the public when the track has been open to them. We learn that each locomotive has its group of fans who want only to ride behind that particular engine. This causes difficulties for station staff responsible for organising the loading and unloading of trains. A track about 50 metres long with a long siding for preparation and disposal of locomotives has now been completed for gauge 1 models. As well as passenger hauling tracks, the society now has facilities for both gauge 0 and gauge 1 models.

New Zealand

It has been noticeable that, although plenty of examples of traditional machining are still to be seen among the work shown by Auckland SME members on club nights, there is a

In Memoriam

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

Eddie Frow
David Jones
Brian Kessler-Lyne

Durban SME
Wigan DMES
Gauge 1 MRA

steady increase in the amount done with the use of CNC facilities. To improve safe operation at the track, two new stop signs have been made for insertion into sockets located at certain places known to be potentially dangerous. There are three such positions around the station point-work, and the use of these signs will ensure that drivers cannot mistake when it is inadvisable to proceed.

Useful publicity for **Hutt Valley MES**, and indeed for the hobby as a whole, should result from an arrangement the club has made with a local bookshop. The shop is prepared to exhibit models supplied by club members, and to accompany them with a display and promotion of books relating to model engineering and allied topics. A couple of recent talks have enlightened members on the use of sunlight to harvest energy. The first was about the manufacture of fuel cells while the second concerned actual uses of solar energy.

The laying of a concrete barbecue area and apron around the station by members of **Maidstone MES** had to be fitted in on the few fine days which occurred during a spell of very bad weather during June and July that appears to have affected the activities of most societies in New Zealand. The job is now complete and all that is needed is a general improvement in the weather so members can make the most of it. An interesting outing in August was to a commercial blacksmith with a forge that houses some interesting heavy machinery. The blacksmith produces items for a number of local businesses which ensured that there was plenty to see.

Holland

The latest copy of *de Model Bouwer* carries several reports on exhibition and rallies held in Holland during early summer, including a well attended open day in May at the **Maasoever Railway** of Mbv Hoekseward, on an extensive ground level railway catering for 5 and 7 1/4 in. gauges. A large complex of buildings house the locomotives and rolling stock, and there is a fully covered station for the comfort of passengers and station staff. Running through a wooded area, the track includes a stretch through a tunnel as well as across a trestle bridge. Several magazine pages are devoted to the revamped Dutch Railway Museum which houses a good collection of locomotives and rolling stock in pleasant surroundings. Details of a number of society events are included but regrettably, by the time these were received, the

events had passed. Nevertheless, it demonstrates the strength of the activity in Holland.

Japan

With a terrible monsoon devastating much of the country, followed by very hot weather that made it uncomfortable to go outside, climatic conditions have also made problems for the **Japan Couplers Friends Club** which organised a night run to take advantage of more suitable temperatures. Two models of a particularly high standard have been much admired by members. One is a 5 in. gauge 0-4-0 based on a German prototype and built by Mr. Shotarou Saitou. It features Hackworth valve gear and a very fine example of a working steam pump, and has all the features of the original locomotive. The other is a recently completed model of a BR Class 4 2-6-4T built to works drawings by Kenji Kantou, a member of the **Japan Miniature Railway Club**. A total of 160 drawings were made to detail all the parts and much information was gleaned from Edward Talbot's book *British Railways Standard Steam Loco-*

motives. Most of the model is fabricated with castings made only for the wheels and cylinders. Mr. Kantou has also used a commercial pressure gauge. Everything on the model is correct to prototype, except for the internal configuration of the copper boiler which has been built to steam properly in the reduced size. An absolute masterpiece, we understand that the locomotive runs as well as it looks. Built to a scale of 1:11.3 which differs very slightly to the more usual 1 1/16 in. to the foot, it is spot on for a model running on 5 in. gauge track.

South Africa

A society from which we cannot recall ever having heard before, **Knysna SME**, has sent us a copy of their very interesting newsletter. It seems that the newsletter is a resurrection of one last published some ten years or so ago. It was confirmed at their May AGM that a considerable amount of work on the track had been undertaken in the previous 12 months. Club evenings are held on the third Wednesday of every month at members' homes on a rotational basis and invariably conclude with a

visit to the host's workshop. Track meetings are on the first and third Sunday morning of every month. The society would be pleased to welcome visitors or potential members and further information can be obtained from the Secretary Mr. E. G. (Chappie) Chapman (tel: 044-533-0345).

The **Durban SME** portable track was kept very busy when the club attended the Durban Wheels Show. A minimal charge made for rides just about covered the cost of coal and oil, but far more important than this revenue was the valuable publicity gained by the society. Requests from 11 members of the public for application forms to join the society will hopefully result in the club gaining some much needed new members. A survey of land which is anticipated to be available for a club track extension has revealed gradients which will require some heavy earthworks; further discussions will therefore be necessary.

Canada

Troubled by weeds, members of **Ottawa Valley Live Steamers and Model Engineers** are re-ballasting their track to a greater width in the hope that this will impede weed growth. Members claim to have the fastest growing weeds to be found anywhere, a claim which we suspect will be hotly disputed by quite a few other clubs! In the interests of environmental conservation, chemical weed killers have been shunned and the weeds are removed by hand, physically digging them out by the roots. The efforts of one member to burn them out seem to have resulted in making them grow even more vigorously. As if the weeds weren't enough of a problem, vandals make their life even more difficult with continual attacks on club facilities. They seem to be fascinated by the toilet, and their attempts to wreck it have kept club members constantly busy replacing the door.

More space has been created in the **British Columbia SME** library to accommodate the increasing number of books available, and to make it easier for members to locate the books they require. A survey has been carried out on the site for the new raised track and a final vote on whether or not to proceed will be taken by the whole membership. Work on the new club locomotive is making steady progress despite a delay in the delivery of motor/gearboxes from the UK. The model will feature a few unusual ideas, including plastic axleboxes with double-row, self-aligning double-sealed bearings.



Above: Shotarou Saito's 5 in. gauge 0-4-0T is based on a German prototype. Below: Kenji Kantou's superb 5 in. BR Class 4 was built to works drawings and is perfect in virtually every respect.



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.

To 20 October Talylyn Railway. First Class for Sunday Lunch. Enquiries: 01654-710472.
To 22 September Talylyn Railway. Talylyn Vintage Train. Enquiries: 01654-710472.
To 30 September Kew Bridge Steam Museum. Exhibition: Richard Trevithick –
Maverick Genius of Steam. Information: 020-8568-4757.

SEPTEMBER

- 20 Rochdale SMEE. Bits & Pieces. Contact Mike Foster: 01706-360849.
20 Romford MEC. Jack Willis: Steam Tugboat 'Portway'.
Contact Colin Hunt: 01708-709302.
20-22 Guild of Model Wheelwrights at Sandown National Woodworking Exhibition,
Esher, Surrey. Contact Biddy Hepper: 01492-623274.
21 Basingstoke DMES. Inter-Club Efficiency Day. Contact Ian Shanks: 01420-561741.
21 Chesterfield MES. Running Day. Contact Mike Rhodes: 01623-648676.
21 Hereford SME. Southern Federation Autumn Rally.
Contact John Arrowsmith: 01432-265151.
21 North London SME. Visit by MENCAP. Contact Tony Dunbar: 01992-465625.
21 STEAM – Museum of the GWR. Meet the Railway Workers.
Information: 01793-466646.
21 Tonbridge MES. Open Day. Contact D. C. Brunning: 01732-352153.
21 Welling DMES. Open Day. Contact Reg Hawes: 0208-859-1952.
21 York City & DSME. David Hulst: Early Steam Engines.
Contact Ken Bateman: 01904-421445.
21/22 Amberley Museum. Miniature Steam & Model Weekend.
Contact Derek Kilburn: 01798-831370.
21/22 Vale of Aylesbury MES. Full size Traction Engine Rally.
Contact Clive Ellum: 01296-623433.
21/22 Claymills Pumping Engines. Open Days. Contact: 01283-509929.
21/22 Fyde SME. Club Stand at NFMRG show. Contact Alan Reid: 01253-882872.
21/22 Kew Bridge Steam Museum. London Open House Weekend: Free Admission.
Information: 020-8568-4757.
21/22 STEAM – Museum of the GWR. The Great Western Steam Convention.
Information: 01793-466646.
21/22 Guild of Model Wheelwrights at Holkham Country Fair, Holkham Hall, Norfolk.
Contact Biddy Hepper: 01492-623274.
22 Hereford SME. Open Day. Contact John Arrowsmith: 01432-265151.
22 MELSA. Bracken Ridge. Contact Graham Chadbone: 07-4121-4341.
22 Plymouth MSLS. Running Day at Plym Valley Railway.
Contact John Brooker: 01752-671722.
22 Staines SME. Running. Contact Mike Kingham: 01932-788793.
22/23 British Columbia SME. Fall Meet. Contact Sean Laurence: (604) 931-1547.
23 Bedford MES. Other Interests Night. Contact Ted Jolliffe: 01234-327791.
23 Cardiff MES. Brean Sands Modellers' Visit. Contact Trevor Jenkins: 029-20755568.
23 Hornsby ME. Meeting. Contact Ted Gray: 9484-7583.
24 Chelmsford SME. Raymond Payne: How to Build a Working Diesel-Electric
Loco. Contact D. Blake: 01376-324205.
24 Historical MRS (E. Lancashire/N. Manchester Group). John Lloyd: Modelling
Trees, Bushes and Other Vegetation. Contact John Sykes: 01706-823989.
24 Romney Marsh MES. Track Meeting. Contact John Wimble: 01797-362295.
24 Wigan DMES. Darren Brown: Robot Wars.
Contact John Chamberlain: 01744-882255.
25 Chingford DMEC. Auction Night. Contact Martin Masterson: 0208-989-5552.
25 Historical MRS (Bedford Area). John Fry: Bulleid Locomotives of the
Southern Region (Part 2). Contact John Channery: 01442-851214.
26 Leyland SME. Meeting. Contact Alan Wilson: 01942-715072.
26 Historical MRS (Bristol Area). Meeting. Contact Gerry Nichols: 0117-973-1862.
28 Hornsby ME. Family Day. Contact Ted Gray: 9484-7583.
28 Maidstone MES. Visit by Beechurst. Contact Martin Parham: 01622-630298.
28 Maxitrak Owners Club. Open Day at Maxitrak Ltd.
Contact Eric Penn: 0208-979-4335.
28 Rugby MES. Night Steam-Up. Contact David Eadon: 01788-576956.
28 Surrey SME. National 2 1/2in. Gauge Ass'n. Rally.
Contact John Cook: 020-8397-3932.
28/29 Elmdon MES. Running at Belbroughton Scarecrow Weekend Festival.
Contact Chris Giles: 0121-458-1291.
28/29 Great Western Soc. (Didcot Railway Centre). Steam Weekend.
Contact Jeanette Howse: 01235-817200.
28/29 St. Albans DMES. Society Exhibition. Contact Roy Verden: 01923-220590.
28/29 Talylyn Railway. AGM Weekend. Enquiries: 01654-710472.
29 Aldergrove ME. Fall Meet. Contact Alex & Bram DeRuiter (604) 856-9420.
29 Chichester DSME. Steam on Sunday. Contact Brian Bird: 01243-542266.
29 Guildford MES. SMEE Day. Contact Dave Longhurst: 01428-605424.
29 Keighley DMES. Open Day. Contact K. Parkin: 01274-564866.
29 Lancaster and Morecambe MES. End of Season Running Day.
Contact Harry Carr: 01524-411956.
29 Lincoln DMES. Running Day. Contact Paul Thompson: 01522-888228.
29 MELSA. Sunday in the Park. Contact Graham Chadbone: 07-4121-4341.
29 N. W. Leicester SME. Enthusiasts' Day. Contact John Elliott: 01455-847040.
29 Ottawa Valley Live Steamers. Steaming Day. Contact John Bryant: 761-1109.
29 Oxford (City of) SME. Running. Contact Chris Kelland: 01235-770836.
29 Romney Marsh MES. Autumn Track Meeting.
Contact John Wimble: 01797-362295.
29 Ryedale SME. Passenger Day. Contact Michael Burch: 01439-788033.
29 Woking MRS. Open Day. Contact Ronald Dewar: 01932-343331.

OCTOBER

- 1 Basingstoke DMES. Meeting. Contact Ian Shanks: 01420-561741.
1 Romney Marsh MES. Bits & Pieces + Bring & Buy.
Contact John Wimble: 01797-362295.
1 South Durham SME. Meeting. Contact B. Owens: 01325-721503.
1 Stamford MES. Brian White: Nene Valley Railway.
Contact David Ash: 01780-751211.
1 Surrey SME. Des Adeley: Talking of Castings. Contact John Cook: 020-8397-3932.
1 Taunton ME. H. Davies: 'An Engine Driver I'd Like To Be'.
Contact Don Martin: 01460-63162.
2 Bristol SMEE. Roy Williams: Severn Tunnel – A Footplate Man's View.
Contact Trevor Chambers: 01454-415085.
2 Chingford DMEC. Bits and Pieces. Contact Martin Masterson: 0208-989-5552.

- 2 Guildford MES. Brain Harris DFC: The Stirling Bomber Project.
Contact Dave Longhurst: 01428-605424.
2 Hull DSME. Jeff Chilver: Basic Techniques. Contact Brian Rylance: 01482-647032.
2 Leeds SMEE. Meeting. Contact Edwin Hughes: 01757-707454.
2 Staines SME. Meeting. Contact Mike Kingham: 01932-788793.
3 Cardiff MES. Bits & Pieces. Contact Trevor Jenkins: 029-20755568.
3 South Lakeland MES. Meeting. Contact Adrian Dixon: 01229-869915.
3 STEAM – Museum of the GWR. Tim Bryan: Take the 'A' Train.
Information: 01793-466646.
3 Sutton MEC. Bits & Pieces. Contact Mike Dean: 0208-657-5401.
3 Lincoln DMES. Meeting. Contact Paul Thompson: 01522-888228.
4 Maidstone MES. Bits 'n' Pieces + Fish 'n' Chips.
Contact Martin Parham: 01622-630298.
4 Portsmouth MES. Video Night. Contact Bob Aldred: 023-92-523366.
4 Rochdale SMEE. AGM. Contact Mike Foster: 01706-360849.
4 Romford MEC. Competition Night. Contact Colin Hunt: 01708-709302.
4-6 Great Western Soc. (Didcot Railway Centre). Day out with Thomas.
Contact Jeanette Howse: 01235-817200.
5 Chelmsford SME. Open Day. Contact D. Blake: 01376-324205.
5 Isle of Wight MES. Track & Pond. Contact Ken Stratton: 01983-760762.
5 Leighton Buzzard NG Rly. Steam Glow. Enquiries: 01525-373888.
5 Maidstone MES. Visit by Sutton. Contact Martin Parham: 01622-630298.
5 STEAM – Museum of the GWR. Meet the Railway Workers.
Information: 01793-466646.
5 York City & DSME. Ron Gilbert: Signalling & Interlocking.
Contact Ken Bateman: 01904-421445.
5/6 Barrow Hill Engine Shed Society. Diesel Gala. Contact Kate York: 01246-472450.
5/6 Kew Bridge Steam Museum. Festival of Steam Models.
Information: 020-8568-4757.
5/6 The Society of Ornamental Turners. Ornamental Turning Seminar.
Contact N. S. Edwards: 01234-359392.
6 Ascot LS. Members' Steam-Up. Contact Tony Alderman: 01932-854393.
6 Bedford MES. Track Meeting. Contact Ted Jolliffe: 01234-327791.
6 Frimley & Ascot LC. Running. Contact Bob Dowman: 01252-835042.
6 Gas Turbine Builders' Ass'n. Fly in at RAF Sculthorpe, Norfolk.
Contact Tom Wilkinson: 01508-570977.
6 Malden DSME. Open Day. Contact John Mottram: 01483-473786.
6 National 2 1/2in. Gauge Ass'n. Midlands Area Rally at Chesterfield DMES.
Contact Clive Young: 01233-626455.
6 Oxford (City of) SME. Running. Contact Chris Kelland: 01235-770836.
6 RAF Halton. 24th International Model Exhibition. Information: 01494-881437.
6 Reading SME. Running. Contact Graham Bustin: 01189-615450.
6 Rugby MES. Members' Running Day. Contact David Eadon: 01788-576956.
6 South Durham SME. Steaming Day. Contact B. Owens: 01325-721503.
6 Surrey SME. Members' Steam-Up. Contact John Cook: 020-8397-3932.
6 Guild of Model Wheelwrights. AGM at Stoke Heath, Bromsgrove,
Worcestershire. Contact Biddy Hepper: 01492-623274.
7 Frimley & Ascot LC. Canal Centre Meeting. Contact Bob Dowman: 01252-835042.
7 Historical MRS (London Area). Meeting. Contact John Millbank: 0208-948-0556.
7 Lancaster & Morecambe MES. Project Night. Contact Harry Carr: 01524-411956.
7 Peterborough SME. Bits & Pieces. Contact Tony Meek: 01778-345142.
8 Dockland & E. London MES. AGM. Contact P. M. Jonas: 01708-228510.
8 Romney Marsh MES. Track Meeting. Contact John Wimble: 01797-362295.
8 St. Albans DMES. Fred Bearton: Steam Crane.
Contact Roy Verden: 01923-220590.
8 Sutton Coldfield MES. Meeting. Contact Roger Timings: 0121-308-5875.
9 Chingford DMEC. Derek Brown on Sharpening Small Drills.
Contact Martin Masterson: 0208-989-5552.
9 Harrow & Wembley SME. Keith Catchpole: Coach 14.
Contact Dr. Roger Greenwood: 020-8427-2755.
10 Cardiff MES. Bring & Buy. Contact Trevor Jenkins: 029-20755568.
10 Historical MRS (Sussex Area). Mike King: Private Owner Wagons in the West
Country. Contact Terry Cole, 17 Coombe Drive Steyning West Sussex BN44 3PW.
10 Keighley DMES. Meeting. Contact K. Parkin: 01274-564866.
10 Leyland SME. Tools & Clocks Night. Contact Alan Wilson: 01942-715072.
10 N. W. Leicester SME. Bits & Pieces and Bring & Buy.
Contact John Elliott: 01455-847040.
10 STEAM – Museum of the GWR. John Chacksfield: William Stanier.
Information: 01793-466646.
10 Sutton MEC. Stationary Engines Run-up. Contact Mike Dean: 0208-657-5401.
11 Chichester DSME. Workshop Instruction Evening.
Contact Brian Bird: 01243-542266.
11/12 Hornsby ME. Birthday Weekend. Contact Ted Gray: 9484-7583.
11-13 Chesterfield MES. Steaming at Papplewick. Contact Mike Rhodes: 01623-648676.
12 Midland Federation ME. Meeting. Contact P. Humphries: 01902-661275.
12 Nottingham SMEE. Night Run. Contact Gerry Chester: 0115-9259096.
12 Oxford (City of) SME. Family Day. Contact Chris Kelland: 01235-770836.
12/13 STEAM – Museum of the GWR. Careless talk costs lives...
Information: 01793-466646.
13 Model 2002: 8th Biennial Model Gala presented by 2403 Squadron Air
Training Corps at The Hurst School, Tadley, near Basingstoke Hampshire.
Contact Keith Searle: 01189-812254.
13 Amberley Museum. Vintage Vehicle Show. Contact Derek Kilburn: 01798-831370.
13 Keighley DMES. Open Day. Contact K. Parkin: 01274-564866.
13 Leeds SMEE. Steaming Day. Contact Edwin Hughes: 01757-707454.
13 Leyland SME. Diesel Day. Contact Alan Wilson: 01942-715072.
13 Lincoln DMES. Running Day. Contact Paul Thompson: 01522-888228.
13 Malden DSME. 7 1/4in. Gauge Open Day. Contact John Mottram: 01483-473786.
13 Nottingham SMEE. End of Season Run & Dinner.
Contact Gerry Chester: 0115-9259096.
13 Ottawa Valley Live Steamers. Steaming Day. Museum's Harvestfest.
Contact John Bryant: 761-1109.
13 Plymouth MSLS. Running Day at Plym Valley Railway.
Contact John Brooker: 01752-671722.
13 Southland SME. Ghost Branchlines Rail Tour. Contact Peter Stark: 03-21-89702.
13 Sutton MEC. Track Day. Contact Mike Dean: 0208-657-5401.
13 Weston Park Min. Rly. SEQLEC 2002. Contact Bruce Whalley: 01952-850555.

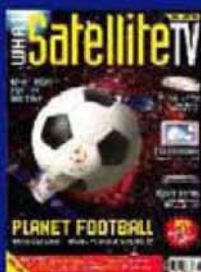
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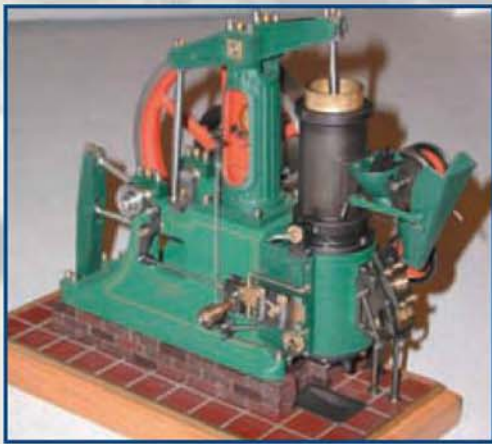
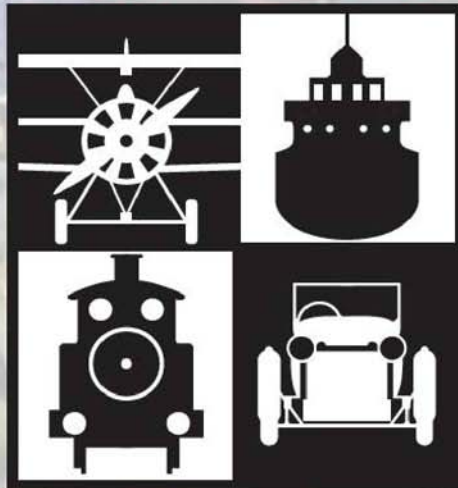
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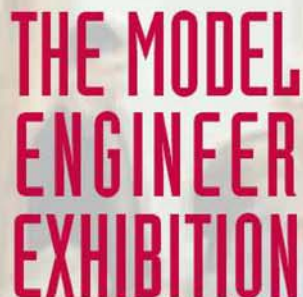
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From M25 North and West: Exit at Junction 10 onto A3 towards London. Exit onto A244 at Esher Common roundabout, signposted to Sandown Park. Turn right onto A307, Esher High Street at T-junction/traffic lights. Sandown Park can be found 1/4 mile along on left-hand side.

From M25 South and East: Exit Junction 9 onto A244 towards Esher, over the roundabout at Esher Common, then as above

By train

From London and the North: From Victoria, Waterloo or Clapham Junction to Esher Station (20-30 minute journey). Taxi rank at station or 2/3 mile walk as follows: left onto Station Road, right at T-junction onto A307. Sandown Park can be found 1/2 mile along on right-hand side.

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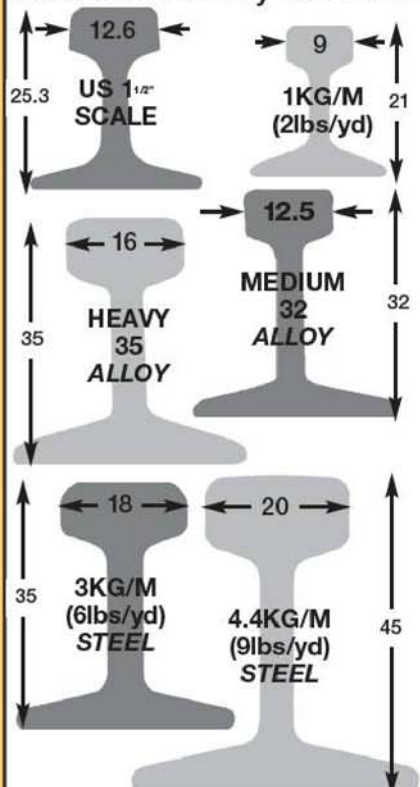
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DRILLS

DRILLS		
ARBOGA ER 25/25" Radial Drill speeds (R) 100-2900 RPM		Just in \$1,495
ASQUITH H-64 001 Mig (5mm) Radial Drill		Immediate coming in \$3,990
FDBCO 1/2" Bench, sitting table		\$245
FDBCO 1/2" Pedestal drill sitting table		\$345
MEDONGS 1/2" pedestal drill		\$245
MEDONGS 2 Mize super pedestal drill		Choice \$275
MEDONGS 1/2" 10 Speed 2MT Bench 240 volt drill		\$390
MEDONGS 1/2" 2 Speed 2MT pedestal drill, table in rack		\$575
POLLARD CORONA 1/2" pedestal drill, 1/2" motor		From \$575
SIP HDP06B 1/2" / 2mt Bench drill		New \$125
STAR TRITE-MERCURY 1/2" 4 speed bench drill		\$275
STAR TRITE-MERCURY 1/2" pedestal drill, 240 volt		As New \$390
WASCO 3MT Pedestal R speed drill		\$445

GRINDING / BUFFING

GRINDING / BUFFING	
CLARKSON MG Tool and cutter grinder	Choice \$550
JONES and SHIPMAN 540 Surface Grinder w/Magnetic Chuck	Ex Collage/Seen no work \$1800
MILFORD 12" Pedestal Grinder	\$325
R.J.H. Buffing Machine, pedestal model	\$325
WAB 650GR 6" Disc Grinder	\$325
VICEROT Grinder, pedestal model	As Is \$145
VICEROT Buffing, pedestal model	See \$145

MISCELLANEOUS/FABRICATION MCH

MISCELLANEOUS/FABRICATION MCH.	
Large quantity of slips, height gauges, squares, straight edges, micrometers, cubes, angle plates, stakes, weights (kilos) and miscellaneous measuring tools. Just in flamesurf CG 100 ceramic chip base	\$345
FLAMEFAST CG 100 heart	\$140
ER EDGE PORT sloting head	\$780
MARLCO broaching press	\$625
KCF M-DATA 020 top welder	\$625
TRANSARC 150 - Transarc 150	\$625
STAR TRITE 18 V 100 ft/wall hand saw complete with welder attachment	\$1800
JONES AND SHIMAN 4" x 24" bench centers	\$245
TOM SENIOR sloting head	\$450
STAR TRITE 18 V 5.5 woodwork and non ferrous hand saw	\$250

DIAMOND Jet saw, variable speed		£345
RJH BT 125 Fetaaw, variable speed		£345
SMART AND BROWN / CLARKSON H3 H5 toggle press	each	£106 / £275
ARRAND 2MT long milling spindle	As new	£75
MYFORD Tri-LEVER Attachment		£245
VERIDICT Clocks, Longshot Metric and Imperial models	As new	£40
RJH variable speed 12" fetaaw		£325
FLAMEFAST LD300 Soldering Iron Slew		£75
GRANITE 12" x 12" Surface Plate		£70
VEROSHEAR Nibbler	Just in	£425
TRIUMPH BURNERD 4 Jaw Chuck		£245
VANCO Linisher	Very Nice	£345
ESEWAY hardness Tester Type R		£425
JONES AND SHIPMAN Broaching Press + Stand		£375
CLARKSON Drill Point & Tap Lead Grinder ATT		£425
CLARKSON Mk1 Radius Grinder Attachment		£245
ABB Inverter & 1/2 hp motor, wired up		£225
FLAMEFAST moulding bench		£100
5P 7" bandsaw, horizontal & coolant	New / £70	
WELLSAW HACKSAW	Choice	£245 - £345
BRIDGEPORT CHERY high speed drilling head		£725
MYFORD dividing head		£395
STARTRITE ac3150 cut-off saw		£750
DUPLEX D20 toolpost grinder		£345
EDWARDS cast iron set rolls		£325
BOXFORD (Imperial only) thread dial indicator		£65
HOFFMAN ROTARY TABLES	Selection	
BURNERD, D13 6 jaw Origins chuck		£345
VANCO, 1" finisher / vertical + extractor		£495
BURNERD, D34 lever collet chuck + collets		£400
BURNERD, LO lever collet chuck + collets		£400
VERTEX Dividing head	New / £245	
VERTEX 6" - 8" - 10" rotary tables	New / From £135	
BOXFORD Turret attachment 41/2" + quantity of drill chucks		£525
MYFORD ML7 / Super 7 rear tool post		£40
MYFORD 254S rear tool post		£40
MYFORD Vertical slide / fixed type (copy)		£60
OLIVER - ADRIAN FILER	New	£49
LOCKWOOD quad headed 2mt Die Holder	New	£40
LOCKWOOD quad headed 2mt Die Holder	New	£40
LOCKWOOD Test Bar / 2mt bored	New	£39
LOCKWOOD Test Bar / 3mt bored	New	£42
MAGNETIC chuck - 15" x 6" fine pole	Never used	£325
TOM SENICH Model E pedestal stand		£150
UNION tool and cutter grinder stand		£135
HARDINGE Capstan type toolpost		£175
HARDINGE Headstock, bed mand, stand and motor		£150
50 INT Tooling Selection	Just in	
STARTRITE 225 woodworking band saw		£975
STARTRITE 145-5 woodworking band saw		£775
ALCOA OF 600T Rapid Melting Furnace		£300
GASRO BF620-2, 24" Bar and Pan general use folder		£325
MYFORD Burned Origins 3 Jaw Chucks	Bored	£250
COLCHES TERHARRISON D13 Burned 4 Jaw 8" light body independent chucks	Bored / £250	
RJH 4" Linisher / Vertical (Built in Extractor)		£625
KLKS various	£200 / £425	
MICROMETERS and associated measuring tools	5/8" packaged as new	
POTTER WHEELS, kits and associated equipment	Just in Cheap	
SPECIAL Powder type press		£225
HARRISON L5 Taper turning attachment		£325
HARRISON L5 Metric Gasbeker	As is	£250
HARRISON L5 Tailstock		£245
NEW FROM NEW ZEALAND - Machine vice, 65mm Jaws precision miniature type ideal for vertical slides and smaller milling machines		£85
5P 1 TONWOBILECRANE Manufactured 2000	As new	£245
MITUTOYO grade A set of slips		£245
MARLCO KNURLERS (slump type)		£75
F.J. EDWARDS 24" hole cutter		£525
RECORD NO.24 quick release bench vice		£30
LINK1 5 ton vehicle crane + top hat		£525
MITUTOYO 100-613 metric set micrometers		£275
COLCHES TER CHIPMASTER / BANTAM turret capstan attachment		£475
NORTON / EDWARDS arbor press		£75 / £145
ALJAX 6" hand saw		£425
SURFACE plate from 12" x 12" to 36" x 36"	Very nice from £30	
WEBER 150 ton mobile garage crane, late blue colour		£495
ELLIOTT 1250 STURDIMILL vertical head	One off (new)	£525
RJH leafier 4" wide belt, pedestal		£345
STEEL STOCK	Just arrived - 10 c/m only	
ELLIOTT U / U2 Slitting Head		£475
SWAGE BLOCKS	£125 / £145	
J&S Universal grinding vice	Choice	£275 / £325
BOX TABLES: Grade A and B, many sizes		£40 - £150
SLIPS / GAUGES Metric / Imperial, New Sets, 67 / 81 piece		£215 / £145
HORIZONTAL METAL BANDSAW 6" x 41/2" capacity	New / £170	
COLCHES TER STUDENTMASTER Round head, face plates, small range		£50 / £300
QUALTERS AND SMITH 6" Hand saw		£345
BORING Heads D2 Morse, R5 Taper, Max. Gap 41/2"	New, each	£30
DDONI Machine Bed Clamps (pair)	Special	£24.50
HEIGHT GAUGES by Ghemman, Sharlow, Moore and Wright		From £95
ELLIOTT 10M Shaper, 10" stroke		£325
DRE Boxes	From £45	
TRANSWAVE 3HP Converter	New	£225
TRANSWAVE 5.5HP Converter	New	£305
TRANSWAVE 22K - RT rotary converter	New	£525
CRIMPON PARKINSON 38 HP, assistant mount, Bostich / Myford Super 7 Type motor	New	£175

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INTRODUCING THE NEW DB RANGE OF LATHE'S



From
£880

Mini - Multi

- Swing over bed: 125mm
- Spindle bore: 8.5mm
- Tailstock travel: 20mm
- Speed range variable: 100-2500rpm
- Range of threads (inch): 1.6-40TPI (metric): 0.4-1.25mm
- Motor: 250W
- Net weight: 25kg
- Distance between centres: 200mm
- Tailstock taper: MT1
- Cross-slide travel: 70mm

Lathe £295
Mill & Lathe £395



Price include VAT
& Delivery UK

Conquest Lathe

- Swing over bed: 180mm
- Spindle bore: 19mm
- Tailstock travel: 60mm
- Speed range variable: 100-2500 rpm
- Range of threads (inch): 12-52TPI (metric): 0.25-1.5mm
- Motor: 1/2hp
- Net weight: 30kg
- Distance between centres: 300mm
- Tailstock taper: MT2
- Cross-slide travel: 70mm
- Dimensions (LxWxH): 770x254x300
- 1-10mm Drill chuck and Arbor

NOW INCLUDES TEST CERTIFICATE

£395



Price include VAT
& Delivery UK

920 Lathe Deluxe

- Swing over bed: 229mm
- Swing over cross slide: 133mm
- Distance between centres: 500mm
- Spindle bore: 19mm
- Taper in spindle bore: MT3
- Motor: 1/2hp
- 6 Speed: 100-1000rpm
- Net weight: 100kg

STANDARD EQUIPMENT:

- 4" 3-jaw chuck with 2 sets of jaws
- 7" 4-jaw chuck with reversible jaws
- Steady rest • Follow rest
- MT2 Dead centre
- MT3 Dead centre
- 4-way tool post
- Face plate
- Tool Box & Tool Kit
- Turn & Spin stand



£699

Price include VAT
& Delivery UK

Model B-Super

- Swing over bed: 420mm
- Distance between centres: 500mm
- Mill drill spindle taper: 19mm
- Tailstock barrel travel: 80mm
- 7 speeds: 60-1360rpm
- Swing over cross slide: 160mm
- Spindle taper: MT3
- Draw bar MT2
- Cross slide travel: 100mm
- Motor: 1/2hp
- Net weight: 155kg

STANDARD EQUIPMENT

- 4" 3-jaw chuck
- 2 dead centres
- 1/2" drill chuck
- Change gears
- MT3 chuck arbor

£725



Price include VAT
& Delivery UK

Comet Lathe

- Swing over bed: 250mm
- Swing over cross slide: 133mm
- Distance between centres: 550mm
- Spindle bore: 19mm
- Taper in spindle bore: MT3
- Motor: 1/2hp
- 6 Speed: 125-2000rpm
- Net weight: 130kg
- Mill Attachment
- Spindle taper: MT3
- Head travel: 215mm
- Speed variable
- Range: 0-3,000rpm
- Motor: 1/2hp
- Net weight: 45kg

£1155

Price include VAT
& Delivery UK



Centurion

- Swing over bed: 420mm
- Distance between centres: 520mm
- Mill drill spindle taper: MT3
- Tailstock barrel travel: 80mm
- 7 speeds: 160-1360rpm
- Swing over cross slide: 160mm
- Spindle taper: MT3
- Draw bar MT2
- Cross slide travel: 200mm
- Motor: 2 x 1/2hp
- Net weight: 230kg

STANDARD EQUIPMENT

- 4" 3-jaw chuck
- 2 dead centres
- 1/2" drill chuck
- Change gears
- MT3 chuck arbor

£1395



Price include VAT
& Delivery UK

Craftsman Precision Belt Drive

- Swing over bed: 300mm
- Distance between centres: 570mm
- Cross slide travel: 150mm
- Tailstock barrel travel: 92mm
- Net weight: 390kg
- Swing over gap: 450mm
- Spindle bore: 36mm
- Compound travel: 69mm
- Range of speeds: 50-1250rpm
- Swing over saddle: 170mm
- Spindle bore taper: MT5
- Tailstock barrel taper: MT3
- Motor: 1 1/2 hp

STANDARD EQUIPMENT:

- 6" 3-jaw chuck with 2 sets of jaws
- 8" 4-jaw chuck
- Steady rest • Follow rest
- Sand • Face plate
- Splash guard • Threading dial
- 4-way thread tool post
- MT2 dead centre
- T-slotted cross slide

£1599

Price include VAT
& Delivery UK



Cub 620/630

- Swing over bed: 300mm
- Distance between centres: 500/750
- Spindle bore taper: MT5
- Tailstock barrel taper: MT3
- Number of inch threads: 33
- Approx shipping weight: 380kg
- Range of metric threads: 0.25-9.0mm
- Swing over gap: 430mm
- Spindle bore: 38mm
- Cross slide travel: 160mm
- Tailstock barrel travel: 70mm
- Range of inch threads: 4-72 TPI
- Number of metric threads: 27
- Motor: 1 1/2hp 240v or 2hp 415v

STANDARD EQUIPMENT:

- Hardened and ground gears in headstock
- Draw-in stand • Foot brake • Mounted light
- Footstock hardened bedways • Face plate
- Emergency stop • 4-way thread tool post
- 6" 3-jaw chuck with 2 sets of jaws
- 8" 4-jaw chuck
- Steady rest • Follow rest • 2 dead centres
- Coolant system w/ back splash guard
- Threading dial • Direct reading dial cross slide
- Removable chip tray

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