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IN THIS ISSUE

● Vol. 195 No. 4262 9 DECEMBER 2005●

On the cover ...

A gorgeous hot relaxed summers day at the annual Guildford rally where everybody had a most enjoyable couple of days. In this issue Martin Wallis looks back on the past year's traction engine rallies, model and full-size. He looks at many of the year's highlights and the low-light theft of Ron Dawe's Gold Medal winning Burrell Scenic Showman's engine and its dragon car. There is also news of a 1:3 Foster modeller taking on a full-size one which had been owned by the Rust Brothers and then spent more than 50 years in a scrap yard gathering rust.

(Photograph by David Carpenter)

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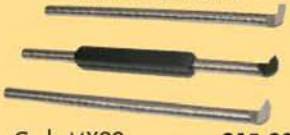

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SMOKE RINGS
With the Editors

Chronos, popular suppliers of an extensive range of tooling, are successful regulars at the Model Engineer Exhibition. This year, they are giving this lathe for a lucky Exhibition visitor to win. The Clark 300 variable speed lathe has many features usually only found on larger lathes . These include - power feed - screwcutting of left and right hand threads - 4-way toolpost - fast travel carriage - compound mitre slide - splash guard and drip tray - chuck guard - self centring 3-jaw chuck - tailstock centre MT2 - change gear set - thread cutting indicator.

Final reminder

This is the last issue in which an entry form for this year's Model Engineer Exhibition will appear. So if you are pleased with a piece of work you have completed, or have underway, fill in and return the entry form now, leaving sufficient time to receive your entrants' information pack.

Whether it is a first effort, or you think it is in with a chance of a Gold Medal, or both (rare, but not unknown) or something in between, fill in the form and get it in the post shortly. If your work is not completed, or you do not want it to be judged for an award, please enter it as a loan entry. All are most welcome.

It is always interesting to see models of a particular prototype or piece of workshop equipment, even if they are not top award winners. We rely on entirely on you, our readers, to share your models.

The setting for the exhibition, Sandown Park racecourse, is truly excellent. Most of the loan and competition models are located on the first floor, in excellent suites used for hospitality and dining on race days. Light and airy, they overlook the course and the Surrey countryside.

The main hall on the ground floor is where you can find the trade stands. Make a list of any bits and bobs you need, you will almost certainly find them there at special show prices from reputable businesses.

Club stands can be found at all levels. This year we are expecting an increased number of displays from clubs and special interest groups, including something very different,the mechanical television group, who have not displayed their fascinating exhibits anywhere before. Another will be a huge display of Meccano. A large number of Model Engineering Societies will be there including, of course, the Society of Model and Experimental Engineers with a good display of fascinating models of all types, and a team of top model engineers to give help and guidance to visitors.

This year we hope to see a number of exhibits of models we have serialised in the magazine in the past year or so. We are really looking forward to seeing Neville Evans' designs in the metal, including *Penrhos Grange*, the Loch and Jones Big Goods. Perhaps a new project, too. Other exhibits from contributors to this magazine will be on show, including the excellent drawings of Ron Isted.

Visitors last year will have marvelled at the unfinished Blackburn agricultural engine of Cherry Hill, with its boiler and cylinders built inside a revolving drum. It will be back again this year, complete and painted, having completed a successful trial run. Cherry has already won no less than seven Gold Medals and seven Duke of Edinburgh Awards. Many of her earlier models can now be seen at the Institution of Mechanical Engineers in London.

There are a number of entries for The Duke of Edinburgh Challenge Trophy this year. This championship award is competed for by previous winners of Gold or Silver Medals and features the creme de la creme of modelling.

Medals are not competed for, but are awarded by the distinguished panel of judges. It can help a lot if you present the judges with some notes about your model.

For the visitor, there is no shortage of bars and somewhere to eat. There is parking on site for several thousand cars, and Esher station is nearby.

This is the 75th time that this exhibition has been held. It looks like being one of the best ever. This really is a golden age for model engineering. Nowhere is it better represented than at Sandown Park.

Floored

We wonder how many readers pay attention to what is under their feet in their workshops. Many, no doubt, put up with whatever floor happens to be there whether it is wood or concrete. However, it is worth giving some thought to this matter as, as has been found in industry, it does make a good deal of difference to the comfort and safety of the worker and his equipment.

For example, if your floor is concrete, at the very least it should be given a coat floor paint of other sealant. This stops the oil soaking into the floor and makes it easier to clean up. It also stops the concrete dust, that is so destructive to machine tools, rising when you sweep up and makes it easier to find things that have been dropped.

One old book lent to us many years ago suggested that the 'best' workshop floor was one made of iron swarf mixed with plenty of salt and laid to a depth of 6 inches. Seeing what salt does to the family car I wonder what effect this mixture had on the underside of the feet of machines stood upon it. However it perhaps worked as well, if not better, than the wood block floors used in some parts of the world. Certainly we would be interested to hear from any reader who has experience of a floor compounded of 6in. of solid rust.

One respected model engineer is known to prefer a carpeted workshop and is adept at scrounging off-cuts from his local carpet warehouse. Very comfortable we would agree but perhaps not compatible with an environment where swarf and coolant abound. Better, perhaps, was old-fashioned linoleum both for floors and bench tops, especially if you had a plain dark colour which made even elusive 10 BA screws visible, and as long as it did not get damp underneath. Nowadays real 'lino' is unfortunately rare and hugely expensive.

Our own Neil Read has just installed some of the rubber matting offered by Machinery Mart and is well pleased with the improvement in comfort it makes. It also stops damage to tools or components accidentally dropped. There is just one snag - he chose the ribbed variety and this makes sweeping up difficult as the brush only wants to run with 'the grain' of the ribs. The smooth or studded type might have been a better choice.

We would like to hear from readers who have experimented with various flooring materials.

CHUCK, the MUDDLE ENGINEER **by B. TERRY ASPIN**

POST BAG

Boiler test pressure

SIRS, - I was most interested in the leading notes of the Nipper and Wallis Savage's article regarding boiler pressure (*M.E.* 4254, 19 August 2005). During 1955 at the LMS depot where I was working, the boilersmith and his mate were on the top frame of an Austerity engine. The safety valves had been removed and a blanking plate had been secured with a copper connecting pipe to the handpump being used. I asked *"What pressure do you pump up to?"* and the reply was *"Twice the blowing off pressure plus 50 pounds"*.

I have never forgotten that remark and in all these years this is the first time there has been any mention of it but it was obviously a requirement of the normal boiler making practice.

K. Birkby, Yorkshire.

Boiler tests

SIRS, - The letter from Mr. Whittaker regarding boiler tests (*M.E.* 4255, 2 September 2005) was very interesting and summarised very well the work of a boiler inspector, or surveyor if you prefer. The 'Thorough' examinations described can be augmented by ultrasonic thickness checks and/or dye penetrant or magnetic particle crack detection tests, and it is customary to also require a hydraulic pressure test, within a ten year period.

Such 'Thorough' examinations should, as stated, be followed by a steam test, or 'Working' examination, basically to check for leaks (from which low water conditions could ensue) and to test the 'Protective Devices', i.e., the safety valves, pressure gauges, gauge glasses, and any low water alarms and devices - if fitted.

Mr. Whittaker asks why model boilers, the type we are more familiar with, have to be subject to hydraulic test every two years.

To try and explain, let's return to the full-sized steam roller boiler quoted, or any other type of steam boiler for that matter. Part of that 'Thorough' examination requires access to the boiler internal surfaces, as Mr. Whittaker correctly points out. If the boiler inspector feels the examination is satisfactory, both in regards of the boiler's condition (internally and externally), and also what the inspector can actually see of the insides, the boiler should pass. And corrosion is not the only problem. Inspectors also look for signs of cracking and scaling which can lead to localised overheating and deformation damage.

But for small boilers, and indeed certain types of steam or air receivers, it is not possible to satisfactorily examine the internal surfaces, a good example being steam pans used in the food industry. To examine these internals could result in the destruction of the vessel! In such circumstances it is generally accepted that a hydraulic pressure test can be carried out in lieu of an internal examination,

So when it comes to model boilers, I would suggest it is not really possible to satisfactorily assess the boiler internal condition, hence the requirement to pressure test the boilers of model locomotives, traction engines etc. at frequent intervals.

And any boiler should be designed with sufficient 'Factor of Safety' (as built into the various boiler construction codes) to withstand a correctly applied hydraulic pressure test without any problem, assuming the boiler is not defective of course. But serious damage to a boiler's integrity can be caused by excessive test pressures. On no account should the test pressure exceed 1.5 times the boiler's design pressure (which is not necessarily the working pressure). I have read proposals by some model engineers that test pressures should be 2x or even 3x the design pressure. This does not prove anything over and above that of a conventional test, and is much more likely to over-stress and damage the boiler components.

It may be worth just remembering that all the air must be excluded from a boiler, prior to a hydraulic test, as compressible 'fluids' such as air or indeed steam, can contain a large amount of stored energy when at pressure.

As in full-sized practice, a subsequent 'Working' examination should take place as already mentioned. But such 'Steam Tests' should not be seen as the method of validating the safety/integrity of a steam boiler. For this a 'Thorough' examination, what ever form that may take, must always be carried out.

Laurence Blundell, Staffordshire.

Shaping curves

SIRS, - I have been reading the *M.E.* off and on since 1960, but this is the first time I felt that I should take pen in hand. I was totally entranced by John Olsen's article on page 569 of *M.E.* 4247, 13 May 2005. I reduced John's table to some elementary trigonometry and decided to share the results with you. The enclosed **table 1** contains the results of my calculations. A span of 10in. between the table pivot and the guide follower was assumed. This direction was called the 'X' axis, while the 'Y' axis was vertical. 'dx' was measured right and left from a mid-point between the pivot and the follower. The cutter was assumed to be at 'dx' = zero and at 'y' = 1.0. All this was before the table was traversed. If the guide bar extended below the table pivot, the generated curve was concave upwards. If the guide bar extended above the pivot, the curve was convex upwards.

The values of 'x' and 'y' in rows 11 thru 15 of table 1 are coordinates of points along the curve. In order to see how close the curve was to a circle an arc was fitted through three points corresponding to 'dx' values of -5, 0, and +5. The radii at points 'dx' of -2.5, 0, and +2.5 were compared. It was seen that the errors were very small.

The effect of cutter height on the radius is shown in **table 2**. It is almost linear.

The use of a 10in. table would facilitate the scaling to a smaller gadget that could cut curves suitable for model work. I recognise that all this is moot because there are not many shapers or planers out there. Still, you never know when a situation will come up where 'you need another string for your bow'.

R. Johnson, by e-mail.

Tap markings

SIRS, - Further to Mr. Tony Finn's letter "*A Cautionary Tale*", (*M.E* 4255, 2 September 2005) it is

Shaping Curves

TABLE 2

Cutter Height - Inches	Radius - Inches
5.00	7.28
4.00	7.93
3.00	8.60
2.00	9.28
1.00	10.00
0.00	10.70

TABLE - 1 — **Shaping Curves**

	A	B	C	D	E	F	G	H	I	J	K	L
2	Pin Space A, In.=		10									
3	Bar angle, Deg.=		25	0.43633	B=A-dx				F=Q+b			
4	Cutter Height,in =		1		sinU=(B/A)*sin(D3)				Z=((SC$2/2)^2+$C$4^2)^.5			
5					U=asinU				x= -(dx)cosb+Z cosF			
6					b=U-(D3)				y= -(dx)sinb+ZsinF			
7					Q=atan((SC$4)/(SC$2/2))							
8												
9	dx	B	B/A	sinU	U	b	Q	F	Z	x	y	
10												
11	-5	15.00000	1.5	0.63393	0.68682	0.25029	0.19740	0.44768	5.09902	9.44073	3.44568	
12	-2.5	12.50000	1.25	0.52827	0.55657	0.12023	0.19740	0.31763	5.09902	7.32591	1.89236	
13	0	10.00000	1	0.42262	0.43633	0.00000	0.19740	0.19740	5.09902	5.00000	1.00000	
14	2.5	7.50000	0.75	0.31696	0.32253	-0.11381	0.19740	0.08359	5.09902	2.59739	0.70963	
15	5	5.00000	0.5	0.21131	0.21291	-0.22342	0.19740	-0.02602	5.09902	0.22156	0.97515	
16												
17												
18												
19	Perp Line	dy	dx	X	Y	dy/dx	M	c	c-c	M-M	X_{ctr}	Y_{ctr}
20												
21	Pt_{-5+5}	-2.44568	-4.44073	7.22036	2.22284	0.55074	-1.81575	15.33318				
22	Pt_{0+5}	-0.02485	-4.77844	2.61078	0.98757	0.00520	-192.259	502.9332				
23									487.6000	190.4430	2.56035	10.68424
24	Check the center											
25												
26	point	X ctr	Y ctr	X point	Y point	dx	dy	Radius	Error			
27												
28	-5	2.56035	10.68424	9.44073	3.44568	6.88038	-7.23857	9.98682				
29	-2.5	2.56035	10.68424	7.32591	1.89236	4.76557	-8.79189	10.00040	-0.01358			
30	0	2.56035	10.68424	5.00000	1.00000	2.43965	-9.68424	9.98682				
31	2.5	2.56035	10.68424	2.59739	0.70963	0.03704	-9.97461	9.97468	0.01213			
32	5	2.56035	10.68424	0.22156	0.97515	-2.33878	-9.70910	9.98682				

possible Mr. Finn has drawn the wrong conclusion from the 'C' marking on his 26tpi BSB taps.

The answer I feel lies in the *Presto Counsellor* booklet on engineers cutting tools; my copy is designated publication PC3. Here it states, "*In the latest revision of BS949 the original four ground tap zone tolerances have been replaced by three ground thread classes for both imperial and metric sizes. There is an additional cut thread class.*

Cut thread tap class (previously zone 5). This class has a much wider manufacturing tolerance and is suitable only for free fit threads."

"*All Presto HSS ground thread taps are supplied to class 2 (unless otherwise ordered) Carbon steel taps are supplied to the cut thread class only.*"

On high speed steel ground thread taps it is common to see the designation 'G', 'GT' or 'GND' all of course signifying ground thread so it therefore seems reasonable to assume the 'C' designates cut thread.

After reading Mr. Finn's letter I checked my stock of taps and some of the BSB were marked 'C' as were some of the dies.

I also have 5/16in. x 40tpi taps and dies marked 'C' and also 5/16in. x 32tpi similarly marked but no manufacturer!

Just to double check I tried my Whitworth form thread gauges against the taps and as far as my ageing eyesight could ascertain all was correct. It has made me wonder in the past if the thread form on cut thread taps is affected by burrs arising from the manufacturing process. Do these burrs get hardened and then cut oversize threads?

It goes without saying that the manufacturers recommendations should be followed to produce well formed threads to a specified size. It may pay Mr. Finn to contact his original supplier who I am sure would be only to pleased to confirm the 'C' marking even after this length of time.

David Spooner, South Yorkshire.

Metric Myford

SIRS, - In response to Mr Hall's letter (*M.E* 4255, 2 September 2005), some years ago I added a screw cutting gearbox to my Myford Super 7. I also purchased a quadrant to allow gear changes to be set up. Being a mathematician by background I wondered how near an approximation I could get to the various metric threads using just the standard change wheels which had been supplied by Myford with the standard (non-gearbox) machine. These wheels, of course, were no longer in regular use having fitted the gearbox. (I also included the use of the 24T gear supplied with the gearbox for mounting on the tumbler stud)

The results are shown on the spreadsheet shown above right. All common metric threads are covered. I also show the results for the largest three BA sizes. Below 2BA I could not find acceptable ratios but in practice I have never had the need or desire to screw cut BA threads smaller than 2BA.

In my view the errors in these approximations are acceptable given the other errors (such as tool shape) that will be present.

For those interested in how I produced the answers, I used the 'Monte Carlo' method. I got my computer to generate random combinations of gear wheels and gearbox settings. Each combination then had to pass a set of tests (no wheel can be chosen twice, the wheels must be able to fit on the quadrant etc.) The thread generated by each combination that passed these tests was then compared with the thread required. It was also compared to the previous 'guess'. If the approximation was worse it was rejected. If better, it was kept. I ran some nine million random combinations to generate the tables albeit, being random, some of these combinations will have been the same. It was not, however, a stressful experience taking only a short time on the computer.

Adrian Garner, via e-mail.

METRIC THREADS

DESIRED PITCH (mm)	TUMBLER STUD	1st STUD DRIVEN	1st STUD DRIVER	2nd STUD DRIVEN	2nd STUD DRIVER	INPUT	GEARBOX PITCH	ACTUAL PITCH (inches)	METRIC PITCH (inches)	ERROR 1 PART IN
3.50	60	35	55	50	38	65	8	0.13780220	0.13779528	19906
3.00	60	25	40	55	45	70	9.5	0.11811347	0.11811024	36575
2.50	60	70	75	50	40	55	9.5	0.09842769	0.09842520	36575
2.00	30	55	60	50	40	35	9.5	0.07874231	0.07874016	36575
1.75	38	40	55	35	30	65	10	0.06889110	0.06889764	19906
1.50	38	55	70	35	25	65	9	0.05905206	0.05905512	-19305
1.25	45	25	50	55	20	70	9.5	0.04921394	0.04921260	36575
1.00	40	30	45	55	24	70	9.5	0.03937116	0.03937008	36575
0.90	38	55	50	45	24	65	8	0.03543124	0.03543307	-19305
0.80	40	45	50	55	38	75	13	0.03149443	0.03149606	-19305
0.75	25	65	60	55	38	45	12	0.02952603	0.02952756	-19305
0.70	24	55	60	50	35	70	9.5	0.02755961	0.02755906	36575
0.60	38	45	30	60	40	65	11	0.02362082	0.02362205	-19305
0.50	40	60	45	55	24	70	9.5	0.01968558	0.01968504	36575
0.45	25	50	40	65	38	60	11	0.01771562	0.01771654	-19305
0.40	40	45	30	65	38	55	18	0.01574722	0.01574803	-19305
0.35	38	55	35	45	20	60	13	0.01377881	0.01377953	-19305
0.30	35	45	20	70	38	55	13	0.01181041	0.01181102	-19305
0.25	24	55	45	38	20	75	14	0.00984279	0.00984252	36575
0.20	38	65	40	55	20	60	18	0.00787361	0.00787402	-19305

BA THREADS

B.A.	TUMBLER STUD	1st STUD DRIVEN	1st STUD DRIVER	2nd STUD DRIVEN	2nd STUD DRIVER	INPUT	GEARBOX PITCH	ACTUAL PITCH (inches)	METRIC PITCH (inches)	ERROR 1 PART IN
0	40	30	45	55	24	70	9.5	0.03937116	0.03937008	36575
1	38	65	50	45	24	55	8	0.03543124	0.03543307	-19305
2	20	65	60	55	38	50	8	0.03188811	0.03188976	-19305

Metric Myford threads

SIRS, - G. D. Hall (*M.E.* 4255, 2 September 2005) might care to look at the series of four articles by D. A. G. Brown, "*Metric Screwcutting on the Myford*", *M.E.* Vol. 186 pages 429, 538 and 638, and Vol. 187 page 68.

Chris Orchard, Northants.

More on Myford lathes

SIRS, - I am writing with response to R. G. Burton's letter and picture in *M.E.* 4254, 19 August 2005. The picture shows a Myford Drummond 'M' type lathe. There is a very helpful Yahoo user group dedicated to this type of lathe. It can be found at http://finance.groups.yahoo.com/group/drummondlathe. Members of the group are great and can usually source any spares required. Also Tony Griffith's excellent www.lathes.co.uk has lots of information on the Drummond M type and its subsequent manufacture by Myford during the war.

Now that I have hopefully answered that, I was wondering if any of the knowledgeable people out there could help me identify my horizontal mill which I am restoring. I have enclosed a picture of it before it was moved home. All I know about it is that it is a Richmond and may be a model 02 or 03. If anybody has any ideas or copies of any manuals or literature I would be grateful to hear from them. I would particularly like to know what taper the spindle is. I know its not a Morse taper or one of the INT tapers. It looks like an INT 30 but without the small parallel portion on the small end and smaller 1/2in. driving lugs, a bit like the CNC type.

Simon McNally, Wiltshire.

Simon McNally's mill needing identification.

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Environmental change

SIRS, - I have just read Keith Wilson's comments on global warming in *M.E.* 4255, 2 September 2005. Well, I am sure that Keith has more knowledge of engineering in his toenail clippings than I have in my head, but he should either steer clear of areas outside his expertise, or expend some of his considerable intelligence on gathering and understanding the facts.

His words of wisdom "*the distortion of a truth is more dangerous than its denial*" could not be more apt when applied to the fog of misleading interpretations spun around the bare facts of climate change. Yes, we are seeing predictable changes in isolation caused by the cyclical changes in the earth's orbit and solar activity, but these pale into insignificance against the changes being caused by human activity. The Villach Statement, a consensus view of the Scientific Committee of Problems of the Environment, a standing committee of the international Council of Scientific Unions, opened by saying: *"As a result of the increasing concentration of greenhouse gases ... in the first half of the next century a rise of global mean temperature could occur which is greater than any in mans history".*

That statement was made in 1985. Even earlier, in 1975, Eugene P. Odum in his book, Ecology, warned that *"What we can apparently expect for the next few decades are new and uncertain, perhaps unstable, balances involving increasing atmospheric CO_2 which heats up the earth and increasing particulate pollution which ... cools the earth. ... Unfortunately international bodies ... are so preoccupied with short term political problems that this common need has yet to receive the attention it deserves."*

The vast majority of us who work in the environmental field do not simply believe in climate change. We have to take it into account in all our day to day planning and activities.

To date we have generally followed the worst-case scenarios set out in the early days of climate change study. The UK is finally waking up to its obligations to the future of the earth and the human race and all its other inhabitants. Nonetheless the same short-term political problems prevent many of the nations that could take effective action from doing so.

We can never prove whether the tragedy on the Gulf coast of the USA was exacerbated by global warming. What is clear is that the environmentalists had warned of the impending catastrophe for years beforehand, and been ignored by politicians. After 30 years of procrastination and obfuscation on the issue of climate change when will the politicians wake up?

But is there any practical contribution model engineers can make? Well our little butane torches won't sway the whole climate too far one way or the other, and we are probably a rather better at being frugal and recycling and reusing than the average! I do think we should not be shy of thinking of new solutions to some of the problems faced by a changing world. From clockwork radios to bio fuel powered Stirling generators and cheaply produced 'elephant pumps', there are many examples of inventions that could easily have been developed by model engineers.

Perhaps at the next Model Engineer Exhibition there could be a class for "*sustainable solutions*"? Who knows, maybe Keith Wilson could come up with a Gold Medal-winning entry?

Neil Wyatt, MIEEM via e-mail.

More on wobblers

SIRS - I refer to Mr. Williams' *Post Bag* letter in *M.E.* 4257, 30 September 2005. This brought back a flood of memories from the days when I read for my degree at the Royal Military College of Science. My maths professor took great delight in setting his students a problem concerning the theory of wobblers. At first sight, analysing a wobblers' operation appears trivial but is not so as us students discovered quite quickly! I no longer have the original working which ran to several pages. But it is known that pressing the wobbler to centre it results in it snapping into concentric running; but a little more pressure results in a radial deflection. Provided that the initial deflection is tiny, the wobbler will still continue to rotate about its end axis albeit off centre; but after a critical further deflection it will become unstable. So one needs to resolve the relationship between the force needed to deflect the tip of the wobbler against its mounting friction when static, and once centred, the force needed to move it a critical distance to render it unstable. The former can be measured easily with a spring balance but the latter is critically dependent upon the coefficient of friction between wobbler disc, or ball, and the target item. This coefficient is of course quite variable and, for all practical purposes, impossible to determine in the workshop. Although I cannot remember exact figures, I do recall for one configuration that if the force needed to move the tip of the wobbler when static is around one ounce (I took my degree 50 years ago hence imperial!), then the difference in the movement required for the wobbler just touching the work piece, to flying into instability, varied between about 0.0005in. to 0.002in. depending on whether the target surface is moderately rough or polished; I stress that these figures are from memory and are only offered to give a feel for the scale of the problem.

Having sorted all that out my maths professor, some months later, asked what would be the effect of using a wobbler on a curved surface, he was not popular! Just as Mr. Williams discovered, the theory shows that there can be a substantial error so do not use on concave surfaces, but on the other hand, it can be shown that a convex surface improves sensitivity!

I wonder if Mr. Williams is aware of the existence of electronic edge finders. These are very sensitive and touching results in an audio beep and/or a flashing light. The specifications of one which I am looking at in a catalogue (J&L Industrial Supply) state repeatability within 0.006 millimetre. These work quite differently from the rotating wobbler and are normally used to find an edge when static; typically on CNC machines. However, unlike the rotating wobbler, most (all?) of them rely on chucking concentricity for their accuracy. A downside for the model engineer is that they are not cheap, several tens of pounds being the order of the day.

Finally, here is a tip for one use of a wobbler. When the wobbler is mounted with a pointed feeler, mount in the chuck and centre the point whilst rotating. This then forms a perfect reference for tool height setting without having to make up a special gauge several of which have been described in *M.E.* Lazy but quick and effective if you already have a wobbler!

Roger Castle-Smith, Bucks.

Metal finishes

SIRS, - I was recently admiring a young niece's collection of 'jewellery', when it dawned on me that the pieces - brooches, bracelets, necklets etc., - actually consisted of very finely made little base-metal castings, in some cases thinly plated (allegedly) with gold or silver or 'flashed' over with some gold or silver coloured metal.

How are these beautiful (in an engineering sense) little castings made? What is the base-metal? How is the thin plating or 'flashing' done? What are the 'gold' and 'silver' plating materials?

I know that 'proper' jewellery uses the lost-wax technique, but I would have thought this method would be a bit slow for such things as bracelet links (as opposed to chain) obviously made by the zillion!

As a model engineering application I was thinking in terms of small non-functioning fittings, for example door handles, luggage racks, lamps etc. for model carriages.

Alan M. Atkinson, North Yorks.

Machining methods

In reply to the letter by Richard Wilson (*M.E.* 4255, 2 September 2005) I suggest that there are good reasons on both sides, and the ideal method must vary with the item concerned. A few months ago I described the machining of the expansion links using the 'accurate parts first' syndrome.

Due to the size of the part, firm mounting is absolutely essential, and it is a bit tricky to achieve this with the outside finished, as is clear from the drawing of the link still 'inside' its blank. I first did the inside, when satisfied I did the outside, finishing off with band sawing off the ends remaining and de-burring etc., with fine files and linisher.

Result: - four matched pairs of expansion links.

Therefore, it seems necessary to decide on the best system for each item before chewing it out.

Keith Wilson, via e-mail.

The clock shown in a typical room setting to give an indication of size.

SIXTEEN DAY PEDESTAL CLOCK

Peter Heimann

introduces a new constructional series on an elegant clock that would grace any home and designed to be built with typical model engineering tools and machinery.

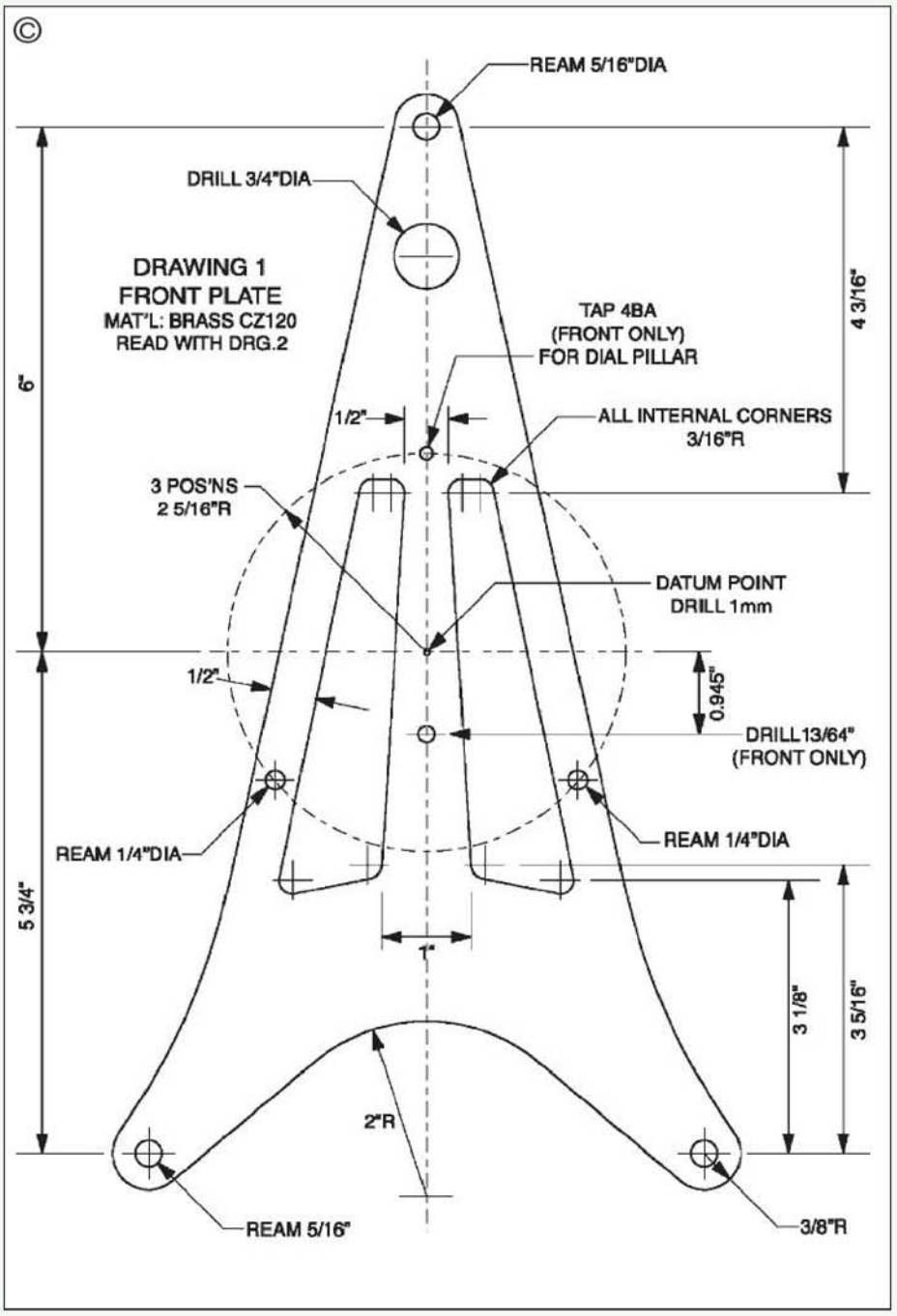
●*Part I*

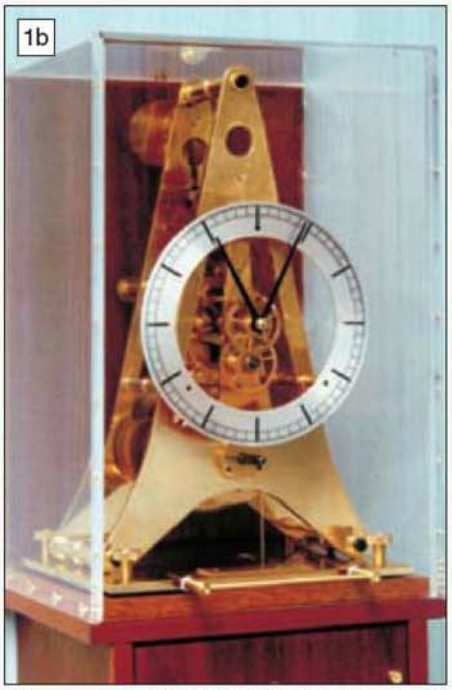
Some years ago, at one of the Bristol Model Engineering Exhibitions, I was attracted by a little A-framed skeleton clock with a gravity escapement designed by Lionel Brown. I obtained the material and cut out the plates before circumstances caused me to put the project on hold.

After some considerable time I looked at it again, but by then my requirements had changed. I now wanted to build a skeleton clock with recoil (anchor) escapement, the beat to be in the region of one second. This is very slow for a small clock, but I felt that it would be possible within the dimensions of the movement by using a compound pendulum. The physics and calculations for such a pendulum are somewhat tricky, but I was quite prepared to resort to trial and error methods. This type is very compact compared with the conventional 'seconds' model which must measure over 39 inches. The mechanics of the movement were to be highly visible, a little unconventional and, of course, keep to a very respectable rate. Lionel Brown's A-frame shape was ideal and I am grateful to him for not objecting to my using this.

My movement was originally spring driven. The clock ran extremely willingly but the rate of time keeping was too variable and in step with the state of winding. I doubted whether even a fusee would entirely cure the problem. Conversion to a constant weight drive proved to be the answer. The result is a pedestal clock of 'grandmother' proportions which behaves reliably and fulfils the criteria I had set.

The overall height of the clock is just over 63in. (1600 mm), the height from floor level to the centre of the 6in. diameter chapter ring being 56 in. (1,420mm).The movement is protected by a clear Acrylic casing measuring 9in. wide by 7.75in. deep (230 x 200mm). There is ▶





Close up view of the finished clock. It is housed in an Acrylic case.

maximum visibility of all components from all aspects (**photo 1b**).

The trunk of the pedestal is made from Sapele veneered MDF board. Clearly there is plenty of scope here for individual variation of design. My intention is to show that the woodwork need not prove an obstacle as the material can be easily purchased cut to size. I believe that the small overall shape will make the unit acceptable in any environment not only to the constructor but also to the 'better half'. The intention is for the eye to focus on the movement rather than on the case.

The compound pendulum pivots on a pair of small ball-races. An adjustable fork on the pallet arbor crutch is in contact with the upper pendulum rod and this allows optimum adjustment of amplitude. An interesting effect of the action is that the crutch and pendulum move in opposing directions. Eventually the rate is fine adjusted by weight differential of the two pendulum bobs. This adjustment is extremely sensitive but only requires patience. The clock is designed to run for sixteen days between winding if required.

As on my previous designs, ball-races are specified for the main barrel bearings, also for the front centre position. I feel that the latter is better than the conventional collar on the minute arbor creating a large shoulder, which is a source of friction. In addition I specify ball races for the weight pulley as this takes high loading and is often overlooked. Ball-races are best de-greased which is easier with the non-shielded variety.

The recoil escapement is more forgiving in manufacture and use than the 'dead-beat' type used in my previous series. However, when properly made, the escapement performs very well and is generally used in domestic timepieces. All gears are cut to modules 0.8 and 0.6, pinions being of the lantern type. Fly-cutters for the escape and ratchet wheels are easily home made and full details will be given in due course. However, if preferred it will be possible to obtain gears ready cut (see materials list).

Material list

Brass sheet CZ120
12 1/2 x 7 1/2 x 3/16in. - 2 off (If supplied as triangles 1 off 16 x 8 1/2in. will suffice).
6 x 6 x 1/16in. for chapter-ring - 1 off.
7 3/4 x 6 1/2 x 1/4in for base plate if incorporated - 1 off.

Brass round bar
1in., 3/4in., say 6in. off of each.
5/8in, 3/8in., 1/4in., say 12in. off of each.

Brass wheel blanks
2 x 1/4in. for upper bob - 1 off
3 1/4 x 3/16in. for great wheel - 1 off
2 3/4 x 3/16in. for lower bob - 1 off
1 1/2 x 3/16in. for ratchet wheel - 1 off
2 3/4 x 3/32in. for intermediate wheel - 1 off
2 1/2 x 1/16in. for various - 4 off
1 3/4 x 1/16in. for various - 2 off
1 1/2 x 1/16in. for various - 4 off

Gauge plate (ground stock)
2 x 2 x 5/32in. for anchor - 1 off

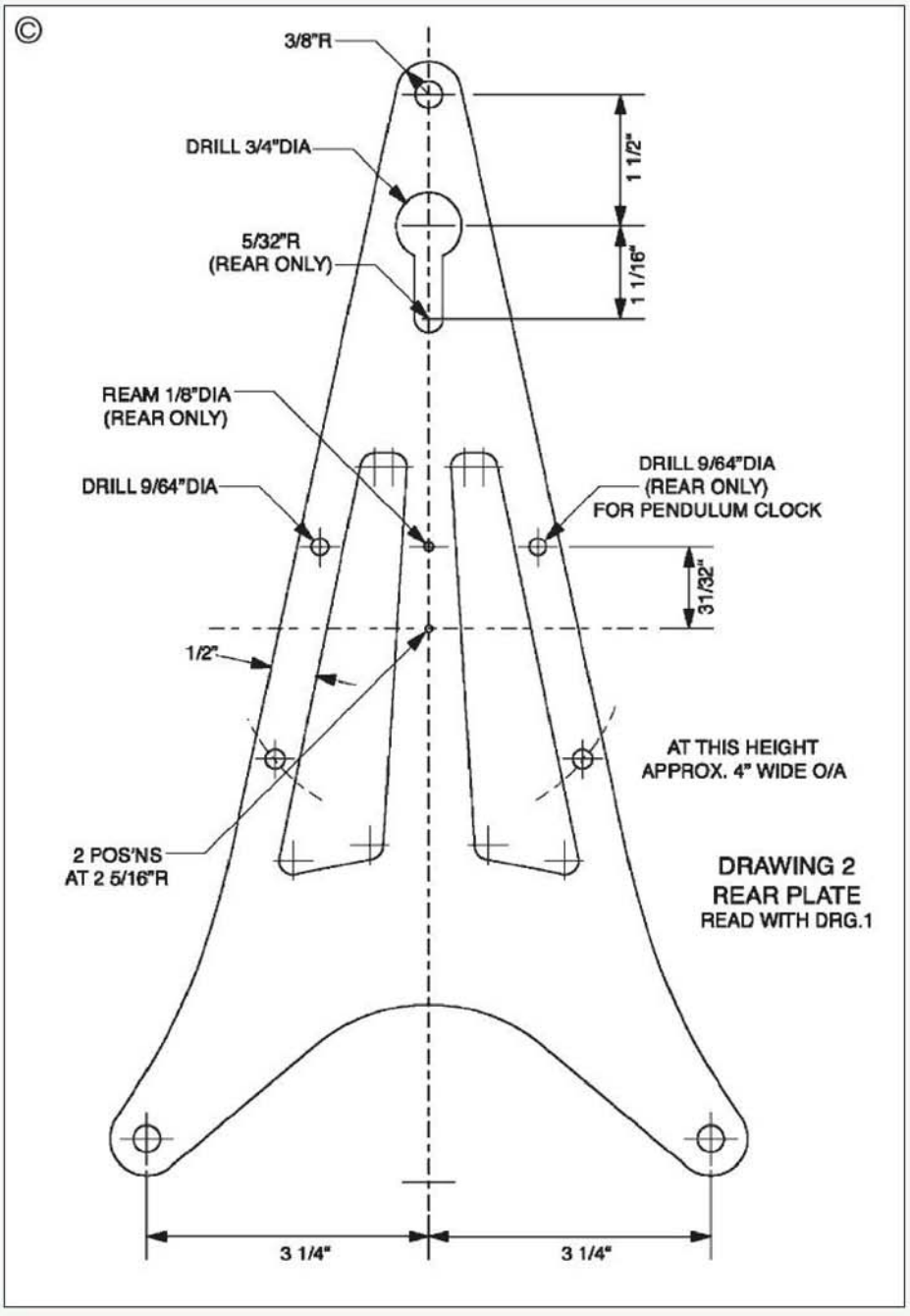
Steel cheese head screws
2BA, and 4BA, by 3/4in. 10 BA by 1/2in. Say 50 off each

Silver steel
1/4in., 3/16in., 1/8in. dia., 1 length each
3/32in. dia. - 3in. lengths

Blue pivot steel
Number 47, 56, 60,67, 1 packet (10) each

Ball Races (Top quality)
5/8 x 1/4in. bore by 5mm wide - 4 off
3/8 x 1/8in. bore by 4mm wide - 3 off

Plus various odds and ends which most constructors will have in house.



The model engineer's average workshop and equipment will be found completely suitable for this project. Full descriptions of procedures and methods will be included as we proceed. Dimensions shown on the drawings are in imperial units. I personally find it easier to convert into metric when required, rather than the other way round. The only exception is when we eventually come to the manufacture of the case. Here the suggested materials are sold in metric sizes, and so I have dimensioned the drawings that way.

The materials list will be found self-explanatory but only the main requirements are shown. A saving can be achieved by ordering the frame plates as two isosceles triangles. The 1/4in. thick brass base plate is not strictly necessary and no doubt costly. However it does greatly add to appearance and I hope that this, or an alternative, will be used.

The front and rear plates are shown on **drawings 1** and **2**. It is best to make a half template of the shape out of some thin steel, aluminium alloy or even stiff cardboard. Turning this from one side to the other will ensure that your marking out is even. It will be found best to clamp the two plates together in order to drill and ream the three 5/16in. holes accurately. Now make a set of special nuts and bolts for all future clamping of the sandwich ready for machining and for draw filing the edges. If milling facilities are available a great deal of hard work will be saved. If not, it is perfectly feasible to chain-drill, saw and file.

The sheet metal will be highly polished when you receive it with surfaces protected by plastic film. It is well worth preserving this finish as much as possible by covering it with a suitable self-adhesive material e.g. wide masking tape. It will be almost impossible to revert to the original standard if the surfaces are allowed to be scratched and damaged. Remember that there are differences between some of the hole positions on the two plates. Make sure that you identify these to avoid future mix-up. They will be handled innumerable times. All holes should be de-burred. Make and keep a stiff paper pattern showing the 1mm central datum point hole and the three positions on the 2 5/16in. radius from datum. This information will be required later on to mark the fixing holes for the chapter-ring.

The 3/4in. holes near the top of the 'A' are easiest dealt with on the milling machine if you have one. Start with a drilled and reamed 1/4in. hole right through both plates Seek for this position with a 1/4in. cutter and clamp the work to the mill table with suitable packing under. Change to a 3/4in. cutter and plunge right through. Obviously you will keep the best faces of the plates facing forward. As mentioned before all edges should be draw-filed and papered ready for final polishing and burnishing later on. I hope that you will feel a glow of satisfaction now that a start has been made on actually cutting metal. I find that the 'thinking about it' stage is by far the most difficult!

●*To be continued.*

List of suppliers

Mr. I. Cobb
8 Poplar Avenue
Birstall
Leicester LE4 3DU
Tel: 0116 2676063
(Brass and Gauge Plate.)

E.K.P. Supplies
The Old Workshop
Bratton Fleming
Nr. Barnstable, Devon. EX3 1 4SA
Tel: 01598 710892
(Precision Screws)

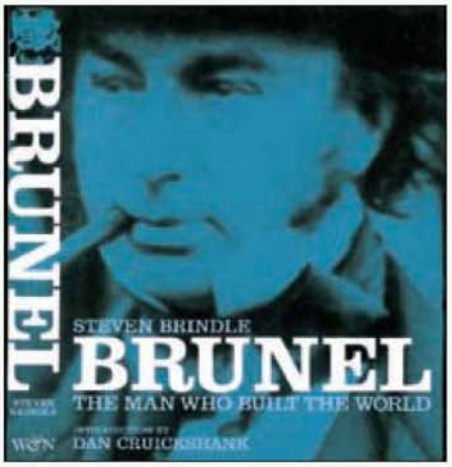
P. P. Thornton (Successors) Ltd.
The Old Bakehouse
Upper Tysoe
Warwickshire CV35 0TR
Tel: 01295 680454
(Gear cutters)

Meadows & Passmore Ltd.
I Ellen Street
Portslade
Brighton East Susssex BN4 I IEU
Tel: 01273 421321
(Pivot steel and general parts)

Mahoney Associates
58 Stapleton Rd.
Bristol
BS5 ORB
Tel: 01179 556800
(General clock parts)

It is suggested that you apply for catalogues from the above. These are a mine of information.

FOR YOUR BOOKSHELF



BRUNEL
The man who built the world
Steven Brindle
Introduction by Dan Cruickshank
Weidenfeld & Nicholson
£25

We know all about Brunel, don't we? Well, no.

When this book arrived for review, the size and quality of the illustrations (even the familiar ones) shouted 'coffee table book'. Wrong again.

Historian Steven Brindle has achieved a successful combination of the the life of the great man, and his family, with his prodigious work, making this not simply a factual account of these matters but also a guide to any young man seeking fame, wealth, recognition, and an early grave. It is the book to give your grandsons, as an inspiration and a warning.

The results of his work are well-known. His talent legendary. What this book sets out is how the man set out to achieve things.

There were no short cuts. Everything was worked out from basics, whether is was a simple project, the world's largest ship, or God's Wonderful Railway. There was never a question of 'second best'. Any such suggestion would incur a sharp rebuke, or withering wit.

Mr Brindle has worked from a great deal of original material, including Brunel's own notebooks, diaries, and letters. He interprets his life, and his work, and how each acted upon the other. He comes close to revealing the secret of genius.

One of the great influences on Isambard Kingdom Brunel was his father, Marc, also a brilliant engineer, and naturalised American. He held no less than 17 patents, including one for making ships pulley blocks, a very early piece of mass production, and provider of a high income. He worked with Isambard for many years developing a 'Gaz Engine' which swallowed up the family fortune, and resulted in a term in prison for debt.

Isambard was left to finish the innovative but troubled Thames Tunnel. That was followed by the contract for the Clifton Suspension Bridge, and the rest is, as they say, history.

The GWR made Brunel's name for all time. Just how much went into it can be gauged by this extract from a letter to the railway's secretary, Charles Saunders:

"*...I have thus cut myself off from the help usually received from assistants. No one can fill up the details. I am obliged to do it all myself, and the quantity of writing, in instructions alone, takes four or five hours a day, and an invention is something like a spring of water — limited. I fear I sometimes pump myself dry and remain for an hour or so utterly stupid. I have spun this long yarn, partly as a recreation after working all the night, principally to have the pleasure of telling a real friend that I am sensible of his kindness, although he hardly allows me to see it...*"

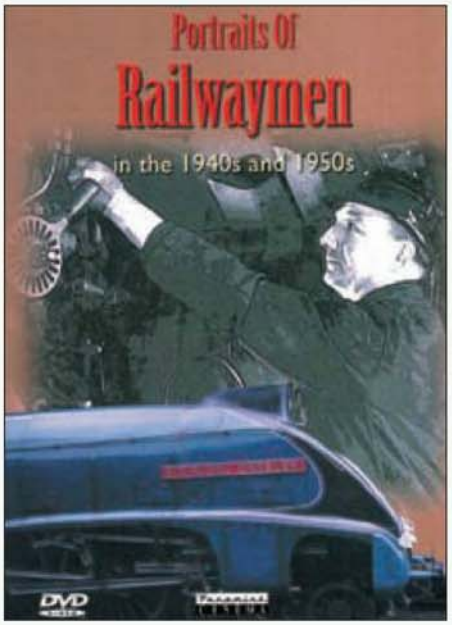
His thinking like this, is mingled with details of the great projects giving as a better understanding of both.

No review of this book would be complete without a mention of the introduction. I admit to quite often skipping these to get to the book proper. Fortunately I did not in this case. It is by Dan Cruickshank, arguably one of our best journalists today. His introduction is just that. He introduces the man to us and puts Brunel in his time, in terms of design, in an outstanding way.

He concludes with a poignant story about the romantic house and estate he planned. Brunel died before the house was built, but the grounds were laid out, not far from Saltash Bridge. "Together they reveal the nature of the man — the incredible span of his genius and of his achievements."

DVD REVIEWS

Enjoy a deep wallow in nostalgia. Load the DVD player with these discs from Panamint Cinema, turn the lights down, grab a glass or cup of something appropriate, and take yourself back to the days before soap operas and supermarkets, when travel was a joy, and stress hadn't been invented.



PORTRAITS OF RAILWAYMEN in the 1940s and 1950s

Four films on a DVD from Panamint Cinema

This DVD should contain a warning: "must not be viewed by health and safety officers!" It comprises four films made in the 40s and 50s.

SHUNTER BLACK'S NIGHT OFF (1941)

Shunter Joe Black finishes a 'normal' day at the marshalling yard, chasing separated wagons rolling down an incline, shoving in a stick to operate the hand brake, suspending his entire weight on the stick to slow the wagon down to stop it crashing (send for the HSO!). Back home at the end of the day, enjoying a pipe, the peace is interrupted by an incendiary raid by the Luftwaffe.

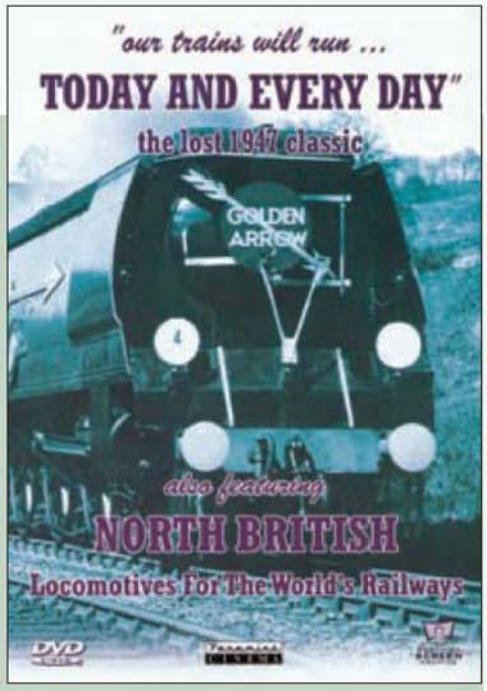
Back to the yard, Joe finds an unattended explosives wagon (send for the HSO!) on fire. Joe manages to find a shunting engine with crew, and gets them to move the burning explosives wagon (send for the HSO!) to a water fountain, and the fire is extinguished (send for the... too late).

A nice piece of wartime propaganda.

THE RAILWAYMEN (1946) gives an insight into the working lives of railwaymen in the 40s. Clearly aimed at recruiting people into a career, the various jobs are outlined, and even gives details of pay and prospects. Fascinating.

PORTRAIT OF AN ENGINEER (1954) is set in the Vulcan Foundry, home of locomotive building for customers around the world. The 1954 cameras follow production engineer Ted Wilson around the factory to paint a good portrait of all the skills and processes needed to produce locomotives, from the drawing office to testing the finished product. This film will be enjoyed by anyone who worked, or would like to have worked, in a locomotive works.

BRITISH LOCOMOTIVES (1959) A review of the challenge faced by locomotive builders contemplating the demise of steam and British Railways' planned shift towards new classes of diesel and electric locomotives, including the amazing Deltics, to boost efficiency. However, steam held on in places such as South Africa, where Beyer-Garratts ruled the veldt.



NORTH BRITISH Locomotives for the World's Railways

It is a good job that The Big Six Film Unit took their cameras to the Springburn Works of the North British Locomotive Company back in 1949. And it is a good job that Panamint Cinema found the film they produced and converted it to a DVD for all to enjoy 50-odd years later.

What an amazing place it was. Considering the size and nature of materials used in locomotive manufacture, it must have looked as organised, clean and neat as a Formula One car factory does to us today.

North British was formed in 1903 by the amalgamation of Sharp Stewart & Co, Dubs & Co, and Neilson Reid & Co, and became one of the top three locomotive manufacturers in the world. Its products, designed and made in Glasgow, were exported around the globe.

The 2000th locomotive was completed while filming was going on. That was the Bartholomew Diaz, for South African Railways. You can still see it working there more than half a century later.

At that time some 5,000 were employed at the works, which covered 50 acres. It was the place of work for generations of families of skilled workers.

This fascinating film takes the viewer through all the major processes of building locomotives — mostly steam then, of course. It starts in the drawing office, and shows the use of models in design work, including a full-sized mock-up of valve gear. Beats CAD!

Film of the machine shop is also compelling; axle turning and grinding, wheel pressing, boring axle boxes, fabricating plate and bar frames. It's all there.

Springburn certainly was bang up to date. Carbide tooling is much in evidence. But what is the candle for in setting valve gear?

The main film is followed by an interesting wartime newsreel short, which looks at the production of War Department Austerity engines at Springburn.

TODAY AND EVERY DAY The Lost 1947 Classic

This part of the DVD was produced from the one copy of the original film known to remain in existence. For that we are grateful for a beginning, which features the magical beat of a King leaving Paddington.

The film traces the history of railway engineering before moving on to the wonders of the 'modern' age such as the Golden Arrow and the unique sea locks for rail boats at Dover. Also the fastest daily run, the Cheltenham Flyer, averaging 71 mph hauling 195 tons, and using just 1.25 tons of coal. And there is a reminder that in those days the railways carried all sorts of goods to try to make a profit.

However, the part of the film most will enjoy is a visit to Swindon Works, and the completion of GWR King, No 6013.

ALSO RECEIVED FROM PANAMINT CINEMA

Three films on a single DVD:
SEAWARDS THE GREAT SHIPS (1960)
THE RIVER CLYDE (1939)
GLASGOW'S DOCKLANDS (1956)

All the above titles are available from Panamint Cinema, Abercorn Schoolhouse, Newton, West Lothian, EH52 6PZ. www.panamint.co.uk

PETE'S PAGE

THOUGHTS ON COMPRESSED AIR (AND OTHER MATTERS)

The compressed air vacuum cleaner used by the author for sucking up sawdust.

Peter Spenlove-Spenlove describes some applications for compressed air before offering a suggestion for keeping your portable work bench firmly anchored whilst working on it.

Photograph 1 shows a simple plastic vacuum cleaner powered by compressed air. It is suitable for removing dry waste like saw dust and I use it to clean out the bandsaw when changing blades.

A thumb trigger admits air to a small bore tube with a jet blowing down towards the cloth bag. The path taken by the air is shown marked in white on **photo 2**. This induces suction in the 7/8in. dia. nozzle and sucks the waste down into the bag. Air consumption at 80psi is high and the internal air pipe obstructs the main nozzle so it is suitable for finely divided waste only. Wood shavings can block the nozzle but are easily removed with the aid of a piece of bent wire.

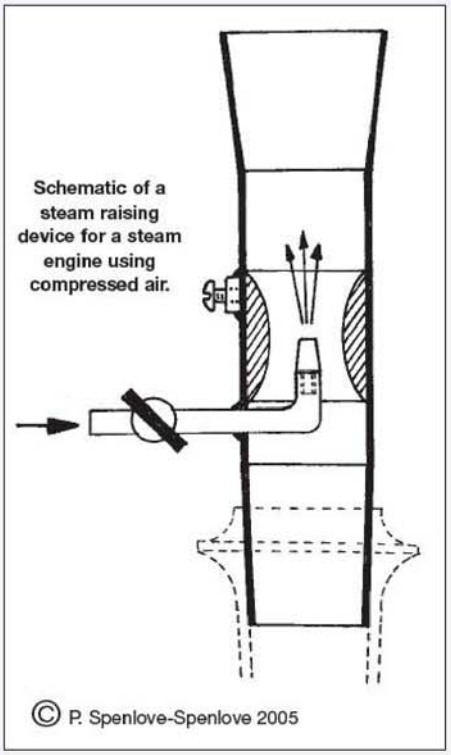
It occurred to me that this method of inducing suction could be put to good use as a means of drawing the fire on a model locomotive to a point where the steam blower can take over. Such units are in use and are energised by an on site compressor or even a good tyre inflator.

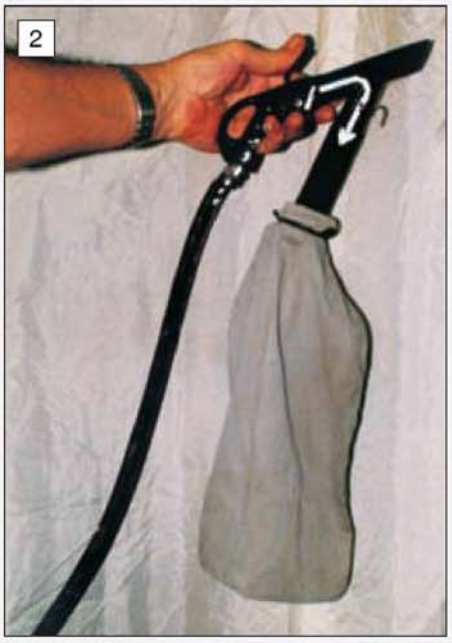
The beginner might wonder what is inside and how they work. The sketch, which is to no particular scale, shows the basic principles. The main component is a piece of tube to fit the model's chimney. Copper water pipe might be suitable. The compressed air is introduced into the main tube by a right angle tube as shown. It is suggested that a replaceable jet is fitted to the end of this feed pipe. This should be drilled with a very small drill initially as it can always be opened up if found desirable in practice. You may find it helpful to have several jets handy to cope with different air supplies.

The cross hatched choke can be slid up and down the tube to optimise the vacuum for a given air consumption. An air valve is also provided to to throttle the air flow to suit circumstances.

I first saw a device of this type in use at a steam rally in the 1950s. A model locomotive was brought into steam by a chimney suction device connected to a large vehicle tyre, which had obviously been well pumped up at a local garage.

It worked well and soon the locomotive was giving rides on a portable track. Nowadays a cheap source of air could be obtained from the small 12Volt tyre inflators, which plug into a car cigarette lighter socket. Motor accessory shops sell these for various prices. I saw a posh one that went up to 250psi but I doubt if anyone has tyres that require that amount of pressure.



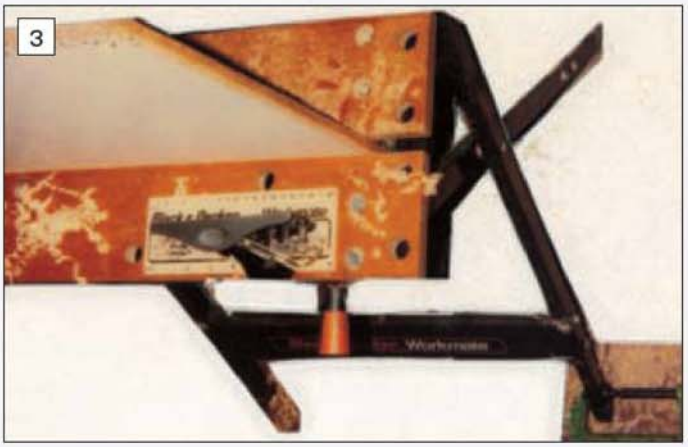


Marked up photograph showing the path of the compressed air in the device.

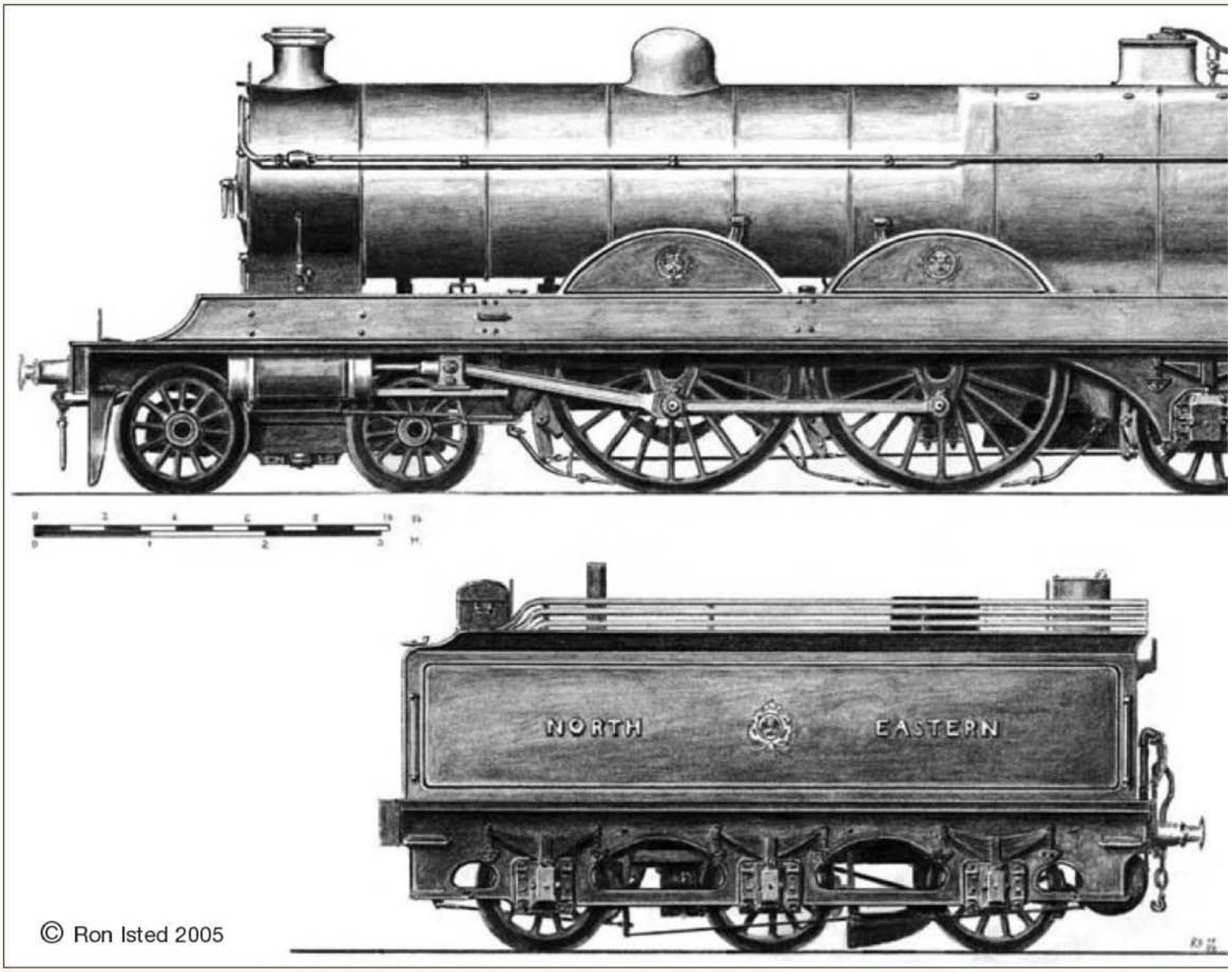
Workmate tip

Many readers will have a small portable work bench of the Black and Decker Workmate type. These come in various guises and some have a foot board to stand on when carrying out operations like planing. Mine is the lighter, simpler pattern without this feature.

As can be seen in **photo 3**, I recently needed to plane a large board gripped between the integral vice jaws that are a feature of these benches. However, the planing forces tended to tip the bench over. To steady it I clamped an old G-cramp on the leg at floor level and placed my foot on that making sure that I planed from right to left. This made all the difference and the bench stayed upright and made no attempt to tip over.



Steadying a Black and Decker Workmate with an old G-cramp. A foot is placed on the clamp.



EDWARDIAN ELEGANCE

Ron Isted
describes the Walter Smith and the North Eastern Railway 4CC Compound Atlantics.
●*Part I*

How many Locomotive Superintendents and Chief Mechanical Engineers have put their signatures to drawings and taken the credit (or very occasionally the blame) for new locomotives to which they've contributed little or nothing? To put it another way, how many locomotives have been designed by the railway's Chief Draughtsman and other members of the Drawing Office staff and then presented to the CME as a fait accompli? Sir Henry Fowler on the Midland/LMS and H. S. Wainwright on the South Eastern & Chatham are fairly well-known examples of men who were content to delegate locomotive design to their Chief Draughtsmen, although Wainwright is usually credited with personally creating the eye-catching colour scheme carried by SE&CR engines at the beginning of the twentieth century. On the other hand O. V. S. Bulleid retained an iron control over the smallest details of his sometimes, controversial locomotives produced in the 1940s for the Southern Railway. We shall now probably never know the truth about the balance of power inside many old railway drawing offices, but there is no doubt that the Chief Draughtsman could and often did wield a great deal of influence.

None more so than Walter Mackersie Smith on the North Eastern Railway at Gateshead. Born in Scotland, the country that has given the world so many talented engineers, he invented a regulator valve while still in his early twenties and soon made a name for himself as a designer of rolling stock. At the early age of 31, he went to Japan as Locomotive, Carriage and Wagon Superintendent of the Imperial Government Railways, and was responsible for the planning and construction of workshops to produce rolling stock in house instead of having to order from abroad. In 1883, still only 40 years old, he returned to England and joined the North Eastern Railway, initially to take charge of *"Workshops and Machinery"*, but was soon promoted to Chief Draughtsman, serving under three Locomotive Superintendents. With his obvious talent and wide experience, not to mention his strong personality, it comes as no surprise that Walter Smith was given a great deal of freedom to do his own thing, especially by Wilson Worsdell, who became Chief Mechanical Engineer of the NER in 1890 on the retirement of his elder brother, Thomas Worsdell.

Walter Smith is now probably best remembered for his very successful piston valve, produced at a time when some railway design offices were running into serious trouble with these rather crucial bits of a locomotive's anatomy. Problems with leakage, trapped water and differential expansion led to a mini-epidemic of bent and broken valve spindles - probably the worst specimens of pre-Smith piston valves had appeared (very briefly) in the 1870s on the Stockton & Darlington section of the North Eastern Railway itself. They consisted of nothing more than solid brass discs, 13in. in diameter, with no provision for releasing water produced by condensation or priming, while the coefficient of expansion of the valves was nearly

Fig. 1

twice that of the unlined valve chest - all in all a pretty good recipe for disaster! Smith's sophisticated designs on the other hand, incorporated a series of segmented packing rings held against the valve face by springs that would be compressed by any excessive rise in pressure and so release any water before it could cause any damage. Invented in the year of Queen Victoria's Jubilee, 1887, and first used by the NER a year later, they ultimately sounded the death knell for the flat 'slide' valve on all but the smallest and lightest of locomotives.

A decade later, Walter was given a completely free hand to rebuild NER No.1619 - a five-year old two-cylinder compound 4-4-0 originally designed by his boss, Wilson Worsdell, as a development of a series of 4-2-2s produced by brother Thomas a couple of years before he retired. The singles had put up some very impressive performances for the period, producing on test no less than 1069ihp at a speed of 86mph - surely an all time record for a locomotive with a single pair of driving wheels. Both the class of ten 4-2-2s and the solitary 4-4-0 were unusual, at least for Great Britain, in combining inside cylinders with outside steam chests, and one might logically have expected the valve gear also to be outside, giving direct drive, as was the practice in other countries. But that sort of logic didn't apply in late Victorian Britain, a period when appearance was considered far more important than accessibility by everybody except the men who actually had to oil round and service the machines and they had no say in the matter. As a result, the engines were equipped with a complicated system of rocking levers and spindly shafts in order to transfer the movement of the inside valve gear to the outside valves, which not surprisingly proved to be a weakness in the design. The outside steam chests themselves also suffered from incipient cracks, although that should have been relatively simple to rectify, since hundreds of locomotives across the channel had been so equipped without problems. While Thomas Worsdell's ten singles were all converted to simple expansion, his brother Wilson's 4-4-0, No.1619, was handed over to Walter Smith to see what he could come up with.

Although the general policy on the North Eastern under Wilson Worsdell was to build generously proportioned simple expansion engines, Smith opted to retain compound expansion on his rebuild of No.1619, but using three cylinders in place of the original two, one high pressure inside the frames and two low pressure outside. Now, contrary to what has been published so many times over the years, especially in this country, this was not an original concept. No less a person than the formidable Locomotive Superintendent of the LNWR, F. W. Webb, had suggested this layout at a meeting of the Institution of Mechanical Engineers nearly twenty years before, although for reasons outside the scope of this article, all LNWR three-cylinder compounds as actually built reversed the position of high pressure and low pressure cylinders. But in 1887, while Walter Smith was busy perfecting his piston valve, a French engineer, Edouard Sauvage, had incorporated this arrangement on a 2-6-0, with the two low pressure cylinders outside, the cranks of which were set at 90deg. to each other, while the crank for the inside high pressure cylinder bisected the 270deg. angle between them. Although a one-off job and completely non-standard, Sauvage's engine survived for well over 40 years, so it was very far from a failure. As a matter of interest, another French design, Andre Chapelon's magnificent 242A1 of 1946, also used this layout and proved to be thermodynamically the most efficient steam locomotive of all time.

Half a century earlier, Walter Smith's rebuild of 1619 employed exactly the same disposition of cylinders and crank angles and was also extremely successful. It incorporated independent notching up of high pressure and low pressure gear, together with options for working as a simple or as a 'reinforced' compound, by admitting live steam to the high pressure steam chest at a pressure selected by the driver - a complex machine to handle. Two good photographs of No.1619, one in its original two-cylinder state and the other as altered by Walter Smith, were published in *M.E.* 4244, 1 April 2005, but unfortunately the caption to the engine as built erroneously describes it as a three-cylinder machine. No further locomotives of the type were built by the North Eastern, but Walter's Midland Railway friend at Derby, Samuel Johnson, took up the design, with the results described in part IX of this series. How great a part in this exchange of ideas was played by Walter Smith's son, who was employed in the Midland Railway drawing office, we shall probably never know.

Successful as the Sauvage-Smith system Midland compound 4-4-0s were, even Walter could scarcely have imagined that more than thirty years afterwards, what had become the biggest railway in Britain would still be relying on his NER 1898 rebuild as the design basis for its front-line express engines. If he had foreseen it, I feel certain he would have expressed his disapproval in no uncertain terms - but let's not get side-tracked by that extraordinary game of power politics played out in the LMS motive power department for the first ten years after the 1923 Grouping. Much more interesting is Smith's reason for retaining compound expansion on the rebuilt No.1619 in the first place, when he must have known he would probably have earned more Brownie points with his chief by converting the engine to a simple. But as we shall see, Walter Smith wasn't like that.

According to various contemporary publications, Smith's stated objective in producing his original NER compound design was to produce economies, not so much by a simple reduction in the amount of fuel burnt, but more importantly through enhancement of the inherent flexibility of the steam locomotive. This additional flexibility could be achieved by making available to the driver, when working hard at starting or on a heavy gradient, the means to extract more power than the engine could possibly produce on a continuous basis. Because maximum power demands are generally intermittent, Smith argued that a relatively small locomotive, capable of developing an exceptionally high power output over a short period, was potentially more economical than a large one working at full power for a small proportion of the journey and therefore likely to be inefficient for the rest of the time. At a time when good locomotive coal cost about 8/6d (42½p) per ton, this reasoning made less sense than might have been the case in later years, when fuel costs constituted an ever-increasing percentage of locomotive department expenses.

Personally, I have reservations about the logic of all this, but there seems little doubt that increased flexibility of control within the driver's discretion, giving a broader range of power output at relatively high efficiency, was Smith's main design philosophy. But more sophisticated controls naturally lead to complications of one sort or another, which in turn lead to a need for better training of staff to handle them, potentially higher maintenance costs, lower utilisation and so on, all of which have to be paid for and offset against any running economies and lower first cost of a 'smaller' engine. If this really was Smith's reasoning, another factor soon caused him to change his mind, at least about the use of small engines.

At the beginning of the twentieth century, the North Eastern Railway, like every other line in the British Isles, was finding that a radical increase in locomotive haulage capacity was urgently needed to cope with the violent upsurge in the amount of deadweight per passenger to be dragged around the countryside. The rapid and widespread introduction of corridor coaches, dining cars, sleeping cars, lavatory accommodation and generally more luxurious rolling stock led to much heavier trains and these had to be worked to ever-faster schedules. The increasing use of steam heating apparatus was also taking its toll on boiler output and the current standard Victorian 4-4-0s were having to be thrashed more and more to keep time, or else double-headed. Neither alternative was a long-term solution to the problem and both had adverse effects on fuel consumption, staff and maintenance costs and ultimately, shareholders' dividends. In the Autumn of 1901, therefore, the North Eastern Railway's Chief Mechanical Engineer, Wilson

Worsdell, General Manager, George Gibb and sundry other members of the Company's Senior Team, took themselves off on a jaunt, at the said company shareholders' expense needless to say, to that land of large locomotives, the United States of America, for what we would now call a fact finding mission. They returned home with hearts and minds set on an Atlantic, a type that had proved very successful in the USA.

On returning to Gateshead, they discovered that their Chief Draughtsman was off on sick leave, so work on the design for the new flagship of the railway's express locomotive fleet (how about that for a mixed metaphor?) went ahead without him. When Walter Smith recovered from his sick bed and returned to the Gateshead drawing office, he was pretty peeved to discover that authority had been given for the construction of no fewer than twenty new express engines straight off somebody else's drawing board. Walter's black beard quivered with anger, it is said, partly at being left out of such a prestigious project and partly from violent disapproval of the new design (the two may not have been unconnected). But by this time the new locomotive, a very large 4-4-2 with a huge 5ft. 6in. diameter boiler, two simple expansion cylinders and weighing in at a massive 73 tons without tender, (4½tons more than Ivatt's Great Northern 'big' Atlantics just down the road), was too far advanced for alteration. The first ten NER Atlantics of class V duly appeared from Gateshead over the next few months.

Although very majestic and imposing machines to look at, they were not an unqualified success and to some extent suffered the indignity of being replaced on many of the best trains by the very successful R and R1 4-4-0s, the latter by the way the prototype of LBSC's 3½in. gauge *Miss Ten to Eight*. By the time the previously authorised second series of ten Atlantics was finally built some years later, many changes had been made to the original design. Whether the NER's irascible Chief Draughtsman actually used the words *"I told you so"* is not known and we can only speculate on the atmosphere in the Gateshead Drawing Office, since this little drama took place a century before the advent of the eavesdropping hidden camera so beloved of modern television. But we do know the outcome: in 1905, Walter Smith was given carte blanche to produce two engines to his own design, and four-cylinder balanced compound Atlantics Nos.730 and 731 emerged from Gateshead Works in April and May respectively of the following year (**figs 1** and **2**).

At first sight, the two new locomotives appeared somewhat smaller than the ten Worsdell Atlantics built a couple of years before, as the diameter of the boiler was six inches less. According to published figures however, Walter Smith's new creations, at 73 tons 12cwt, weighed over half a ton more than Worsdell's class V machines, not to mention over 20 tons more than his own rebuild of 1619 eight years previously - so much for his earlier 'small engine' theories. Yet again, I would suggest these 'official' figures need to be taken with a very large pinch of salt, not least because when the two compound Atlantics were later superheated, their overall weight miraculously decreased by well over a

Fig. 2

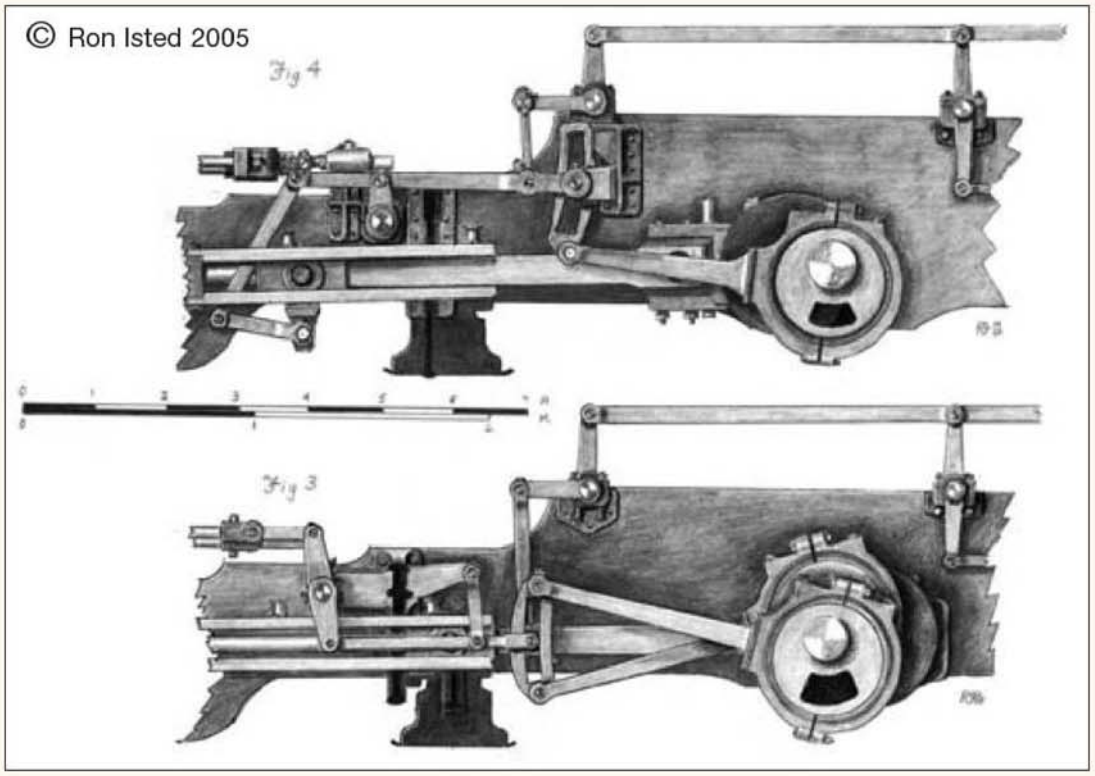
ton, while at the same time the adhesion weight increased by a couple of hundredweight. It's amazing what you can do by fiddling with spring loadings in full size practice as well as in our sizes! Whether the boiler diameter was reduced because of genuine considerations of weight, or whether Walter Smith was making a point to prove his design was more efficient and therefore didn't require such a great big kettle is unclear. Perhaps more significant was the increase in grate area from 27 to 29 square feet combined with a Belpaire firebox, the only time the NER employed this type.

Although the smokebox looks extremely short, the front tube-plate was recessed into the boiler barrel by nearly three feet, doubling the smokebox volume and bringing the tube length down to 15 feet. The barrel itself consisted of three sections, all five feet diameter and butt jointed, rather than the more usual telescopic construction. The whole boiler assembly was in fact very well proportioned and proved far superior in steaming capacity to the more massive looking jobs mounted on the Worsdell V class Atlantics. On the other hand, just how much of the ability of Smith's engines to boil water was enhanced by his own design of cross water tubes originally fitted in the firebox is debatable, to put it mildly. They were very soon removed, with no obvious effect on performance. The boiler pressure was 225psi and the engines were fitted with three safety valves, a pair of 3⅛in. dia. Ramsbottom valves plus an additional 2¾in. dia. direct loaded valve mounted on the Ramsbottom front column. The safety valve cover was very similar in shape to that on the original Johnson Midland compounds as featured in part IX of this series.

Visually, Nos.730 and 731, officially classified 4CC (4 Cylinder Compound), appeared to be almost identical twins, but while No.730 was equipped with Stephenson valve gear, her sister employed Walschaerts, again the only example on the North Eastern, (**figs. 3** and **4**). Naturally these two graceful Edwardian ladies coyly concealed such intimate items inside their frames and the valve gear was further hidden from view (and the feeder) by what has been described as a 'box-like structure' the full width of the engine, extending from just behind the buffer beam right through to the cab. I have counted about 60 oiling points just for the inside gear on the General Arrangement diagram of the Walschaerts engine, No.731, so it would be interesting to know the official 'preparation time' (if any) allowed to the crew. This extraordinary number of joints was partly due to the use of so many rocking shafts because of various off sets - even the radius rod and valve spindle are both divided. It is only too apparent that accessibility was once again sacrificed to appearance, but as will be suggested later, at least the box-like structure could perhaps be turned to advantage in a miniature version. At this point, I can't resist the temptation to quote a comment on the subject of accessibility made by the late Cecil Allen in his book British Atlantic Locomotives, with specific reference to these two engines: *"It is remarkable... how locomotive engineers have covered up their motions in this way.... rendering more difficult the work of examination and lubrication."*

On both locomotives, two sets of gear operated all four piston valves by means of rocking shafts, while the four cylinders were in line, centred over the bogie and directly beneath the visible section of the smokebox. The 14¼in. high pressure pair were supplied by 7½in. piston valves with inside admission, and the 22in. low pressure pair by 10in. piston valves with outside admission. This was a smart piece of design, because with the high pressure and low pressure cranks set at 180deg. to each other, the piston valves actually moved in unison, while the passages between high pressure and low pressure were admirably short and direct, as was the final exhaust from the low pressure. Last but certainly not least, the valve spindle glands were not subjected to high pressure steam. The general design incorporated most of the usual Smith sophistication, including reinforced compound working at variable pressure by means of the characteristic 'pressure regulating valve' on the right hand side of the smoke-box and operation as a two-cylinder simple, using the 22in. dia. low pressure cylinders.

But one facility, and to my mind a crucial one, was lacking: the ability to notch up the high pressure and low pressure gear independently. I am aware that several writers have claimed that this was possible on these two locomotives, but neither the various general arrangement drawings, nor the drawings of the motion show any trace of mechanism for doing so, while those of the Walschaerts engine, No.731, clearly show a brace fixed across both high pressure and low pressure valve spindles. Maximum valve travel on this locomotive was 4⅝in. for both high pressure and low pressure while the Stephenson fitted engine, No.730, had a maximum travel of 4 1/16in. for the high pressure valves and 4 9/16in. for the low pressure, achieved by rocking shafts of unequal length. On both locomotives the lap was 1 1/16in. high pressure and ⅞in. low pressure, with an exhaust clearance of ⅛in. on the high pressure side only, the low pressure being set line for line. The four valve chests were horizontal, but the 10in. dia. low pressure chests



were pitched at 1ft. 3 3/8in. above the centre line of the motion, while those for the 7 1/2in. high pressure were 1 1/8in. higher.

All four cylinders drove onto the leading axle and while the outside high pressure pair were horizontal, the inside low pressure cylinders were inclined upwards (toward the crank axle) at an angle of 1 in 38 1/2. Only the big 22in. dia. low pressure pistons were equipped with tail rods and the crank webs were circular. Both locomotives were reversed by lever rather than the screw you might have expected on an express passenger engine; but with a very finely divided quadrant. Meanwhile the driver's physical labours were aided by a steam reverser, the connection to which can be seen at upper right in figs. 3 and 4. Although the high pressure cylinders were outside, 6ft. 2 1/2in. apart, their valve chests were offset inwards, being at 3ft. 10in. centres, more or less in line with the locomotive's main frames, the upper sections of which were cut away to accommodate them. The design of this section of the locomotive was not unlike that of the first GWR outside cylinder 4-6-0 of 1902, subject of the initial article in this series, and like the Swindon engine, the main frames were in two parts, with the overlap just behind the rear bogie wheels. This point of potential weakness was strengthened by a very substantial stretcher that also acted as the motion plate. Although well braced throughout their length, the frames were only 1in. thick, which seems rather flimsy for a locomotive of this size and weight, while the supplementary outside frames for the trailing wheels were just 7/8in. thick. Incidentally, the shape of the upper edge of the main frames was not identical on the two locomotives, due to the different positions of rocking shafts, but was presumably not considered a problem in the days of one-off jobs.

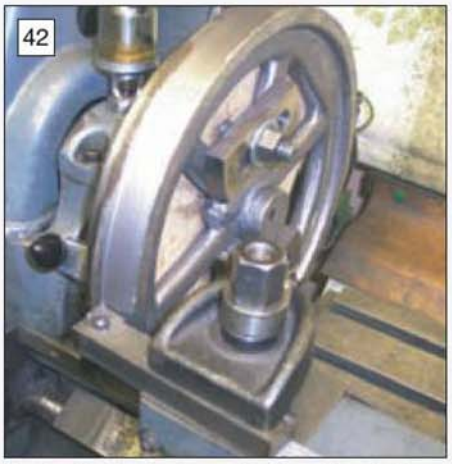
The bogie wheels were 3ft. 7 1/4in. dia., the trailing wheels 4ft., but the coupled wheels were 7ft. 1 1/4in., the largest ever used on an Atlantic in this country. Please note I am here using the term 'Atlantic' in its original and specific definition of a 4-4-2 with outside cylinders, so please don't write in about the Lancashire and Yorkshire engines. One small peculiarity of the NER 4CCs lay in the arrangement of springs on the coupled axles: laminated on the front driving axle, and helical on the trailing coupled, the reverse of the usual practice where mixed springs were used. Even NER No.1619, Smith's original 4-4-0 rebuild, as well as the Midland compounds and hundreds of other locomotives, had them the other way round, and you might have expected the riding of the NER compound Atlantics to be a bit lively, but they apparently rode very well as vehicles.

By the way, as yet another warning never to accept 'official' documents at their face value, I should tell you that copies of the two original NER Gateshead General Arrangement diagrams of Nos.730 and 731 obtained from the National Railway Museum, York, show helical springs on both driving and coupled axles. However, an otherwise similar contemporary GA of No.731 received from Darlington Railway Centre and Museum shows the correct arrangement, a strange inconsistency (see references). The springs are also shown correctly, I am delighted to say, in a sectional elevation of No.730 published in *Model Engineer and Electrician* No.430, 22 July 1909, which was reprinted (with permission) from a technical journal published by the German Institute of Mechanical Engineers! This was the first time a properly detailed side elevation, plan and front elevation of these locomotives had ever been published in this country, so the item was quite a scoop for this magazine, even though dimensions were given in metric equivalents. It seems extraordinary that the heavy guns of the contemporary technical press such as *Engineer* and *Engineering* virtually ignored these two elegant engines when they came out, but then the North Eastern Railway, although one of the largest and most prosperous systems in the land, was not based in London.

Yet another inaccuracy on the original general arrangement diagrams from the National Railway Museum concerns the Gresham steam sanding gear. The drawings show one sand-pipe in front of the driving wheels only and another to the rear of the coupled wheels. The contemporary 'pipe and rod arrangement' drawing from the same source, however, shows an additional pipe in front of the rear, coupled wheels, and this is confirmed by official photographs. The NRM GA also shows, incorrectly, the trailing wheels unbraked, while on the drawing of No.730, the Stephenson engine, the draughtsman has even forgotten the safety valve lever! Once again, the drawing from Darlington Railway Centre and the 1909 *Model Engineer and Electrician* article both show all these details correctly. While on the subject of brakes, both engines were Westinghouse fitted, standard practice on the NER, but they also carried a vacuum brake ejector for working stock off 'foreign' lines. An archaic feature for the beginning of the 20th century was the use of a 4in. thick genuine wooden beam for the buffer beam, clad on each side with steel, but for some reason the wood was tapered off at each end, leaving a gap between it and the rear steel plate at the outer extremities. Another relic of earlier days of railways was the retention of safety chains either side of the main coupling on the rear of the tender.

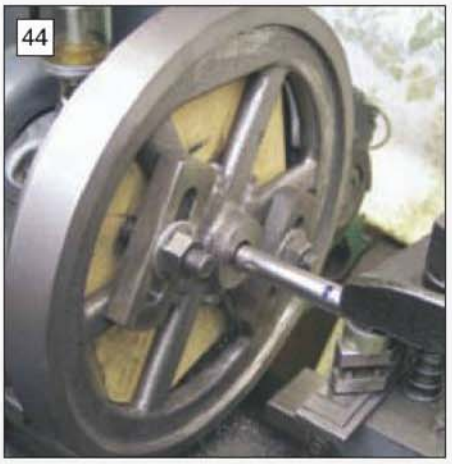
Walter Smith's two 4CCs have more than once been described as the *"best engines the North Eastern ever had"* and in dynamometer tests in 1906 they certainly outperformed in every way the railway's class V Atlantics, S class 4-6-0s and R class 4-4-0s by a considerable margin. Hauling a load of 455 tons, an exceptional figure for that period, No.730, the Stephenson fitted engine, covered the NER's famous racing ground of 44.1 miles between Darlington and York in 45 1/4 minutes start to stop. With a sustained speed of 54 1/2mph up a gradient of 1 in 391, the drawbar pull was held steady at no less than 2.9 tons, registering a dbhp of 1030. Perhaps even more remarkable was the recording of a pressure drop of only 2psi between boiler and high pressure steam chest, a tribute to the excellent design of that part of the steam circuit. With an even heavier train of 475 tons, the same engine knocked 1 1/2 minutes off the *Flying Scotsman* schedule of 92 minutes for the 80 1/4 miles from York to Newcastle, including a signal check costing a minute. On this occasion, in spite of having only four coupled wheels, and very large ones at that, the Atlantic made a spectacular start out of York, reaching 50mph in just three miles from the start, and took five minutes less to Newcastle than the competing 4-6-0 hauling a train lighter by almost a hundred tons. At one stage, No.730 was whirling her enormous 16-coach train along at 72mph, but the hill climbing was also first class throughout and the whole performance was really quite extraordinary for an unsuperheated engine hauling more than seven times her own weight.

●*To be continued.*



Turning the flywheels was facilitated by placing a piece of MDF between work and faceplate.

Machining the flywheel face nearest the faceplate with a hooked tool.



Cutting the key way in the bore of one of the flywheels with a special slotting tool.

BUILDING THE RED WING MOTOR CO. AIR-COOLED ENGINE

Jim Service

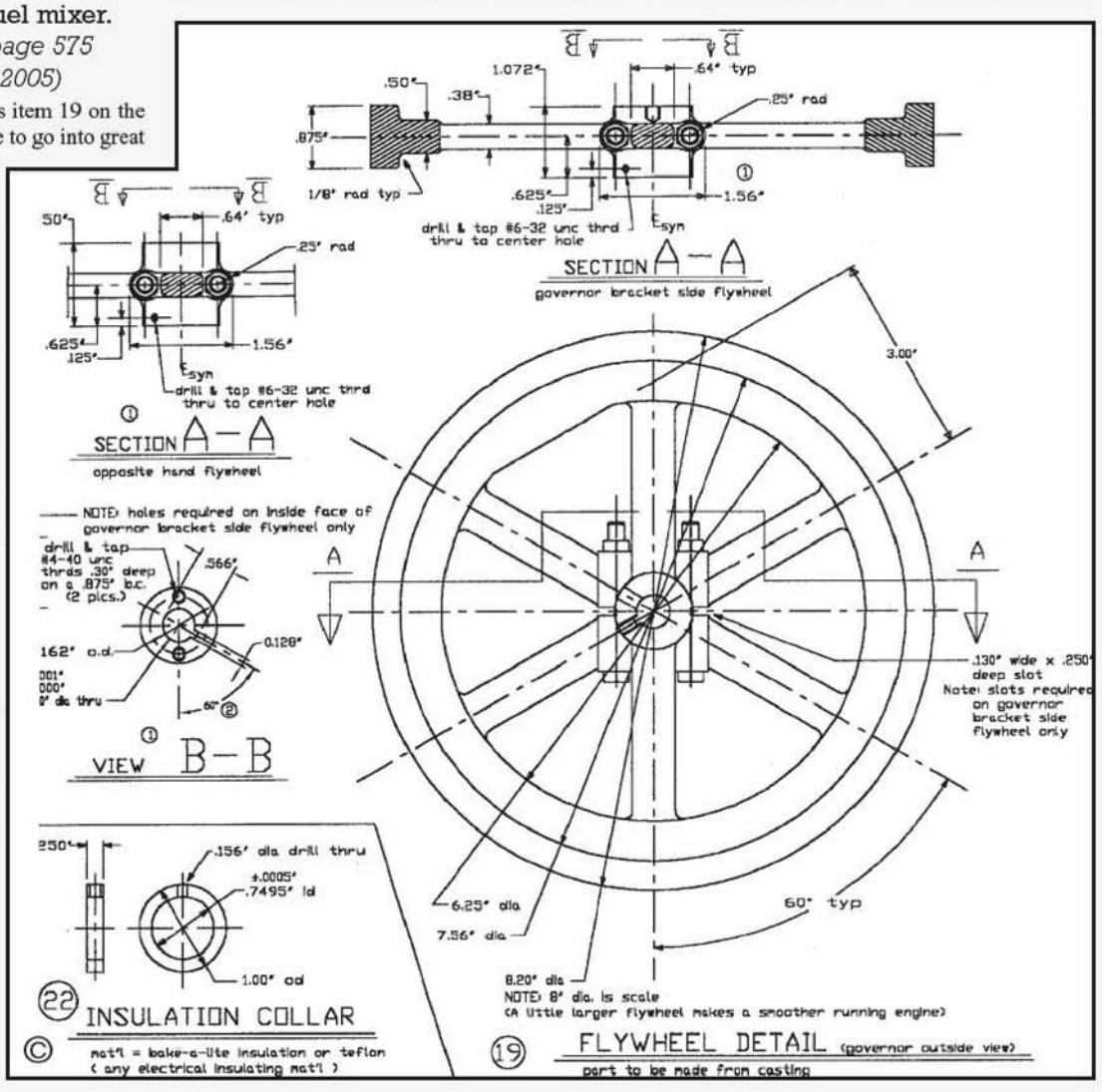
concludes the series on this delightful farm engine by dealing with the flywheels and fuel mixer.

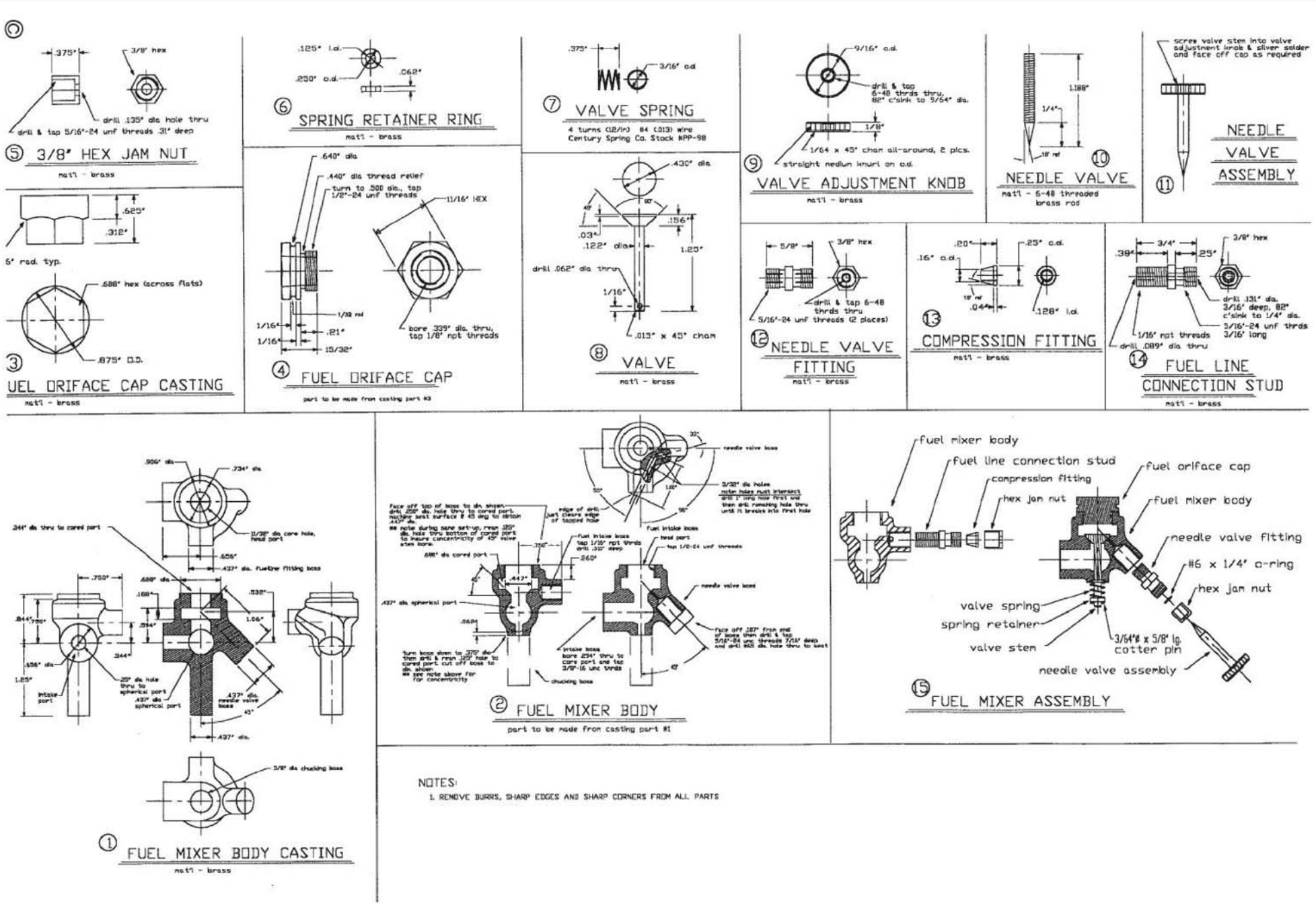
●*Part IV continued from page 575 (M.E. 4260, 11 November 2005)*

The flywheels are shown as item 19 on the drawings. I do not propose to go into great detail on how these are machined as the procedure has been described in these pages on many occasions After grinding off all the unwanted bits, the wheel was mounted on the face plate with two bolts with a piece of MDF between the spokes and the faceplate (**photo 42**). This is a tip I got from *M.E.* and it is a good one. It was set to run reasonably true and its face and sides were machined to size, using a tungsten carbide tipped tool. **Photograph 43** shows a method of machining the rear face of the wheel at one setting. The angle of the tool shown does not have to be so obtuse. This holder was used only because it happened to be available. The bore was drilled and bored to size. The key way was cut using a slotting tool as in **photo 44**, traversing the lathe carriage and removing approximately 0.003in. of stock at a time. It is very important to locate the key ways as per the drawing.

Fuel mixer body

This was held in the 4-jaw, faced to 0.846in. from the centre of the air-intake. For the valve seat, the only means available to me was a precision 1/2in. countersink drill, so the top part of the casting was taken out to 1/2in. diameter. A 1/4in. drill was used to drill through to the cored port. Then a 1/4in. centre drill was inserted in this hole to go through the cored port to drill a centre at the bottom of the port. This was then drilled and ▶



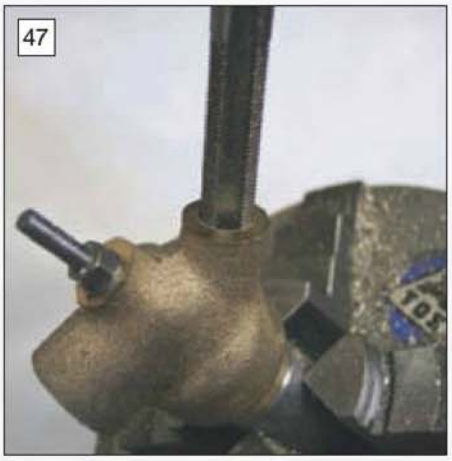


NOTES:

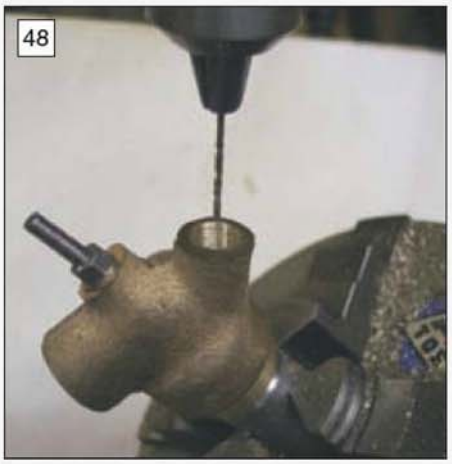
1. REMOVE BURRS, SHARP EDGES AND SHARP CORNERS FROM ALL PARTS

Machining the thread in the top of the fuel mixer body for the cap.

The mandrel devised for drilling the jet hole so that it comes out correctly in the valve seat face.



Tapping the fuel mixer body 5/16 x 40 for the needle valve fitting.



Drilling the jet hole in the fuel mixer body with a No.65 drill.

The method used to line up the drill prior to drilling the transfer port hole.

Drilling the transfer port hole in the fuel mixer body casting.

reamed to 1/8in. for half an inch deep. The countersink was then used to form the valve seat. I cannot say it is exactly 0.447in. across but it looks approximately that. It was then cut 24tpi as in **photo 45**, a suitable orifice cap item 4 will be made later.

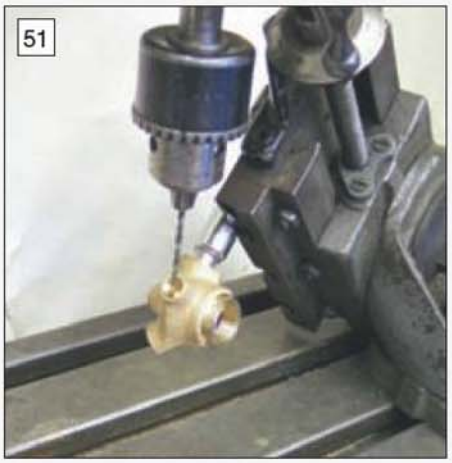
The chucking piece was then cut off with a slitting saw; the boss for the adjusting screw was reduced by 0.187in. as per drawing. Locating the hole in this is a bit tricky; I believe some American builders refer to this as *"poke and hope"*. However, although the method about to be described, will not guarantee the jet-hole to be dead-centre in the valve face, it should at least end up within the perimeters of the valve-face.

A short length of light alloy rod was machined in the chuck to 0.5in. diameter and drilled and tapped 5BA. A taper was made 45deg. so that the small end was exactly 0.25 inch. Chuck and work were then transferred to a dividing head on the milling machine table also set at 45deg. (**photo 46**). Not everyone will have a dividing head, but if the alloy rod is made say 2in. long, it can be held at 45deg. in the milling vice which should achieve the same result. Using a short scriber in the milling chuck, the table was adjusted so that the scriber point was central to the alloy rod and centred on the dummy valve face. Lock everything to maintain this setting. The mixer body was then set on the rod and held in place with a 5BA nut. It was then drilled 7/16in. deep in stages to size L drill. (It is important to take this out in stages a little at a time as the set-up will not tolerate heavy drilling or worse still drill snatch). It was then tapped 5/16in. x 40tpi and the jet hole drilled as per drawing (**photos 47** and **48**).

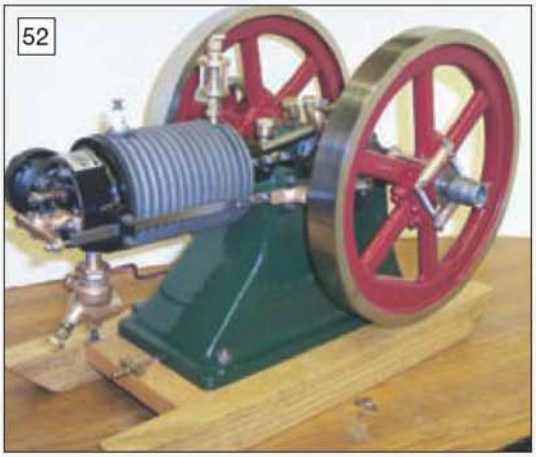
The transfer port between fuel inlet and the adjusting screw-chamber is also tricky, but with a little care it can be done in one go - see **photos 49** and **50**. **Photograph 51** shows how this can also be done, using a swivelling vertical slide. In this case the air inlet hole is drilled and tapped 3/8in. BSF and mounted on a screwed mandrel, bolted to the slide.

At the start, I mentioned the need for a 3/8in. hole at the fuel take-off point to be used for clamping the casting. Since this hole was already there, it was used to connect the gas supply from the inlet to the mixing tube as in the photograph of the finished engine. The petrol filler cap shown between the cylinder and the main bearings is a dummy.

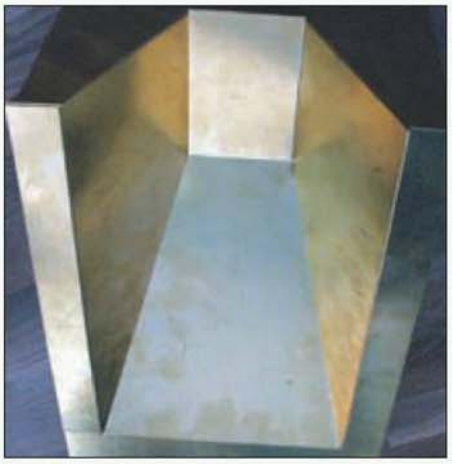
Timing of the engine is very straight forward and easy. My engine fired up after only a few minutes of adjusting the exhaust cam and ignition lever. The adjusting screw on the push rod also needed a bit of tweaking to get smooth running.



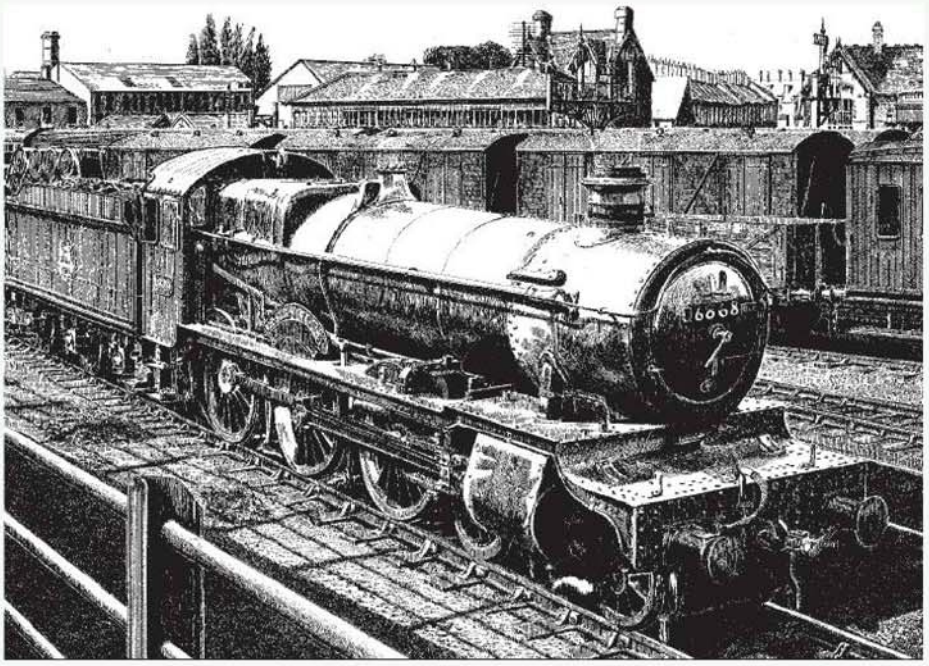
An alternative method of drilling the transfer port holes using a swivelling vertical slide.



The completed engine on its wooden skids. A neat project for I/C engine fans.



The coal space and tank top of the 3,500gal. tender body available from Bruce Engineering.



PENRHOS GRANGE

Neville Evans
deals with the GWR 4,000 gallon tender tank.

●*Part XXV continued from page 568 (M.E. 4260, 11 November 2005)*

I have purposely left all the details of the smaller tank until a separate issue. It will be apparent that the tanks appear to be so similar that mistakes in cross reference are too easily made. The full size drawings are of course on separate sheets. The under-frames however are common to both tanks and were interchangeable, as they are on the model. I have shown the tank as being held down via the sole plate by six, 5BA screws soft soldered into the plate. These screws will have to be specially made as they are of brass or bronze with large heads. They will have to be inserted before the rest of the tender tank has been assembled. I enclose some pictures of the first tender tank from Pete Thomas, as shown at the Midlands exhibition. They were very well received, the remark that I liked best was from David Aitken (he of the exquisite workmanship) he said that he was *"sick as a parrot"*. A great compliment I thought.

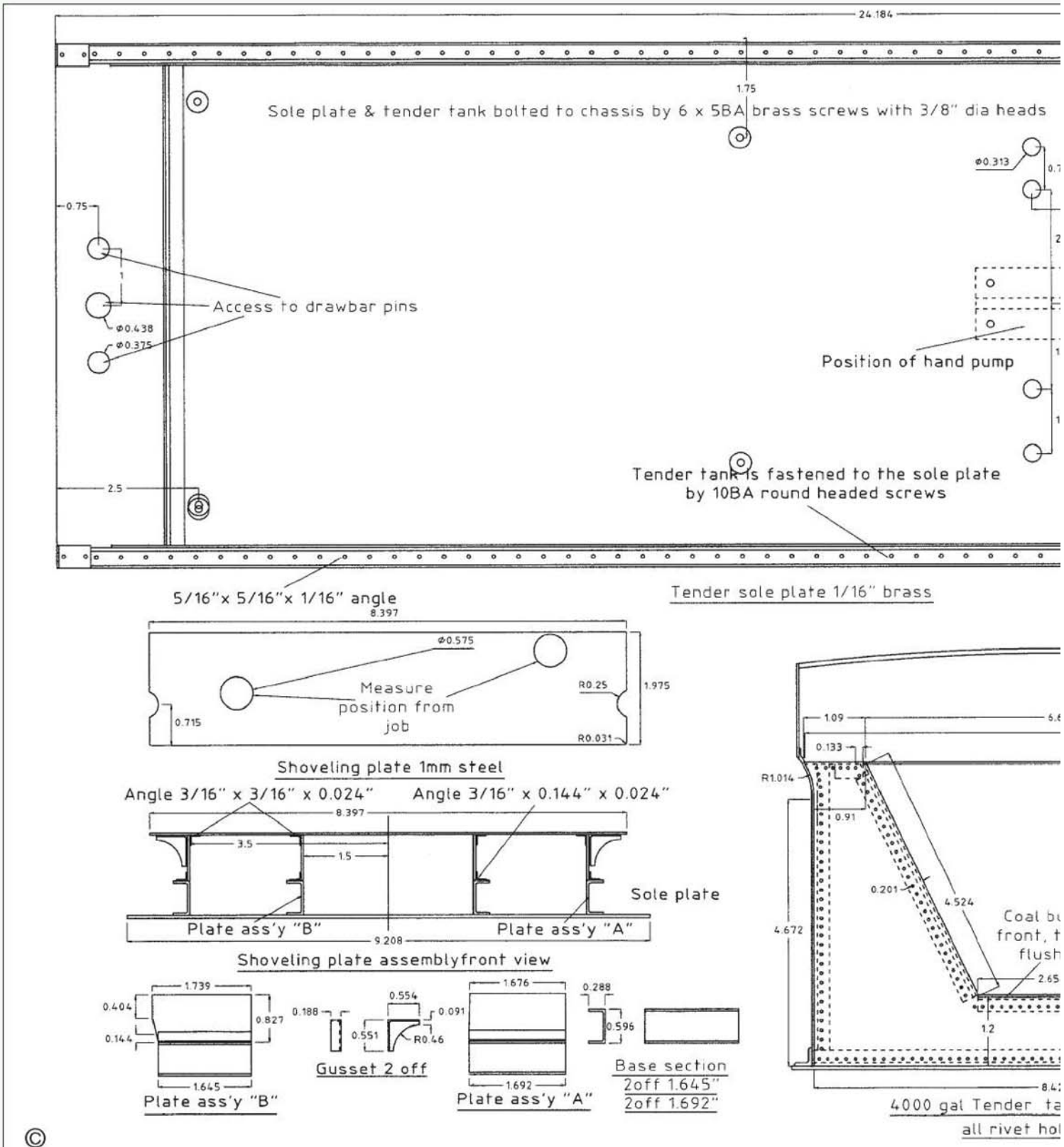
The side view of the model 3,500gal. tender body.

Hand pump

This particular accessory is, in my opinion, of limited value, especially in an emergency. I would consider that the most appropriate course of action in the event of a water shortage in the boiler, is to drop the fire. I certainly wouldn't recommend pumping small amounts of cold water into an overheated boiler, which smacks to me of re-inventing the flash steam plant. I think that making a new fire is infinitely preferable to making a new boiler. I must emphasise however that this is a purely personal opinion, and that there are other functions such as boiler testing for which a hand pump can prove to be invaluable. I therefore include for your inspection drawings of a suitable artefact.

Detail of the coal rail of the 3,500gal. tender at Toddington. Note the angle joining the side and top.

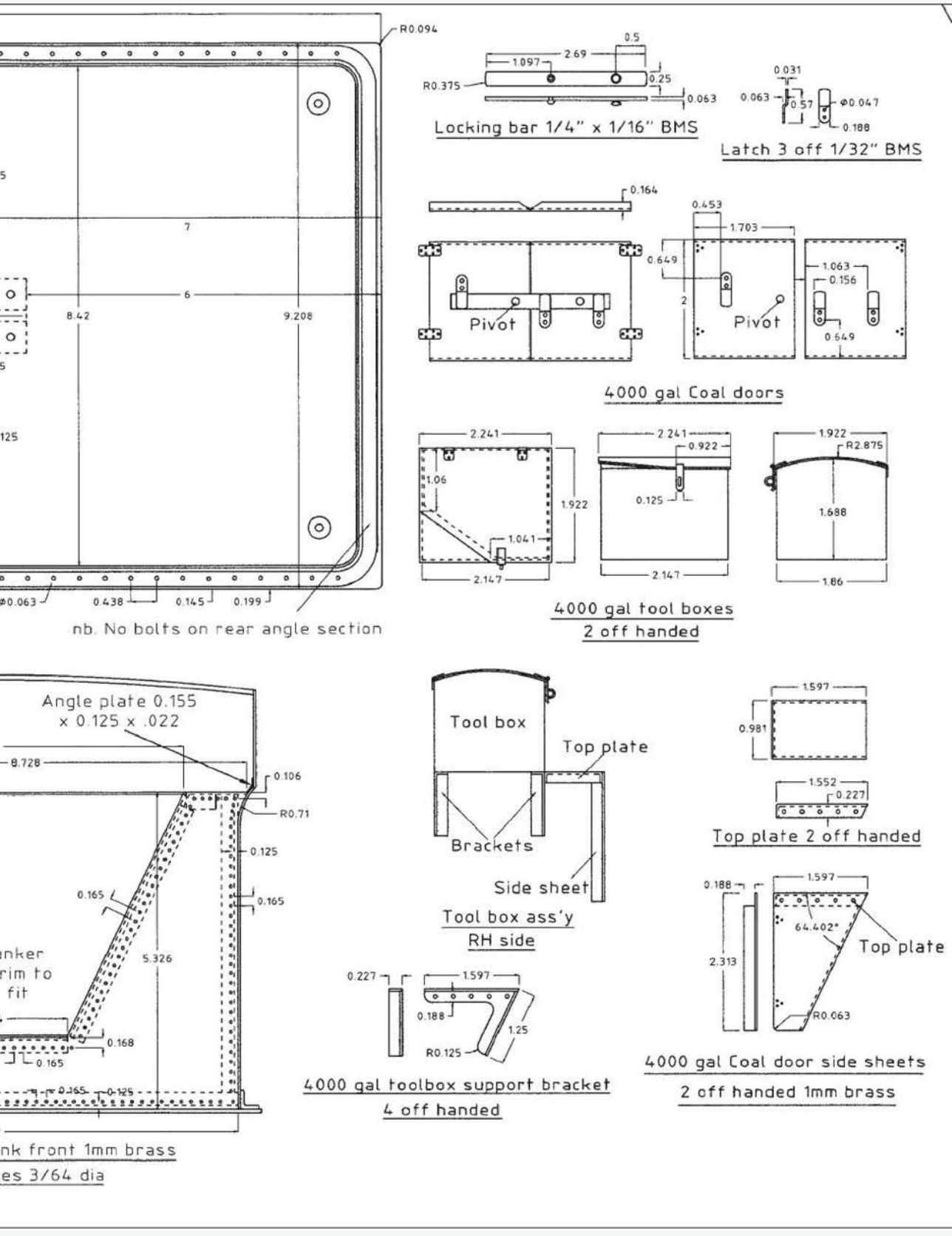
Coal door detail showing the latch and rivet layout. This photo was also taken at Toddington.



The design that I have detailed is well proven, and should last the life of the locomotive, with reasonable care and good luck. It is based as usual, on the use of O-ring shuttle valves, which are easy to make and fit and should need little or no servicing between refits. The main body of the pump is fabricated out of odd pieces of brass, silver-soldered together. I have resisted the temptation to include a strum box with filter gauze on top, in favour of simple 90deg. elbow joints which can be bought as proprietary articles from a hydraulic supply shop. They come complete with a variety of fastening nuts and fittings and I would never dream of using anything else. You can buy your piping, both flexible and plastic in the same place, together with those neat little clips that stick it all together. While you are about it see what you can get in the way of hydraulic switches for switching water on and off, as well as regulating pump flow via the return valve. Don't forget the gauze strainers on top of the injector feed unions.

Shovelling plate

This is a simple fabrication, that appears on most GWR tenders (I hesitate to say all, for fear of awakening the seemingly inevitable exception to this particular rule). The object of the exercise is to adjust the height of the front of the tender to suit any size of locomotive. Obviously the freight engines are naturally lower at cab floor level than the passenger engines, which might have wheels that are two feet larger in diameter. Hence the fact of one standard tender, and lots of different



shovelling plates to suit each locomotive. This particular plate is meant to suit the 'Grange' and 'Manor' classes only. When we get to the Collett 'Hall' and Churchward 'Saint' classes, we shall have to adjust the height of the plate to suit each one, all perfectly simple.

The shovelling plate itself is held up by four vertical members which are sat on U-section lengths which can be conveniently bent up from 1mm brass strip. These four pieces are held together with 3/16 x 3/16in. angle brass as per the appended artwork. The shovelling plate should, I think, be made from steel plate if only for the sake of appearance. The complete assembly is then fitted to the sole plate by a few discretely placed screws. Note that the various water control, brake and water scoop levers and stands have to be fitted through the shovelling plate. The two large and obtrusive stands will need to be threaded through the large holes before fitting their handles. There is a second plate fitted to the rear of the shovelling plate that is angled down into the coal space. This plate will have to be made to measure, so to speak, so as to fit onto the tapered coal plate.

Toolboxes and coal doors

The toolboxes are pretty straightforward and are available as 'foldies' cut to precision limits by Pete Thomas ready for soldering up. The hinges and locks are available as doll's house fittings and are now stocked by many model engineering emporia. Note that the 4,000 gal. ▶

Aerial view of the shovelling plate. That for the model would be best made from steel like the prototype.

Lower part of the toolbox showing the support bracket and plates used on these tenders

boxes differ from the 3,500gal. in that the taller 4,000gal. tenders are marginal on loading gauge clearance and have to have the outside corners lopped off in order to effect clearance. The smaller 3,500gal. ones don't have the same problem and possess complete lids. Or so I thought. In fact as bits and pieces are swopped around preserved engines, you might have any sort of toolbox that comes to hand. The delightful Collett 0-6-0 that I photographed at Toddington has a 3,500gal. tender with 4,000gal. toolboxes. I'm not complaining folks, just warning you that all is not what it may seem in the preservation world.

The drawing shows the deeper, 4,000gal. doors and side sheets, so beware. Don't mix up the two tenders or disaster awaits, the parts may have a superficial resemblance but in fact are very different in size and shape. These pieces merit no further description. They may be available as ready cut out parts for them as wants them. Just rivet them up and solder them on.

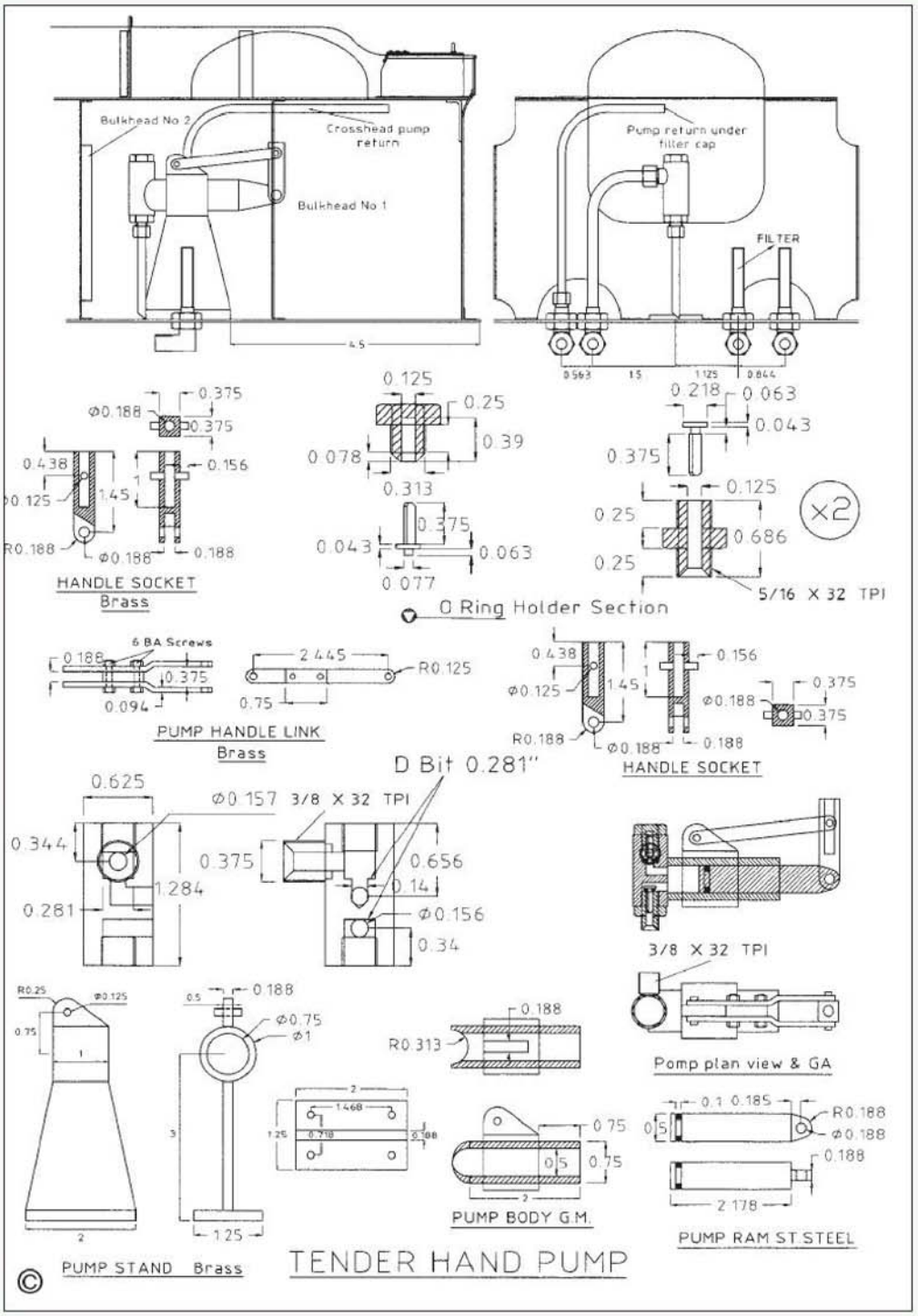
Cock up corner

I must apologise for an error that has crept into the tender tank drawings on page 567 of *M.E.* 4260, 11 November 2005. The width of the tank bulkheads has been omitted. It should be 8.42in. across the outside of the flanges. Sorry folks.

Penrhos Grange axleboxes

With reference to Keith Wilson's letter in Post Bag of 2 September last (*M.E.* 4255), his fears are unjustified, there is no mistake in the published design of my axleboxes. I am well aware that in full size practice it is necessary to add a further dimension to the spring geometry by using a double hinged buckle. In smaller practice however it is quite unnecessary. Our little locomotives are about 1,800 times lighter than their full size counterparts, and although our tracks are more uneven than full size, I can assure builders of these engines, that they will have no problem whatsoever with this form of simple, easy to make, long lasting axlebox and spring assembly. The plate spring will flex enough to absorb many times the amount of movement that it will be subjected to. Just fit and forget.

●*To be continued.*



ROAD STEAM

OUT AND ABOUT 2005

Martin Wallis
reports on some of the memorable events he has attended up and down the country during the past year.

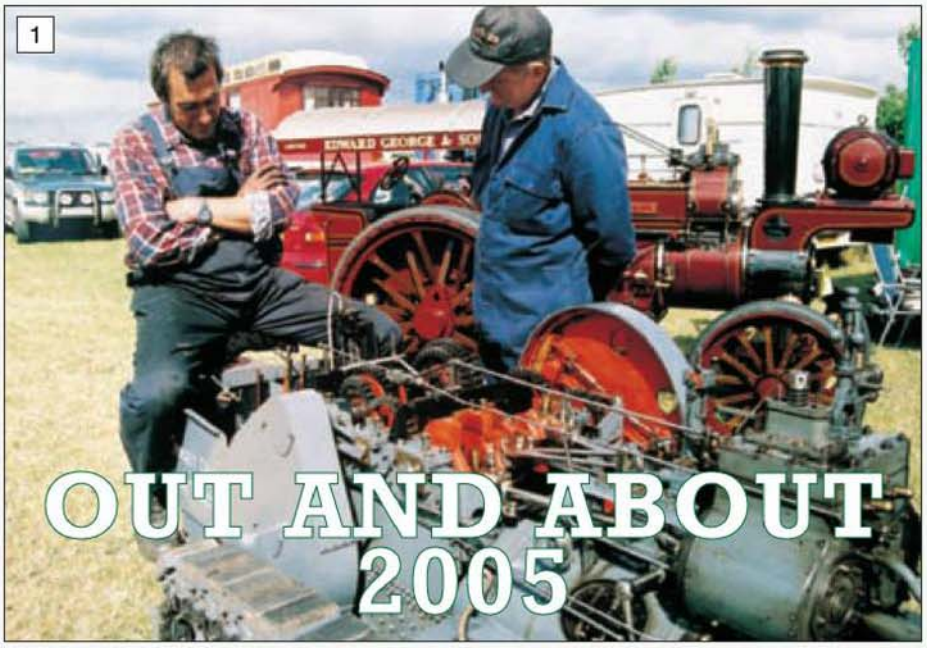
The past year has been an excellent one for Road Steam enthusiasts with many fresh models out and about at the exhibitions and in steam on the rally fields. The star of the year was probably Steve Baldock's chain track tractor, see **photo 1**, which seemed to have managed to attend just about every rally, and was about as different and interesting a model as you could ever wish for.

Sandown

The year started with an excellent selection of models at the Sandown Exhibition; and my first sight of the stunning 3in. scale Fowler Super Lion *King Carnival II*, built by the late Dick Hodges (**photo 2**). The prototype was built as a showman's road locomotive, but was cut down in the ownership of Pickfords and subsequently sold to the boiler makers John Thompson of Wolverhampton. The model was superb in every detail and beautifully crafted, but surprisingly was only awarded a Silver Medal. I was a little perplexed but later understood it lost marks as it was not lined out: which was odd as this was exactly as John Thompson used it and entirely prototypical.

Harrogate

The Harrogate 2005 exhibition proved as ever to be an excellent show, under the masterful guidance of Lou Rex. Among the 138 stands listed was The Great Northern Steam Company, which has traded for 9 years developing and manufacturing larger scale models of traction engines and railway locomotives. Their latest venture is a 'model' of no less than 12in to the foot, a full size replica of the Foster 'Wellington' tractor, complete and ready to drive away. Sadly my picture of it was none too special, but perhaps one of our editors can help *(always happy to oblige - see photo 3-Ed.)*.



Steve Baldock discussing his 4in. to the foot scale chain track tractor at the Pickering rally in August.

Dick Hodges' 1:4 scale super Lion B6 road locomotive King Carnival II, *presented exactly as used by John Thompson.*

Replica Foster 'Wellington' traction engine offered by The Great Northern Steam Company.

The 4in. to the foot Tasker 'Little Giant' tractor Athach Beag, *which was built by Harry Clyne.*

Roy Butcher's part finished half scale Burrell steam wagon.

Detail of Roy's back wheel, note the use of a commercial, pressed on, vulcanised rubber tyre.

Keith Osborne's stunning full size Foster 7 NHP Contractor's Engine. Strumshaw was its first outing.

Richard Vernon's 1909 BAA Fowler No.11717, an unusual engine designed for colonial use.

As ever there were numerous models in steam outside to compliment the impressive show of models in the show halls. A model that caught my eye was a 4in. to the foot Tasker 'Little Giant' tractor called *Athach Beag* (Gaelic for Little Giant), which was built by Harry Clyne (**photo 4**).

The model was built in just 18 months, but in Harry's words *"almost 12 hours a day, 7 days a week"*. Harry and his wife had travelled from mid-Scotland to attend the Harrogate Exhibition. The castings are drawings are available from Camden Steam Services, a regular advertiser in *Model Engineer*.

Strumpshaw

At the Strumpshaw rally, near Norwich, I finally caught up with Roy Butcher's 6in. to the foot Burrell overtype steam wagon, a model I had heard much about (**photos 5** and **6**). The model was started in 1998 and is based on the double chain drive Burrell 5 ton wagon No.4008, the surviving bits of which are in Michael Lugg's yard. I was aware of No.4008 the, so I thought, sole surviving Burrell wagon but was assured by Roy that parts of two further Burrell wagons still exist, some chassis parts of one is apparently used as a bridge and another part chassis is supposed to be buried in a farmyard.

A few readers may remember the very fine 1:3 Foster on the rally fields a few years back constructed by Keith Osborn and 2005 saw the first appearance of his next project, a near identical Foster but this time full size (**photo 7**). The engine was originally owned by the Rust Bros of Buxton Lammas, ending up in 1946 in a scrap yard at North Walsham, Norfolk. There it stayed for over 50 years until it was purchased by a dealer in 1999, who subsequently sold it to Keith. It was in a truly dreadful state when Keith bought it, the engine took four years and four months to restore. In addition to a new boiler a new flywheel had to be cast as the original was cracked in the boss where the key is driven in.

As an experienced model engineer Keith was quite at home with machine work and all the motion was put up in lathe to be skimmed, a new set of clacks was manufactured as the originals had de-zincified and were unusable, a complete

One of the rear wheels of the Fowler type BAA traction engine.

A drivers eye view of the Fowler BAA colonial traction engine.

Mr. Garnett's 1:3 scale McLaren road locomotive looked very impressive in its blue livery.

The McLaren was the more impressive from the other side when the novel arrangements for the driver's comfort are taken into account.

The Sentinel 'Steam Elephant', once used on Teignmouth Quay for shunting duties, now resident in the Netherlands.

Fun with the dynamometer at the Great Dorset Steam Fair. The McLaren produced 13bhp.

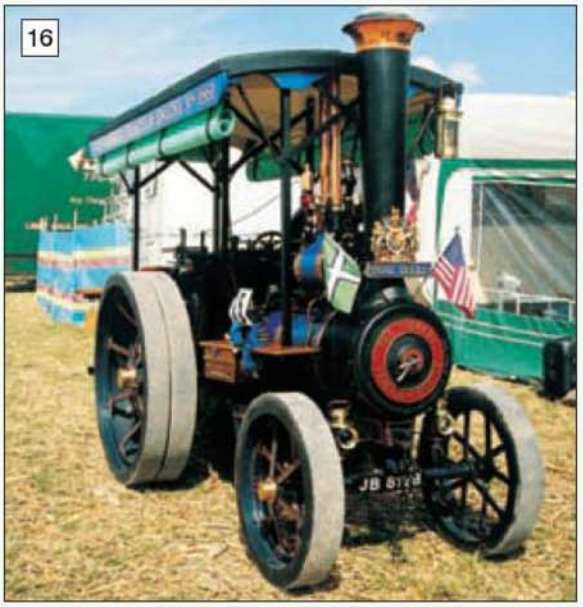
set of all the nuts with the correct pre-war hexagon sizes was made, and the crankshaft was carefully re-machined after it had been built up with weld - a job that took three weeks.

BAA colonial engine

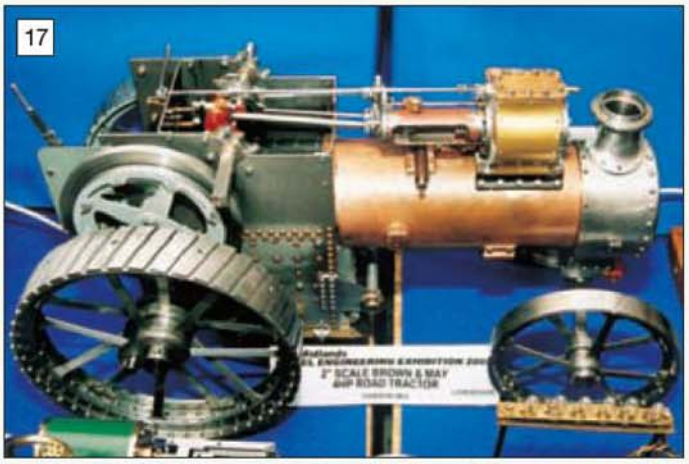
Each year a selection of full size engines, recently overhauled and freshly painted, make their debut on the rally fields. In some cases it might be the reappearance of an old friend, perhaps after major boiler work, but for maximum excitement the 'first time out' of a very rare engine is hard to beat (**photos 8, 9** and **10**). Such an engine is John Fowler type BAA colonial traction engine No.11717. It is rated at 6nhp, weighs 8 tons, and was completed in March 1909. Fowler classified this design as 'BAA' and their literature refers to them as 'Anglo-Australian' light pattern traction engines.

Only nine of this type were produced, eight of which went to Australia and one to South Africa. Apparently they were designed to ▶

A demonstration of steam threshing and bailing that took place at the Great Dorset Steam Fair.



Ron Sheppard's fine half size Burrell, complete with engine lamps, a further lamp hanging from the canopy, side sheets,rest, flags and tool box.



In among the club stands at the Midlands Model Exhibition was a beautifully made 1:6 scale Brown and May tractor by Llew Bedder.

compete with the lightweight American engines but with their 8 ton rating and 6nhp it is hard to see where the advantage was. Five such engines survive today, two in Australia, two repatriated to the UK from Australia, and the engine exported to South Africa.

Note the large gear visible behind the rear wheel which is not the final drive as might be expected but the drive gear for the winding drum. For road use a differential is fitted on the second shaft with each rear wheel taking its drive from pinions meshing with annular gear rings, one mounted inside the rim of each of the back wheel rims

The first impression is that the boiler was mistakenly fitted upside down - the foundation ring rivets appears to be at the top. Climbing aboard the mystery is solved, the top of the boiler is a large pressing rivetted in place with the flat area supported by substantial nutted crown stays. Note the clean and tidy three cock water gauge, two test cocks, and the steam manifold partially hidden behind the rivetted seam.

Great Dorset Steam Fair

The Great Dorset Steam Fair, or GDSF, is not necessarily the largest gathering of model road steam engines - that honour probably goes to the excellent Lincoln show - but it is an extremely good 'working' rally. Every encouragement is given to modellers to drive something with their engine. In addition to thrashing, generating, sawing, baling, pumping, haulage, lifting (crane engines) and ploughing there was this year a dynamometer for the exhibitors to play with. Engines were belted up to a substantial 110V DC generator, the power output recorded, and the brake horsepower (bhp) duly calculated (**photo 14**). The scale of the engines and the bhps calculated were chalked on a board.

Your author's half size Fowler managed 9.9bhp which with understandable poetic licence was quickly inflated to 10bhp, but was then soundly beaten by Colin Dix's half size McLaren which chalked up no less than 13bhp. To be fair the McLaren is a larger engine with a 16in. dia. barrel compared to the Fowler's 15in., however much pleasure was derived from the performance of a 6in. Burrell (also 15in. barrel) which had been on the dynamometer at an earlier rally and did not do anything like as well. The load was the traditional salt bath and two copper rods, the bath being quite quickly brought to the boil by the half size engines and the copper pipes looked very much the worse for wear afterwards.

A fine model I had not seen before was Ron Sheppard's half size Burrell No.3861 built in 1920, an engine which was sadly scrapped at the end of the war. The model was largely built by Geoff Squirrel but was completed by Ron. The model was beautifully finished in blue. It weighs in at 1 ton 10cwt (**photo 16**).

Most respected

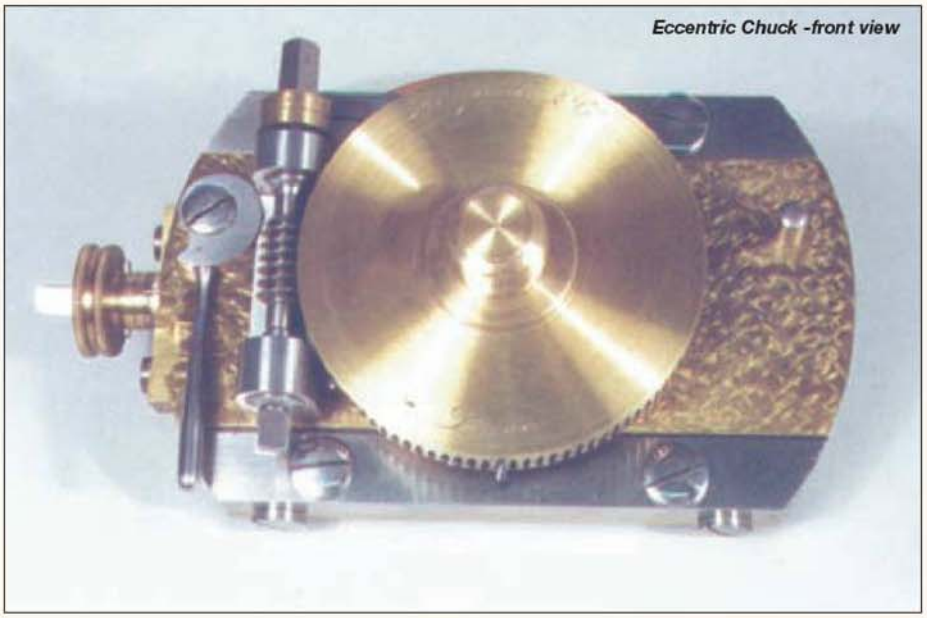
Unfortunately 2005 will also be remembered for the theft of Ron Dawe's Gold Medal and Duke of Edinburgh Award winning 2in. to the foot scale Burrell scenic showman's engine. This superb model, along with his carved dragon car was stolen from the boot of his car in the early evening of 26 May. The car was broken into and the model, which was bolted to the floor and weighed over 2hundredweight, was removed. Ron is probably the most respected and well thought of model engineer on the 'rally circuit' and the shock and misery soon travelled the country. I was not in the least surprised to hear that a model engineer with a thicker wallet than Ron's put up a £1,000 reward, followed shortly afterwards by another model engineer's pledge of a further £1,000, and presently I understand the reward for the safe recovery of the model is no less than £3,000.

During the weeks that followed the theft Ron's phone nearly melted. Ron found he had more friends than he felt possible and sales rooms all around the world were, quite literally, being watched. I know Ron would like to thank all the kind folk, a number he knew but many he has never met, who have offered help and expressed their sympathy.

It might be possible to confuse Ron's 1:6 Burrell for Ronald Clarke's published design *Thetford Town* but the care and attention to detail makes Ron's model difficult to miss. For pictures and further details visit **www.modeleng.org** and click on 'lost models directory'.

I understand several models, both road steam and otherwise, have been lost over the last couple of years from the Kent area. If anyone has any lead or has any information please contact the police, Ron himself, or our worthy editor. With regards to the thefts readers may note where a full name is given in these notes a county or club is not.

Part of the line up during the grand parade at Rushden Cavalcade 2005


Eccentric Chuck -front view

PLAIN MAN'S GUIDE TO ORNAMENTAL TURNING

John Edwards

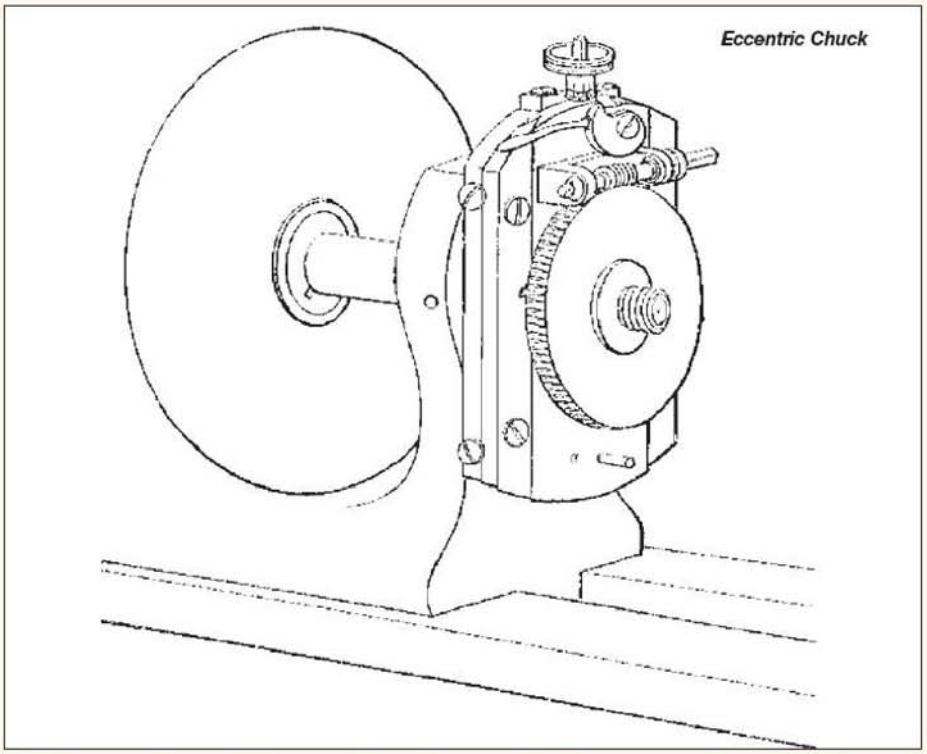
examines some of the principal ornamental chucks and their uses.

●*Part VI continued from page 577 (M.E. 4260, 11 November 2005)*

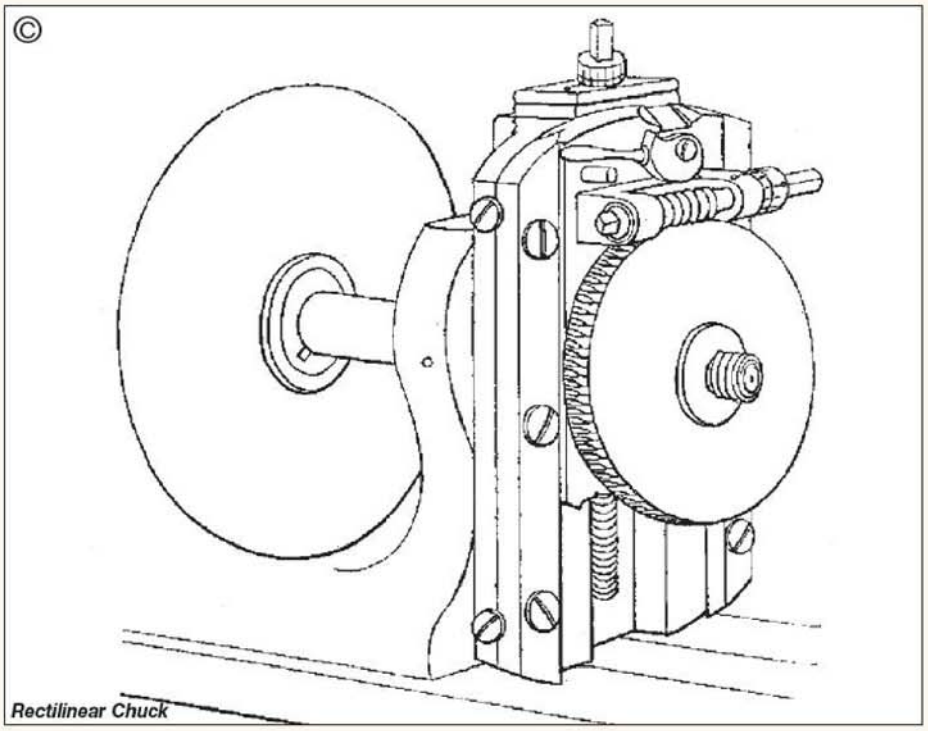
The Eccentric Chuck is used for multi-centre turning. It comprises a foundation plate which screws onto the spindle nose with parallel slide bars between which runs a sliding plate controlled by a leadscrew. On the sliding plate is mounted a worm-and-wheel of 96 teeth with a copy of the spindle nose in its centre on which the work is mounted. There is a locking pin to lock the slide with the nose at centre. By removing the locking pin and rotating the leadscrew, the slide is extended and the nose becomes eccentric to the axis of the lathe spindle; off-centre turning may then take place. Multi-centre turning is achieved by rotating the worm-wheel to different angles in relation to the orientation of the slide. This chuck may be run at normal speed when in its neutral or centre position but it should only be run quite slowly when eccentric unless suitable counterbalance weights are attached. There is no 'best speed' but all equipment should be free from vibration while running.

The Rectilinear Chuck is a larger version of the Eccentric Chuck. It has the advantage that the slide may be extended at either end so it may be used like a vertical slide for cutting straight lines or a series of cuts along a straight line. Being considerably heavier than the Eccentric Chuck, it is not intended to be run at speed but it can be rotated by the slow-motion drive. It has a nosewheel of 120 teeth so is capable of some divisions not possible on the 96-tooth wheel of the Eccentric Chuck. It is also useful as a platform for the Oblique Chuck.

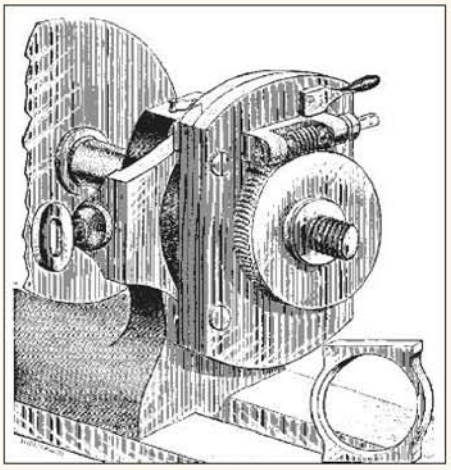
The Ellipse Chuck is constructed in a similar way to the Eccentric Chuck except that the slide bars are fixed to the sliding plate and there is no leadscrew. The foundation plate is screwed to the lathe spindle and rotates while the sliding plate floats. There are two steel pallets mounted squarely across the back of the slide bars at top and bottom and these embrace a cam-ring; the cam-ring plate is clamped horizontally on the centre line across the face of the headstock with two adjusting thumb-screws and, when the cam-ring is positioned centrally, the slide will not float because, as the chuck rotates, the pallets are always an equal distance from centre. However, when the cam-ring plate is moved off-centre (but still horizontal), the pallets, in embracing the ring, pull the sliding plate away from the centre each time it returns to horizontal; i.e. twice in each rotation; and similarly, each time the plate returns to vertical the slide is pulled back to centre. Meanwhile, the cutter, being in a fixed position on the centre line, cuts an elliptical path on the work. Like the Eccentric Chuck, the nosewheel may be adjusted so that ellipses or patterns comprising elliptical cuts may be placed at any orientation. For extra stability some chucks have a sliding-block (see engraving), which is a ring with two parallel flats on its outer rim; the ring rotates around the cam-ring and the pallets slide along the flats; thus the bearing surfaces are continuous whereas, without the intervening sliding-block, the direct bearing between the pallets and the cam-ring is only tangential.

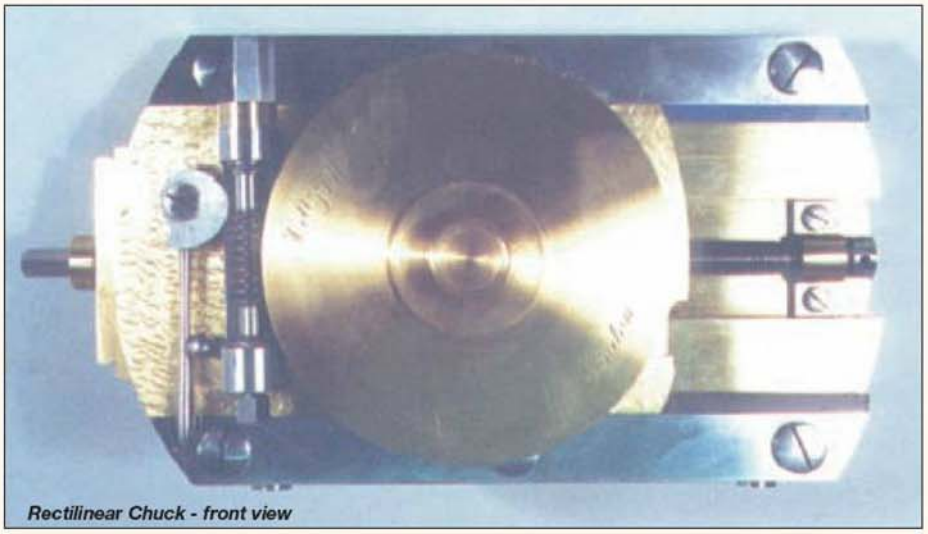

Eccentric Chuck

The elliptical box shown in the final photograph was made on the Ellipse Chuck; the lid and base were fixed to wood chucks with a paper and glue join. The insides and edges were turned at the same cam-ring setting so they were exactly parallel and finished to a tight fit; the lid was parted off and taped to the base. Then the lid pattern was cut with the ECF. The side pattern was done progressively from the edge of the lid, cutting through the tape. The fitting of the lid was eased afterwards. Finally the box was parted off at the paper join and the wood chuck turned



Rectilinear Chuck


Ellipse Chuck with sliding block


Rectilinear Chuck - front view

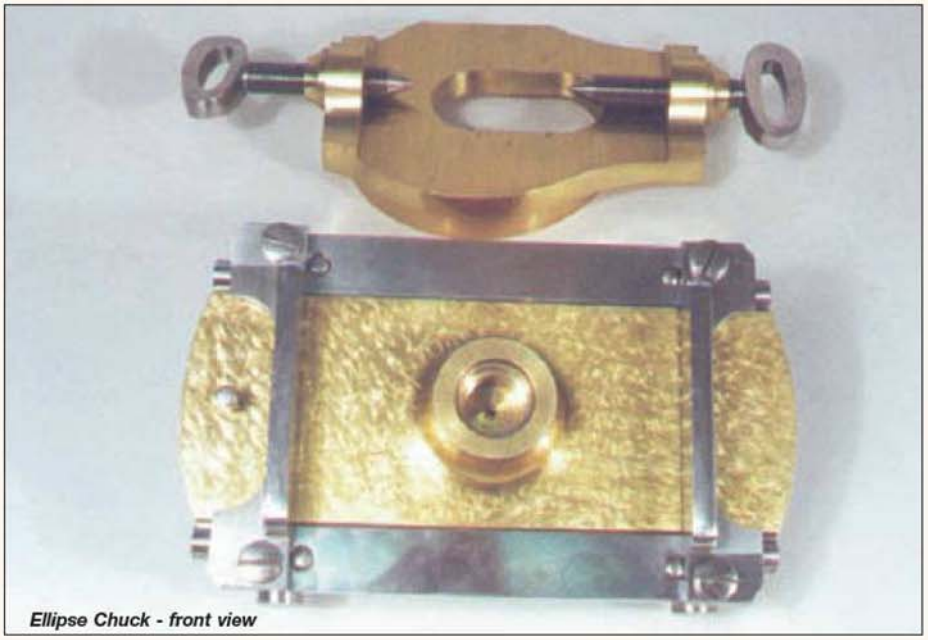

Ellipse Chuck & Cam-ring - rear view

to fit the inside profile so the bottom could be finished.

The next article will continue with the principal ornamental chucks and their uses.

If any reader wishes to know about the Society of Ornamental Turners or, indeed, anything about O T equipment and techniques not covered in this series, the author can be contacted by telephone on 01732 355 479 or by email at johnf.edwards@virgin.net

● *to be continued*


Ellipse Chuck - front view

Typical adjustable reamer assembled with its extension pilot and tapered pilot sleeve.

Component parts that go to make a standard adjustable reamer into a pilot reamer.

PILOT REAMERS

Neil Read
discusses how to use these, apparently, elusive tools

It is frequently necessary in maintenance work and general engineering to ream two plain bearings both to size and in alignment with one another. Typical examples are king pin bushes on motor cars, the main crankshaft bearings on single cylinder I/C engines, lathe countershaft bearings and even lathe mandrel bearings. Reaming applications of this nature are frequently undertaken using an adjustable reamer. These allow the stock to be removed in minute bites and ensure a close fit with the mating part even if, as is often the case, the shaft is to some odd size for which no standard reamer is available.

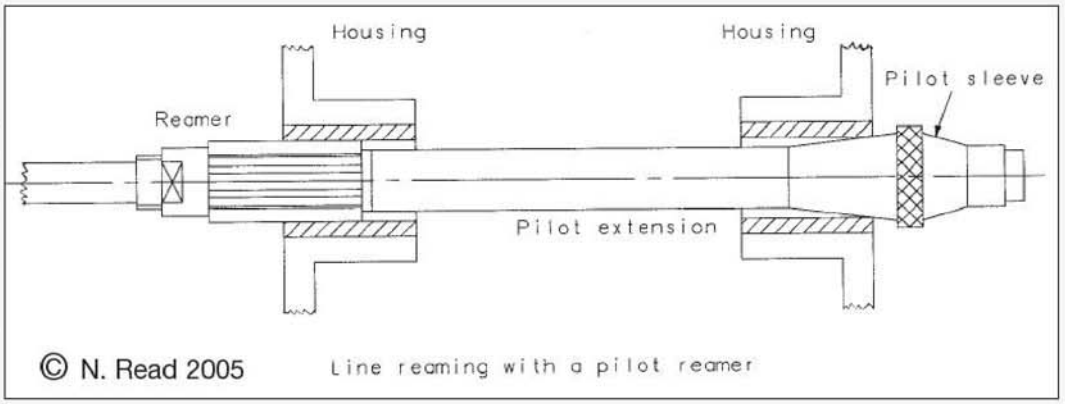
When, as is usual in these circumstances, alignment between the bearings is critical the fitter will often use a device called a pilot extension on the end of the reamer. This consists of an accurately ground shaft that screws on the end of the adjustable reamer. A pilot sleeve with a double external taper is provided with this extension piece. The assembled pilot reamer is used as in the schematic. First the tapered pilot sleeve is located in one of the bushes to be reamed. The reamer, complete with its pilot, is then threaded through the bushes from the opposite direction such that the pilot engages with the pilot sleeve. The first bush can now be reamed to size secure in the knowledge that alignment with the opposite bush is being maintained. When reaming operations on the first bush are complete then the pilot sleeve is placed in the finished bush and the reamer transferred to the other end of the work for reaming the second. Either taper of the pilot sleeve can be used according to the nature of the work. It will be apparent that provided the pilot extension is true to the reamer and a good fit in the pilot sleeve (whose tapered outer diameters must be concentric to its bore) then the finish reamed bushes will be in close alignment with one another and you should get no nasty surprises when assembly time arrives.

Note that the pilot extension replaces the bottom, adjusting nut on the reamer and to avoid it burring up in use it is usually supplied with a hardened thrust washer, which is placed between the pilot and the cutting blades. You can see the lower adjustment nut has been placed on the upper thread of the reamer in the photo so that it does not get lost.

My reason for writing this short article is that conversations with readers leads me to suspect that pilot reamers have become an endangered species in the home workshop. This is hardly surprising, as a trawl through the catalogues of a number of major supplies to the engineering industry has failed to find them listed. Most of my own adjustable reamers were made by a British company called Taylor & Jones (tel: 01484 665321) and I was delighted to find that this company have bucked the trend amongst British industry and are still in business. A check on their website (**www.taylorandjones.co.uk**) revealed that they still list adjustable reamers and that pilot extensions are available across the range. They also supply replacement blades for their reamers should yours be dulled with use. I also own the odd adjustable reamer of foreign manufacture and, in my experience, though widely advertised by model engineering suppliers these are rarely, if ever, offered with pilot extensions.

It occurred to me that a model engineer who owns the necessary adjustable reamer could, once the principle was understood, easily turn up a suitable pilot extension from mild steel for any job he might have to hand. A piece of bar could be bored in the lathe and screw cut to a close fit on the reamer. Remember to provide sufficient depth of thread to allow the reamer to enjoy its normal range of adjustment. A stub mandrel could then be turned up in the lathe with a copy of the reamer's thread machined on it. The embryo pilot extension could then be screwed on to the mandrel, carefully centred and its outer diameter turned to size. Suitable spanner flats could then be milled or filed on to it. If you are fussy you could also turn up a hardened washer but for one job it probably is not necessary. The pilot sleeve should be turned with care as its tapers need to be truly concentric to the bore and the bore must be a close running fit on the shaft. If only a single reaming operation is to be carried out then just one taper would, no doubt, suffice and this would make this part easier to machine.

The basic rules of reaming apply when using adjustable reamers. Use a lubricant if recommended for the material being worked. Take the stock out gradually. If you attempt to remove too much at once not only will it be hard work but also you may well cause chatter marks in the bore. One, perhaps obvious, point is that for best results the bores of the housing need to be reasonably in line and the O/D of the bearing bushes reasonably concentric to their bores. This way the stresses on the reamer will be reduced and alignment achieved without effort. I have sometimes found it beneficial to correct housing misalignment with a larger size of reamer before turning and fitting new bushes but then, I am sometimes told I am a fussy old Technical Editor.



Line reaming with a pilot reamer

GWR LOCOMOTIVE BAR FRAME EXTENSIONS AND CYLINDER ARRANGEMENTS

Peter Rich

concludes his case for authenticity in model locomotive design.

●*Part IV continued from page 580 (M.E. 4260, 11 November 2005)*

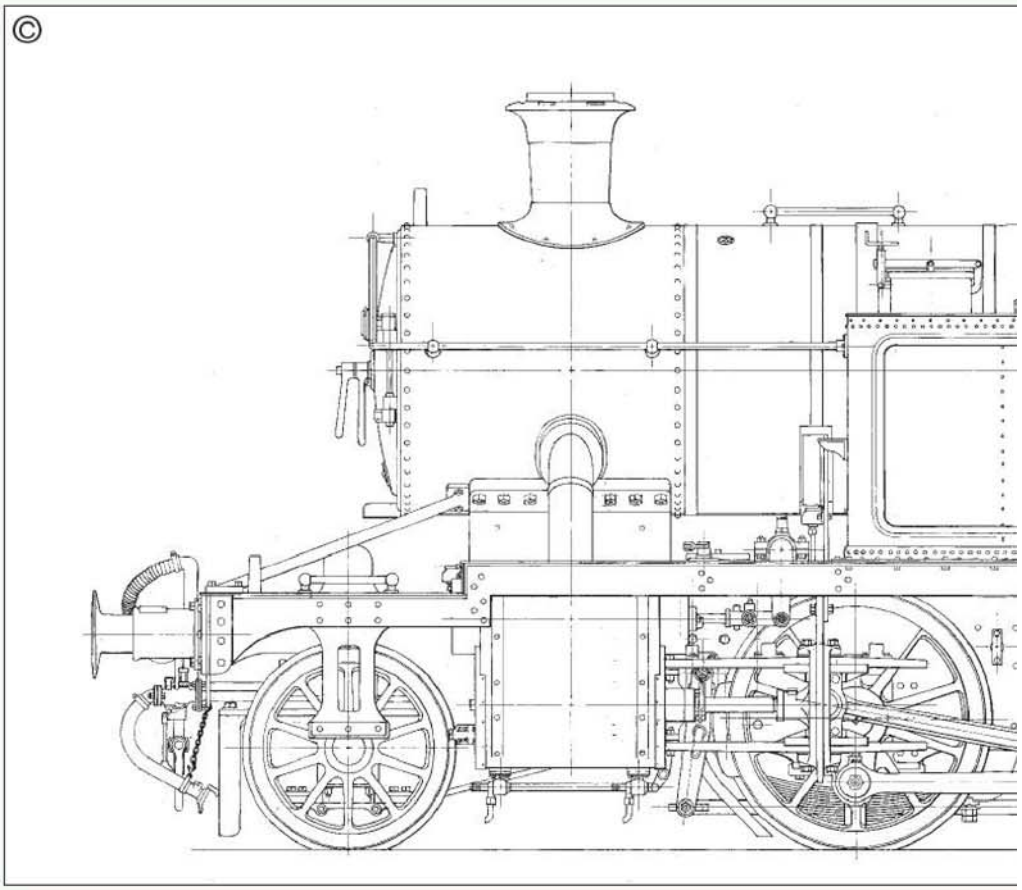
The full size bar frame is generally 2in. thick over its length but is splayed out to a flange at its ends (as shown in the drawings) to facilitate attachment to the front buffer beam and to the front of the plate frame. The buffer beam attachment is by normal 7/8in. dia. snap head rivets, however the fixing to the main plate frame is by twelve 1 1/4in. dia. (fourteen in the case of the 'Grange' and 'Manor' classes) 'fitted' bolts, which I am told were driven in with hammers. However I am a little doubtful of this as I would have thought that, in view of the numbers involved, Swindon would have provided some kind of press for this purpose. I have made tight fitted bolts on my models and found it went fairly easy, but I have provided drill starts (to be filled with paint) in the hexagon heads of the bolts to facilitate removal if it becomes necessary.

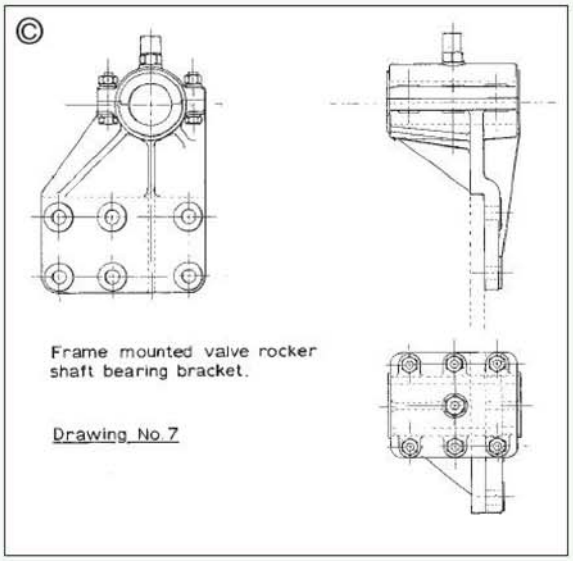
In addition to the bogie bearers, the bar frame on bogie fitted locomotives also contains the vacuum brake reservoir just behind the buffer beam and also the vacuum brake cylinder located at its rear. Although I have not shown them on my drawing (my drawings are, after all, for my models not of the full size locomotive) the racking plate was also provided with apertures for the 'take off' for the exhaust steam injector. At the rear of the bar frame and attached to the front of the main plate frame will be seen the front plate, frame stretcher (Swindon also referred to this as the 'motion plate'). This was extended vertically and its top edge formed to a radius to just clear of the boiler. A steel angle was rivetted or bolted to the top radius of this on its front or rear face (depending on the class of loco) and fitted up to, but not attached to, the boiler. This enabled the boiler to rest on this stretcher while the bar frame was being removed in the event of damage. As far as I can see this was a feature of all G.W. locomotives fitted with this type of framing except for the 3473 4-4-0 tender and 2221 4-4-2 tank engines.

To sum up, as far as I am concerned there never has been any really good reason for model engineers to change the design of the front end of G.W. 2-cylinder locomotives. For many years we have been losing out on the good features of the design, and in fact have introduced unnecessary complications. By not following full size practice we have made our work of construction and design that much more complex. Building models to full size ideas and drawings is easy but becomes complicated and more difficult when people, who believe they know better than the full size engineers, decide to alter things. What you have to bear in mind is that full size engineers were not idiots and usually went for the easiest and best method of doing things having taken every consideration into account. In the past some of our model designers have redesigned full size locomotives to suit model engineer's purposes. However, in their efforts to 'make things easier for constructors' have actually made parts far more difficult to make as per my reference, in the previous article, to the design of the bogie top frame for Martin Evans' *Torquay Manor*. There are many examples of this aspect of design where the designers of our models have not properly thought through problems and they are still continuing to this day.

I do not understand why some model designers put off designing the cylinders with the half smokebox saddle contained in the same casting. To be quite frank, there is not really anything greatly difficult about them as producing them is only a matter of pattern making and model engineers have tackled far more difficult patterns and castings in the past. Some years ago I made patterns to make flexible moulds in order to produce wax patterns for lost wax castings of the cylinders for my 'Saint' design. I do not want to go into any depth about lost wax cylinder castings at this time as I have in preparation an article on this subject and these cylinders together with many other patterns will form part of that article. All that I will say now is that they were cast on my workbench top so if I can do that then there cannot be that much difficulty for you to cast scale cylinders with all of their advantages.

In view of what I have said over these four articles I pose the question: When you consider building a model, is it your intention to drive it around and crash it into things? If the answer to my question is no, then I have to ask a further question: That being the case, why worry about reputed weakness resulting from a scale interpretation of the design of any full size engine front end frame? This, then, was the bar frame construction of G.W. two cylinder locomotives and I have no doubt whatsoever that some far more experienced model engineer than me is going to write in and tell me that





what I have said is clap trap. However, I hope that what I have said will be enough to get some constructive discussion going on the subject.

We have always been told that the bar frame was an introduction to Britain, by G.J. Churchward, of an American idea/ design. However, this is not strictly true as American built bar frame locomotives were running about in the U.K. some years before Churchward produced his version. As I said earlier in these articles, the Americans built locomotives by the thousands with this type of framing therefore it would be nice to have some comments from our American friends on this aspect of design. I cannot recall an American viewpoint of weakness in bar frames and cannot help but wonder if it is only we British who worry about this particular topic.

With this article, purely for information, I have included drawings of the other rocker shaft bearing brackets as fitted to other than 'Saint' class locomotives. **Drawing 7** shows the bearing bracket as fitted to the rest of Churchward's designs and later Collett designs, which had the standard short connecting rods. The exception to this last 'length of connecting rod rule of thumb guide' are the 28xx and later 2884 classes which had the standard, triple taper, long connecting rods. It is also noticeable that the die block suspension link and rocking levers are made to the same length as on the other long connecting rod locomotive rather than to the longer dimensions of the shorter con-rod locomotives. This was no doubt to take advantage of the connecting rods angularity and the effect it had on the quadrant link suspension pin offset.

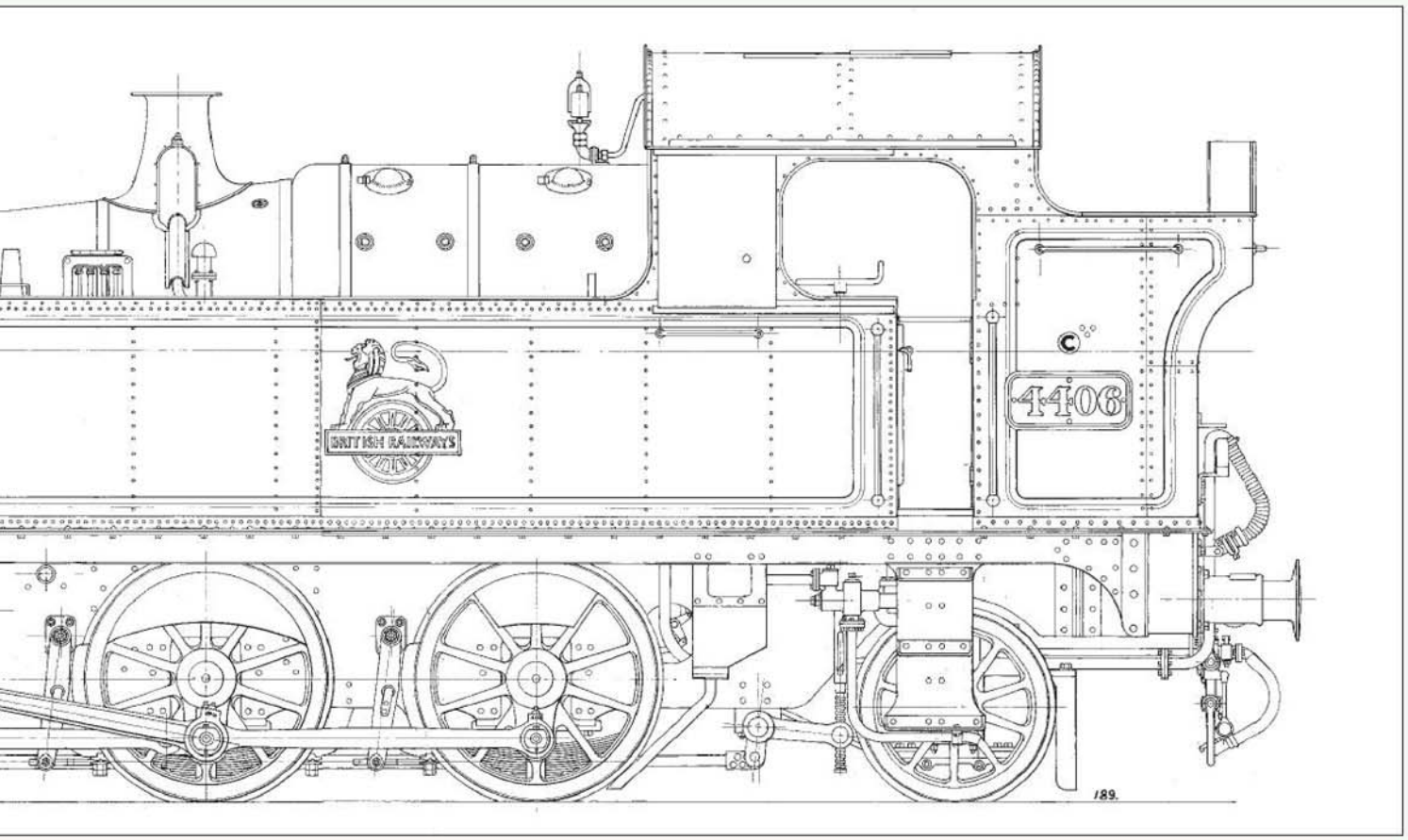
Drawing 8 shows the altered design as fitted to the Collett and Hawkesworth 'Hall' and 'County' class 4-6-0s. The rocker brackets fitted to the 'Granges' and 'Manors' were slightly different from these.

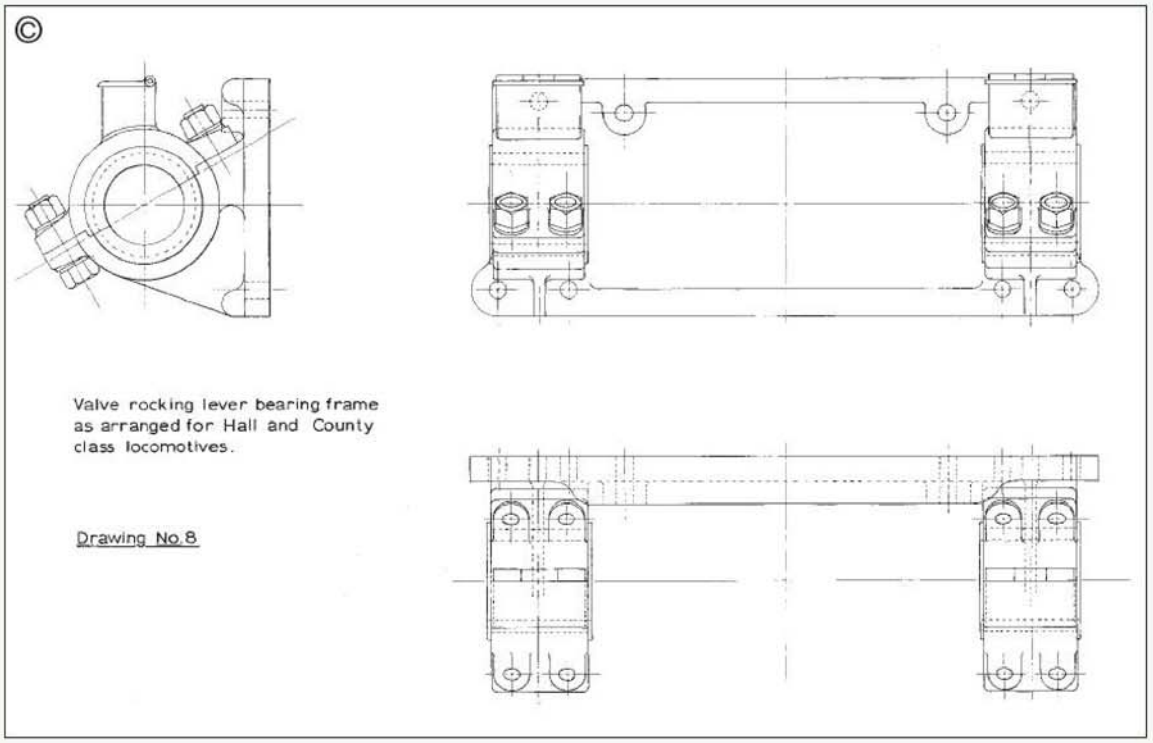
Finally, just a few details about the cylinders for these locomotives. The cylinders with inside steam pipes carried their sniffting valve on the side of the smokebox saddle on the vertical line through the cylinder centre. On those locomotives which were fitted with outside steam pipes this valve was also on the side of the smokebox saddle but not necessarily on the vertical cylinder centre line as some locomotives carried it to the side of this centre line. The outside steam pipe cylinders required a cast-in internal passage for this purpose whereas the inside steam pipe type did not. In these instances the valve on the left hand cylinder was usually ahead of the steam pipe but to the rear of it on the right hand cylinder.

All of these locomotives were fitted with three drain cocks per cylinder, of the plug cock type in the early days, one of which was for the steam chest. On the early locomotives this particular drain cock was out of sight up behind the cylinder and was mounted on the end of a vertical column from the base of the steam chest. However when the flanged, spring loaded plunger type were introduced the third (steam chest) drain cock was moved down and mounted under the cylinder on its centre line at a slightly lower level than the others. This drain cock was now fed by a pipe from the steam chest.

Researchers into these locomotives will see that, on the very early engines, pressure relief valves were not fitted to cylinder covers in their later familiar place. Pressure relief valves were fitted but they were located out of normal sight on the steam passageway to the inside of and above the cylinder covers underneath the valve chests. This was one aspect of the design of the pattern for my models, which I found particularly difficult to solve, however, it was done with a bit of 'jiggery-pokery'.

In the early days the piston rod stuffing box was mounted horizontally across the cover but this was later modified to slope at an angle downwards with the outside being in the down position. The reason for this modification was to facilitate easier access to the inside, securing stud, now in the up position, when new gland packing was required which, incidentally, was





Valve rocking lever bearing frame as arranged for Hall and County class locomotives.

Drawing No.8

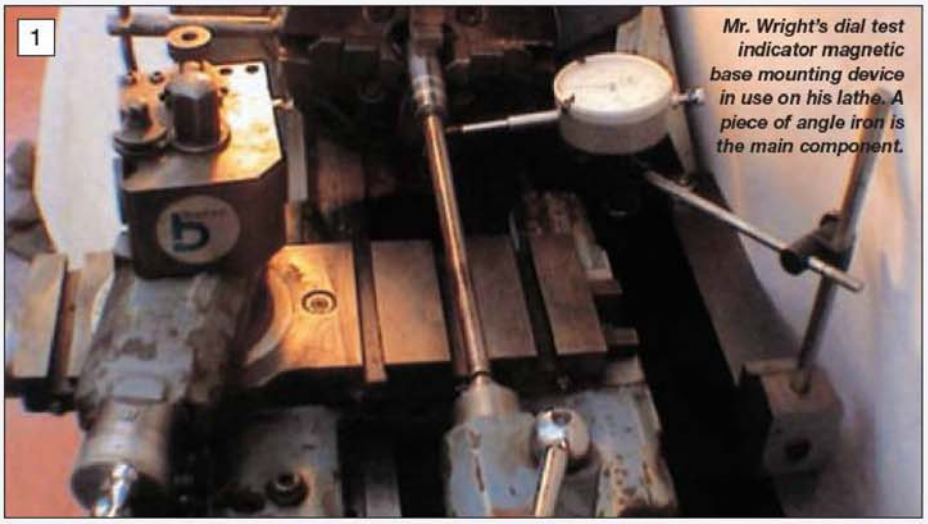
spring-loaded. It occurs to me that if the facility of spring loaded, gland packing was provided on our models then this would make gland packing easier and would obviate the need for such things as O-ring glands on piston rods.

The standard Churchward valve travel in these cylinders was 6 1/4in. but on the Collett 'Hall', 'Grange' and 'Manor' classes the travel was increased to 7in. while the Hawkesworth 'Countys' had it increased to 7 1/2 inch. On all of these locomotives the increase was achieved by simply increasing the length of the outer rocker arm on the final drive to the piston valve, re-positioning the rocker shaft bearing bracket to a higher level and then lengthening the inside valve rod.

Any alteration to the cylinder arrangement had an effect on the valve gear of these locomotives. However one of the facts which nobody in our world ever mentions is that, on G.W. engines with the 'Churchward' version of the Stephenson launch link valve gear, the relationship of the centre of the quadrant link suspension fulcrum point to the centre line of the quadrant link is very important. It is also very dependent on the angularity of the connecting rods at the 50% stroke position of the piston. It was allowed for by adjusting the suspension pin offset to allow the quadrant link centre line to fall in its correct position for the 50% stroke point, hence the two different back sets for the quadrant link suspension pin in this valve gear on the full size locomotives. As far as I can see Mr. D.L. Ashton does not mention it in his excellent treatise on Stephenson's valve gear however his description of the method he uses to find the position of the pin automatically takes into account the angularity of the connecting rod. In locomotive types employing the same valve gear but different length connecting rods, ignoring the connecting rod angularity when setting out this valve gear in relation to its quadrant link pin can cause the valve gear to become deranged and biased rearwards which, obviously, Churchward and his team realised.

I have included my **drawing 9** of locomotive 4406, from my 7 1/4in. gauge designs, for the benefit of those readers who are not familiar with this class of G.W. locomotives. This is one of the tank engine classes of small locomotives I referred to in my first article, which Harry Holcroft stated suffered habitually from 'weak' front ends. It is a matter of interest to me that the first engine of this class No.115 (later 4400) and No.4406, were first stationed in my area in their first years just about a century ago and worked mainly on the Blaenavon branch

I was out on parade with the band the other day when we came to a lull in operations with a 'stand easy' and my mind drifted off. I was thinking that once again I was up on Machen Mountain trying out a new set of pipes I have made and was practicing a slow march named *The Dark Island* by I. Mclaughlan (Creagorry). It occurred to me that over the years very little has been published in *M.E.* about lost wax casting so I thought I would expound my views when...whoops, the Drum Major has just brought us up to attention so we will now be returning home with the *Black Bear*. Watch this space!



Mr. Wright's dial test indicator magnetic base mounting device in use on his lathe. A piece of angle iron is the main component.

WORKSHOP WRINKLES

Ron Wright
proposes a simple modification applicable to most lathes.

This device (**photo 1**) is intended to provide a firm platform for a magnetic base in order to facilitate the use of a dial test indicator. It is particularly applicable to lathes with a V-flat bed, which are not well adapted to accommodating a normal size magnetic base. The device comprises of a length of flat and square angle iron mounted horizontally behind the lathe bed. This is supported by two tubular uprights attached by long studs to the lathe drip tray.

Best results are obtained if the angle iron is parallel to the lathe bed in both the horizontal and vertical planes although this is not essential as usually the magnetic base is not slid from one position to another. The device provides a base for positioning the indicator, not only adjacent to the chuck, but also the cross-slide and tailstock. It is therefore possible to check cross-slide position and tailstock set-over using a dial test indicator without the magnetic base fouling the lathe saddle.

John Chappell
explains how to make leather cup washers.

These washers are used in pumps, such as those used to pump up bicycle tyres. The main thing in making these is to achieve a thin smooth edge that will seal against the pump barrel on the pumping stroke and act as a valve, letting air past it, on the return stroke. A pair back to back will act like a piston.

To make these washers first obtain some smooth finished leather. This can be cut from old shoe uppers, belts, upholstery or even an old leather jacket. Cut a disc from it rather larger than needed to form the washer and punch a hole in its centre. Soak it in water until it is completely wet.

Meanwhile turn up a metal washer having an outer diameter smaller than the pump barrel by three or four times the leather thickness. Drill a hole in the middle for a retaining screw.

Now select a piece of material rather larger than the diameter of the pump barrel. Aluminium alloy would be fine for this. Chuck it in the lathe, face it off and bore a socket in it to the diameter of the pump bore and as deep as the finished washer is to be. To avoid wrinkles do not bore any deeper than is necessary. Drill and tap for a central clamp screw.

Take the wet leather and manipulate it into the socket you have just bored using your fingers. Fit the clamp washer and tighten the screw. Leave to dry out thoroughly. This is best done in the lathe if you have doubts about your ability to rechuck the work accurately as the next step requires the work to run true.

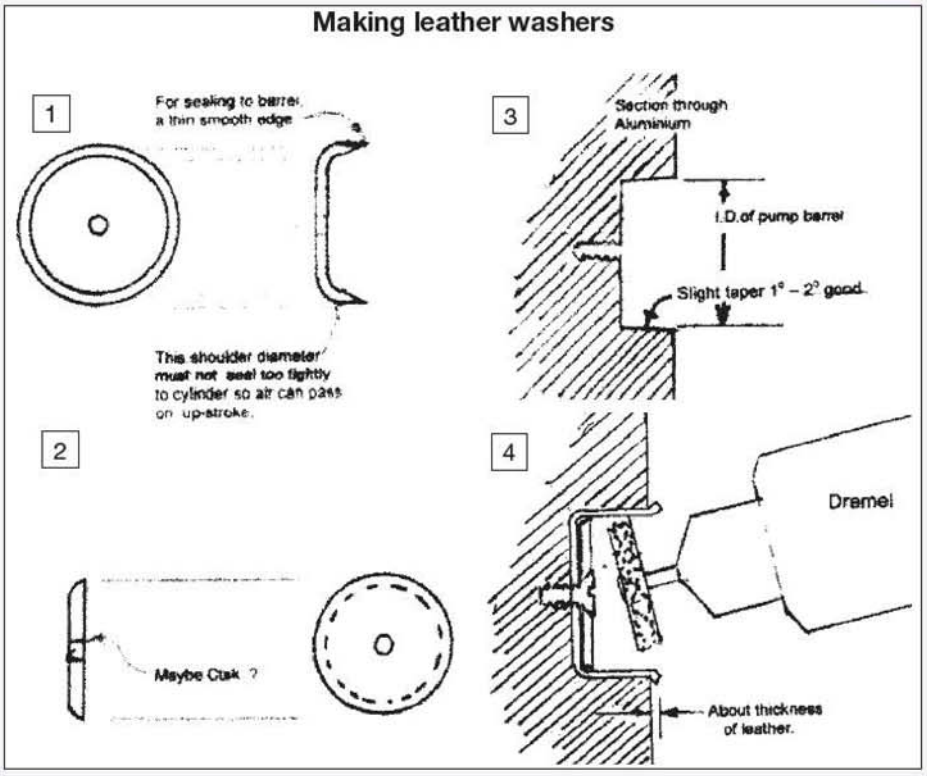
It is now necessary to grind the lead angle on the leather washer such that it leaves a thin bevelled edge that will seal when pumping air. Set your Dremel up in the tool post with a small grinding wheel or sanding drum mounted in the chuck. Set it round at an angle to form the bevel and such that it grinds the edge of the work furthest away from you. This way the work rotation and grinding wheel rotation oppose and this increases the cutting speed. Take care to avoid the grinding wheel contacting the locking screw. It is sometimes best to use a countersunk screw to avoid this.

Now the nice bit; advance the cross-slide slowly until the grinding wheel puts the bevel on the washer and just leaves a witness on the edge of the socket. Oil the washer thoroughly before fitting it to the pump. The washer must be fitted thin edges first. A piece of shim or other thin material wrapped round the washer can help with introducing it into the barrel.

Don Francis
describes a couple of items that can make life easier for the model engineer.

The first item is a piece of kitchen equipment, namely a plastic turntable sold as an aid to cake icing. Provided with a suitable timber top, these will bear an amazing amount of weight and are useful in locomotive assembly work and when painting individual parts. Mine has survived the building of a 3½in. gauge Britannia and is currently supporting a 1½in. to the foot Allchin traction engine, which is nearing completion. It is satisfying to be able to access both sides of the model with just a touch of the finger.

Item two is a pair of locking forceps obtained from Proops Bros. I wish I had bought a pair of these years ago. They are indispensable for fitting tiny bolts and nuts and other small items in inaccessible places. Made for surgeons, they are of the finest quality and stand up to any amount of abuse without distress.



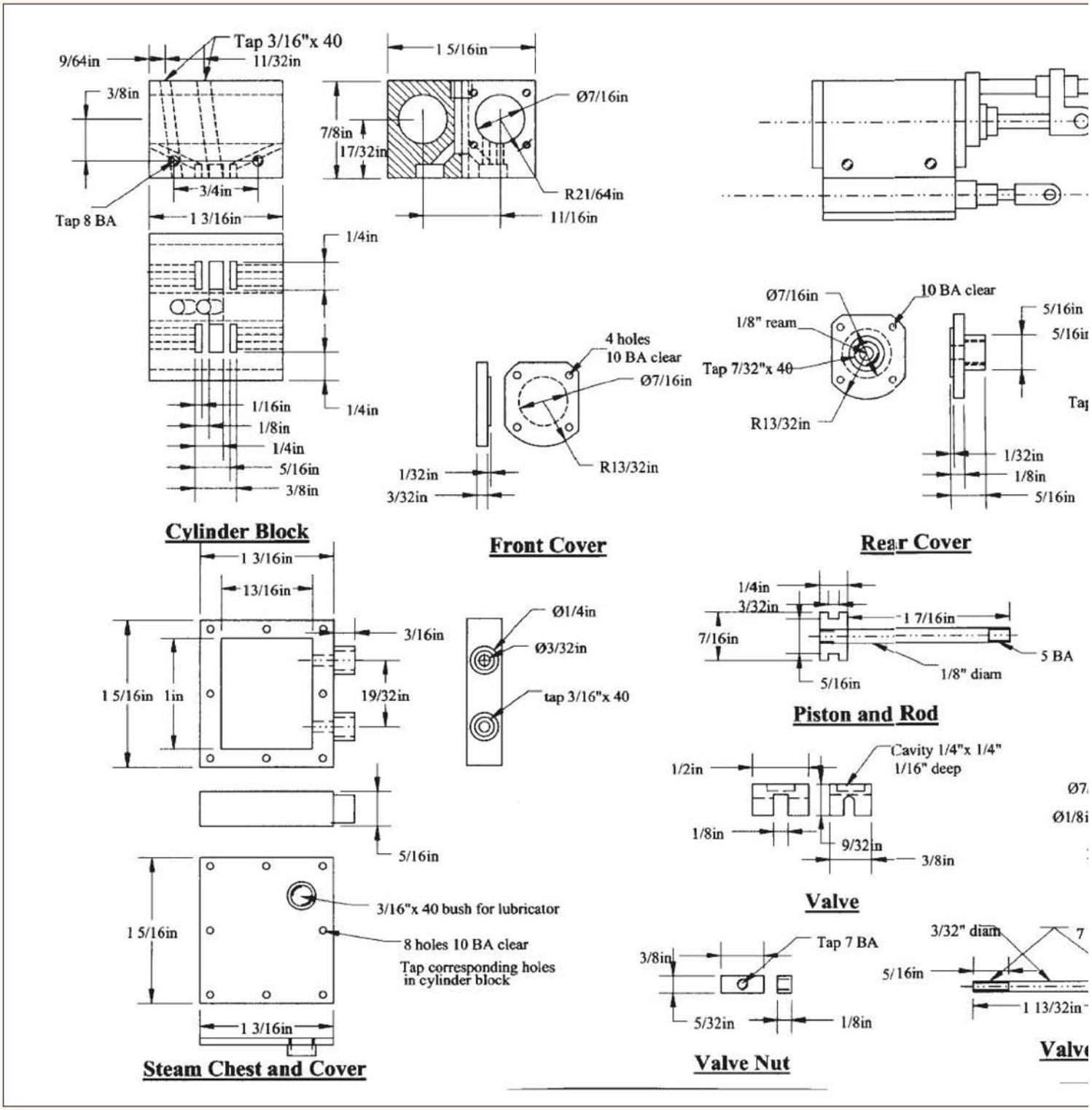
A GWR 1400 CLASS LOCOMOTIVE IN GAUGE 1

G. R. Thornber

continues construction with the cylinders.

●*Part IV continued from page 561 (M.E. 4260, 11 November 2005)*

The cylinders make up into a very neat compact unit largely due to the crosshead and slide bar arrangement. This design is attributed to John Barrett who used it in his articles on *'City of Truro'* published in *Engineering in Miniature* some while ago. The cylinders are inverted with the valves underneath. Bores of 7/16in. dia. are used. The cylinder block is best machined from a cast gunmetal block. The valve ports are more or less conventional 1/16in. wide with 1/16in. lands and a 1/8in. wide exhaust. With a valve 1/2in. long and a cavity of 1/4in. this gives a lap of 1/16in. and a total valve travel of 1/4 inch. The



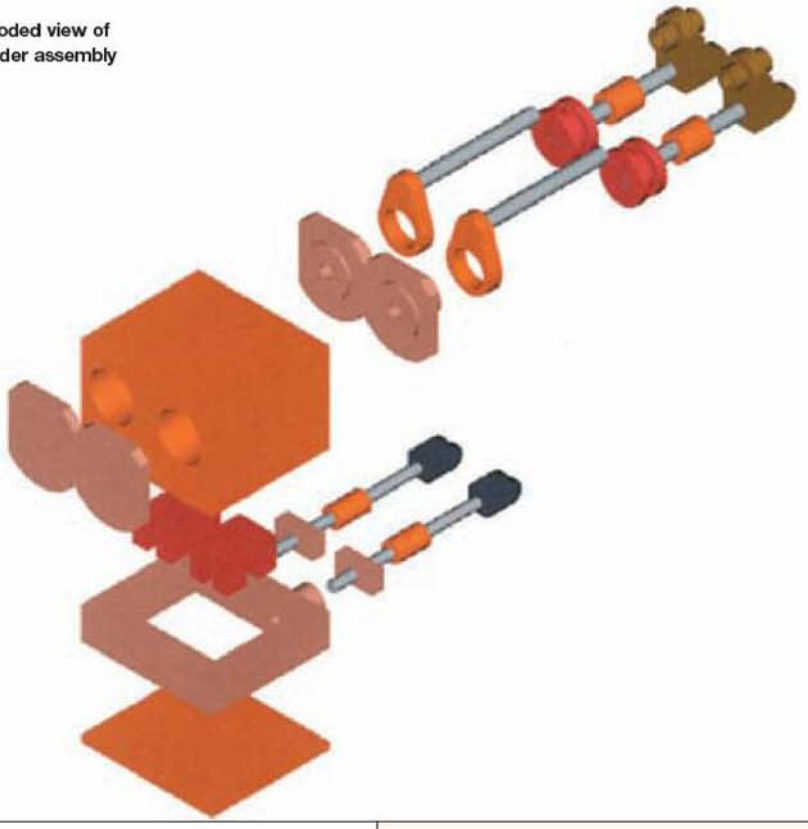
holes that go between the bores for the steam and exhaust are inclined at 7.5deg. to the vertical so that they are vertical when the cylinders are in place.

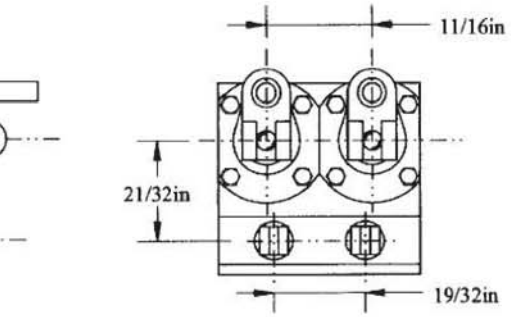
The front and rear covers are conventional. Although I have shown hex head bolts on the drawings you might prefer to use cheese head screws as the heads are not very accessible once the slide bars are fitted. They do no, of course, show so to me this is perfectly acceptable. The slide bar support fits over the boss on the rear cylinder cover. Try to get the holes truly vertical and parallel. The crosshead is made in two pieces. An L-shaped portion and a small cylinder. This cylinder can be soft-soldered into the L bit, which will allow any small discrepancies to be taken out.

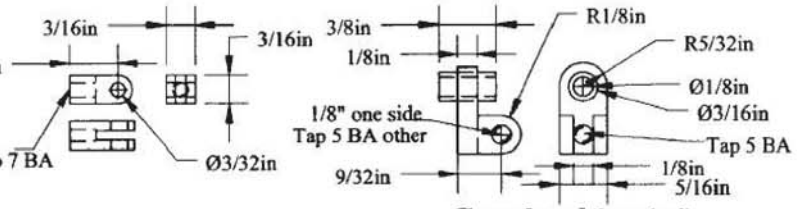
The valve chest and cover need no explanation, but note that there is a bush in the cover to take a banjo fitting for the lubricator. This bush must not protrude into the steam chest.

●*To be continued.*

Exploded view of cylinder assembly

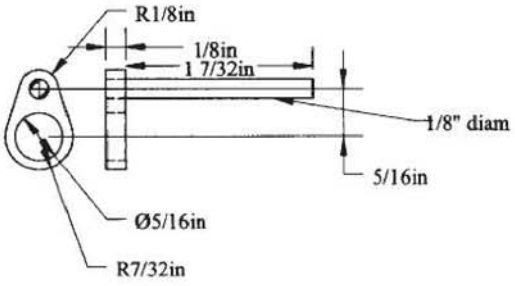




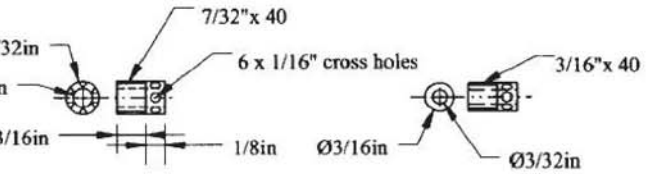


Crosshead(handed)

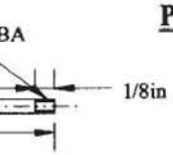
Valve Rod Clevis



Slide Bar



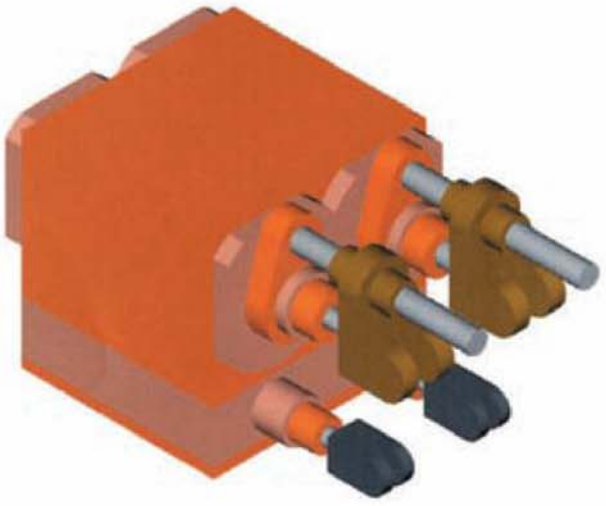
Piston and Valve Gland Nuts



e Spindle

Great Western 1400 Tank

View of cylinders assembled



CLUB DIARY

A minimum of 6 weeks notice is required for diary entries. Clubs and Societies are asked to include a telephone number for the assistance of would-be visitors.

DECEMBER

10 **Erewash Valley MES.** *Santa Special.* Contact Jim Matthews: 01332-705259.
10 **Furness MRC.** *Pennine Exhibition.* Contact Colin Burns: 01229 837079.
10/11 **Furness MRC.** *Wigan Exhibition.* Contact Colin Burns: 01229 837079.
10 **Glasgow & S.W. Rly Ass'n.** *Tom Macfarlane: Road Transport in the G&SW area.* Contact Bruce Steven: 0141-810-3871.
10 **Hornsby ME.** *Christmas Party.* Contact Ted Gray: 9484-7583.
10/11 **Reading SME.** *Santa Specials.* Contact Brian Joslyn: 01491-873393.
10 **Sutton MEC.** *Christmas Party.* Contact Bob Wood: 0208-641-6258.
10 **Westland & Yeovil DMES.** *Running Day.* Contact Gerald Martyn: 01935-434126.
11 **Canvey R&MEC.** *Santa Specials.* Contact Brian Baker: 01702-512752.
11 **Chichester DSME.** *Santa's Steam on Sunday.* Contact Brian Bird: 01243-536468.
11 **Frimley & Ascot LC.** *Santa Run.* Contact Bob Dowman: 01252-835042.
11 **Furness MRC.** *North Turton O gauge test track in operation.* Contact Colin Burns: 01229 837079.
11 **Hornsby ME.** *Running Day.* Contact Ted Gray: 9484-7583.
11 **N. W. Leicester SME.** *Santa Specials.* Contact John Elliott: 01455-847040.
11 **Pinewood MRS.** *Santa Special.* Contact Ivan Hurst: 01252-510340.
11 **Sutton MEC.** *Track Day.* Contact Bob Wood: 0208-641-6258.
12 **Bedford MES.** *Christmas Quiz.* Contact Ted Jolliffe: 01234-327791.
12 **Melton Mowbray DMES.** *Andy Clark: Polly Model Engineering Ltd.* Contact Phil Tansley: 0116-2673646.
12 **Saffron Walden DSME.** *Club Christmas Dinner.* Contact Jack Setterfield: 01843-596822.
13 **Crawley ME.** *Fish & Chip Supper.* Contact Allan Sinclair: 01293-888203.
14 **Andover DMES.** *Christmas Party.* Contact John Berry: 01960-882616.
14 **Harrow & Wembley SME.** *Slide Presentation.* Contact Dr. Roger Greenwood: 020-8427-2755.
14 **High Wycombe MEC.** *Chinor and Princes Risborough Railway.* Contact Eric Stevens: 01494-438761.
14 **St. Albans DMES.** *Christmas Social Evening.* Contact Roy Verden: 01923-220590.
15 **Cardiff MES.** *Quiz Night.* Contact Trevor Jenkins: 029-2075-5568.
15 **Rugby MES.** *Christmas Party.* Contact David Eadon: 01788-576956.
15 **Sutton MEC.** *Quiz and Mincepie Night.* Contact Bob Wood: 0208-641-6258.
16 **Brighton & Hove SMLE.** *Seasonal Social Evening.* Contact Mick Funnell: 01323-892042.
16 **Canvey R&MEC.** *Christmas Party.* Contact Brian Baker: 01702-512752.
16 **North London SME.** *Robert Candish: RHDR.* Contact David Harris: 01707-326518.
16 **Rochdale SMEE.** *Dave Kinsella: Restoring an Aspinall Peacock 4-4-0.* Contact Mike Foster: 01706-360849.
16 **Romford MEC.** *Bring & Buy Sale.* Contact Colin Hunt: 01708-709302.
17 **Guildford MES.** *Christmas American Supper.* Contact Dave Longhurst: 01428-605424.
17/18 **Nottingham SMEE.** *Santa Specials.* Contact Gerry Chester: 0115-9259096.
17 **York City & DSME.** *AGM.* Contact Pat Martindale: 01262-676291.
18 **Harlington LS.** *Mince Pie Run.* Contact Peter Tarrant: 01895-851168.
18 **Leicester SME.** *Santa Specials.* Contact Raymond Wallis: 0116-285-8824.
18 **Tyneside SMEE.** *Christmas Party.* Contact Ian Spencer, 0191-2843438.
18 **York City & DSME.** *Running Day.* Contact Pat Martindale: 01262-676291.
19 **Hornsby ME.** *Christmas Social.* Contact Ted Gray: 9484-7583.
19 **Peterborough SME.** *Party Night.* Contact Tony Meek: 01778-345142.
20 **Chesterfield MES.** *Meeting, Members' Slides & Photo Competition.* Contact Mike Rhodes: 01623-648676.
20 **East Somerset SMEE.** *Christmas Meeting.* Contact Roger Davis: 01749-677195.
20 **Northampton SME.** *Christmas Drinks.* Contact Pete Jarman: 01234-708501 (eve).
20 **Nottingham SMEE.** *Geoffrey Kingscott: The Last Train from Trent Station plus Christmas get-together.* Contact Graham Davenport: 0115-8496703.
20 **Taunton ME.** *Mince Pies & Natter.* Contact Don Martin: 01460-63162.
21 **Bournemouth DSME.** *Christmas Party.* Contact Dave Fynn: 01202-474599.
21 **Guildford MES.** *Bits & Pieces.* Contact Dave Longhurst: 01428-605424.
21 **Leeds SMEE.** *Quiz Night.* Contact Colin Abrey: 01132-649630.
21 **MELSA.** *Meeting.* Contact Graham Chadbone: 07-4121-4341.
22 **Cardiff MES.** *Club Chat.* Contact Trevor Jenkins: 029-2075-5568.
22 **Leyland SME.** *Annual Christmas Dinner & Dance.* Contact A. P. Bibby: 01254-812049.
22 **Sutton MEC.** *Music Night.* Contact Bob Wood: 0208-641-6258.
23 **North London SME.** *Workshop Evening.* Contact David Harris: 01707-326518.
24 **Bournemouth DSME.** *Humbug Day.* Contact Dave Fynn: 01202-474599.
24 **Hornsby ME.** *Boiler Inspection.* Contact Ted Gray: 9484-7583.
24 **Nottingham SMEE.** *Santa Specials.* Contact Gerry Chester: 0115-9259096.
26 **Cambridge MES.** *Boxing Day Steam-Up & Get-together.* Fulbrooke Road. Contact Rex Mountfield: 01284-386128.
26 **Canvey R&MEC.** *Boxing Day Steam-Up.* Contact Brian Baker: 01702-512752.
26 **Cardiff MES.** *Steam-Up and Family Day.* Contact Trevor Jenkins: 029-2075-5568.
26 **Guildford MES.** *Boxing Day Steam-Up.* Contact Dave Longhurst: 01428-605424.
26 **High Wycombe MEC.** *Boxing Day Steam-Up.* Contact Eric Stevens: 01494-438761.
26 **Leeds SMEE.** *Boxing Day Steam-Up.* Contact Colin Abrey: 01132-649630.
26 **Leyland SME.** *Boxing Day Mince Pie & Steam-Up.* Contact A. P. Bibby: 01254-812049.
26 **Maidstone MES (UK).** *Boxing Day Run.* Contact Martin Parham: 01622-630298.
26 **Stockholes Farm MR.** *Steam-Up.* Contact Ivan Smith: 01427-872723.
26 **Sutton MEC.** *Boxing Day Run.* Contact Bob Wood: 0208-641-6258.
27 **Bradford MES.** *Mince Pie Steam-Up.* Contact John Mills: 01943-467844.
27 **MELSA.** *Tuesday in the Park.* Contact Graham Chadbone: 07-4121-4341.
27 **Staines SME.** *Post Christmas Steam-Up.*Contact Stan Bishop: 01784-241891.
28 **North London SME.** *HO Group Afternoon.* Contact David Harris: 01707-326518.
29 **Cardiff MES.** *Club Chat.* Contact Trevor Jenkins: 029-2075-5568.
29 **Sutton MEC.** *Wind-up/Wind-down Night.* Contact Bob Wood: 0208-641-6258.
31 **New Jersey Live Steamers, Inc.** *Midnight Run.* Contact Karl Pickles: 718-494-7263.

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1 **Brighton & Hove SMLE.** *New Year's Steaming.* Contact Mick Funnell: 01323-892042.
1 **Chesterfield MES.** *Arctic Running.* Contact Mike Rhodes: 01623-648676.
1/2 **Claymills Pumping Engines.** *Open Days.* Contact B. Eastough: 01283-812501.
1 **Frimley & Ascot LC.** *New Year's Day Run.* Contact Bob Dowman: 01252-835042.
1 **Leyland SME.** *Chairman's Run.* Contact A. P. Bibby: 01254-812049.
1 **New Jersey Live Steamers, Inc.** *New Year Run Day.* Contact Karl Pickles: 718-494-7263.
1 **Nottingham SMEE.** *New Year's Day Run.* Contact Gerry Chester: 0115-9259096.
1 **Peterborough SME.** *New Year's Day Run.* Contact Tony Meek: 01778-345142.
1 **Portsmouth MES.** *Frostbite Run.* Contact John Warren: 023-9259-5354.
1 **Saffron Walden DSME.** *New Year's Day Steam-Up.* Contact Jack Setterfield: 01843-596822.
1 **Sutton MEC.** *New Year's Day Run.* Contact Bob Wood: 0208-641-6258.
1 **Tyneside SMEE.** *New Year Run.* Contact Ian Spencer, 0191-2843438.
1 **Westland & Yeovil DMES.** *Frost Bite Run.* Contact Gerald Martyn: 01935-434126.

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CTC500	5 Dr. cabinet	35Kg	£84.95	£99.82
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CAG115C	115	720w	£29.37	£22.95	£26.97
CAG115	115	500w	£30.49	£23.95	£28.14
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CM145	150mm/6" Digital Vernier	£19.95	£23.44

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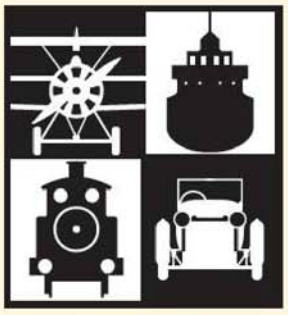

THE MODEL ENGINEER EXHIBITION

Please return completed form to:
Model Engineer Competition, The Leys,
Church St., Twyford, Bucks. MK18 4EU

ENTRY NO.

OFFICE USE ONLY

CLASS | ENTRY NO.

ENTRY FORM - COMPETITION & LOAN MODELS

PERSONAL DETAILS (Please print)

Surname ..... Forename(s) ..... Age .....

Address .....

.....

.....

Post Code ..... Home Tel: ..... Daytime Tel: .....

Model Club or Association .....

Have you entered before? (Y/N) .....

Do you purchase or subscribe to a Highbury House Communications plc magazine? (Y/N) .....

How many years have you been a modeller? .....

Mail Order Protection - please tick this box if you would prefer not to receive mail from other companies which may be of interest to you ☐

MODEL DETAILS - PLEASE TICK BOX IF MODEL IS FOR LOAN ☐

Entry Class (competition entries only) .....

Model Title (to be used for catalogue and display card) .....

.....

Model Description .....

.....

.....

Model Scale ..... Length ..... Width ..... Height ..... Weight .....

Type of construction .....

.....

Parts not made by you and commercial items.....

.....

Have you supplied a photograph? (Y/N) .....

Are you supplying Judges Notes? (Y/N) .....

Value of model (Highbury House Communications plc will not insure the model unless a value is entered) £.....

Name and address of local newspaper .....

.....

NB Please make a copy of this form and any photographs enclosed for your own reference. Please note that Highbury House Communications plc will not accept liability for any loss of documents or photographs submitted with this form

TO HELP YOU GET THE BEST FROM THE MODEL ENGINEER EXHIBITION

These notes are written purely for guidance. Full information is contained in the Competitors' Information booklet which is sent to every entrant as part of the information package. If you have an item and are unsure as to the Class into which it should be entered, leave that section blank and we will take care of it. The Judges have the right to move any competition exhibit into another class if they feel that by doing so its chances of gaining higher marks or a more appropriate award are improved.

If the item is offered as a Loan exhibit please indicate this by writing Loan on the form in the box identifying the Class. Loan models are not judged but carry all other privileges associated with competition entries.

Part built models are particularly welcome in the Loan Section; visitors like to see work in progress, and entry does not preclude the item being entered in competition when completed.

The classes listed below are those associated with mainstream model engineering.

Club exhibits

Where a club is exhibiting, each model should be entered on a separate entry form and clearly identified as a club exhibit by entering Loan/Club in the class section box. This ensures that we have a full record of all models on display during the show and facilitates matters of administration and insurance.

Additional forms

If you do not wish to deface your copy of the magazine we are happy to receive photocopies of the entry form, one for each model. We will be pleased to send out extra forms if required, so if you know of a modeller who is not a reader of one of our magazines but who you think may wish to participate, please advise them to contact our Exhibitions Office , or simply photocopy the entry form for them.

The success of the show depends largely on the number of models on display. Your work could well be the stimulus which inspires someone else to start in the hobby. There can be no doubt that this event is our showcase on the world of modelling in all its aspects. Every modelling discipline needs more and more participants, and it is by displaying not only the crème-de-la-crème, but also examples of work of a more achievable standard, that people are encouraged to join into the wonderful world of modelling, in whatever aspect.

We look forward to seeing a sample of your work at the show!

COMPETITION CLASSES

Engineering Section

- A1 Hot air engines.
- A2 General engineering models (including stationary and marine engines).
- A3 Internal combustion engines.
- A4 Mechanical propelled road vehicles (including tractors).
- A5 Tools and workshop appliances.
- A6 Horological, scientific and optical apparatus.
- A7 General engineering exhibits — not covered by the above

Railway Section

- BI Working steam locomotives 1in scale and over.
- B2 Working steam locomotives under 1in scale.
- B3 Locomotives of any scale, experimental, freelance or based on any published design and not necessarily replicas of full size prototypes, intended for track duties.
- B4 Scratchbuilt model locomotives of any scale, not covered by classes BI, B2, B3, including working models of non-steam, electrically or clockwork powered steam prototypes.
- B5 Scratchbuilt model locomotives gauge 1 (10mm scale) and under.
- B6 Kitbuilt model locomotives gauge 1 (10mm scale) and under.
- B7 Scratchbuilt rolling stock, gauge 1 (10mm scale) and under.
- B8 Kitbuilt rolling stock, gauge 1 (10mm scale) and under.
- B9 Passenger or goods rolling stock, above 1in scale.
- B10 Passenger or goods rolling stock, under 1in scale.
- B11 Railway buildings and lineside accessories to any recognised model railway scale.
- B12 Tramway vehicles.

Marine Models

- C1 Working scale models of powered vessels (from any period). Scale 1:1 to 1:48
- C2 Working scale models of powered vessels (from any period). Scale 1:49 to 1:384
- C3 Non-working scale models (from any period). Scale 1:1 to 1:48
- C4 Non-working scale models (from any period). Scale 1:49 to 1:384
- C5 Sailing ships and oared vessels of any period - working.
- C6 Sailing ships and oared vessels of any period - non-working.
- C7 Non-scale powered functional models including hydroplanes.
- C8 Miniatures. Length of hull not to exceed 15in for 1:32 scale; 12in for 1:25 scale; 10in for 1:16 scale; 9in for 1:8 scale. No limit for smaller scales.
- C9 For any model boat built from a commercial kit. Before acceptance in this class the kit must have been readily available for at least 3 months prior to the opening date of the exhibition and at least 20 kits must have been sold either by mail order or through the retail trade.

Scale Aircraft Section

- D1 Scale radio control flying models
- D2 Scale flying control-line and free flight
- D3 Scale non-flying models, including kit and scratch-built
- D4 Scale flying radio controlled helicopters

Model Horse Drawn Vehicle Section

- G1 Carriages & other sprung vehicles. (Omnibuses, trade vans etc.) Wagons, carts and farm implements. Caravans.

Junior Section

- J1 For any type of model, mechanical or engineering work, by an under 14 year old.
- J2 For any type of model, mechanical or engineering work, by an under 16 year old.
- J3 For any type of model, mechanical or engineering work, by an under 18 year old.

All entries will be judged for standard of craftsmanship, regardless of the modelling discipline, i.e. a boat will not be competing against a military figure. Providing a model attains sufficient marks it will be awarded a gold, silver or bronze medals

Model Vehicle Section

- K1 Non-working cars, including small commercial vehicles (e.g. Ford Transit) all scales down to 1/42.
- K2 Non-working trucks, articulated tractor and trailer units, plus other large commercial vehicles based on truck-type chassis, all scales down to 1/42.
- K3 Non-working motor bikes, including push bikes, all scales down to 1/42.
- K4 Non-working emergency vehicles, fire, police and ambulance, all scales down to 1/42.
- K5 Non-working vehicles including small commercial vehicles (e.g. Ford Transit). Scale from 1/43 or smaller.
- K6 Any available body shells including Concours, in any scale or material, to be judged on appearance only.
- K7 Functional model cars/vehicles which must be able to move under its own power of any type. Can be either free-running, tethered radio controlled or slot car, but must represent a reasonable full size replica

DUKE OF EDINBURGH CHALLENGE TROPHY

Rules and Particulars

1. The Duke of Edinburgh Challenge Trophy is awarded to the winner of the Championship Award at the Model Engineer Exhibition.
2. The trophy remains at all times the property of HIGHBURY HOUSE COMMUNICATIONS PLC.
3. The name of the winner and the date of the year in which the award is made will be engraved on the trophy, which may remain, at the discretion of HIGHBURY HOUSE COMMUNICATIONS PLC in his/her possession until required for renovation and display at the following Model Engineer Exhibition.
4. Any piece of model engineering work will be eligible for this Championship Award after it has been awarded, at The Model Engineer Exhibition, a Gold or Silver medal by HIGHBURY HOUSE COMMUNICATIONS PLC.
5. No model may be entered more than once.
6. Entry shall be free. Competitors must state on the entry form:
   (a) That exhibits are their own bona-fide work.
   (b) Any parts or kits that were purchased or were not the outcome of their own work.
   (c) That the model has not been structurally altered since winning the qualifying award.
7. HIGHBURY HOUSE COMMUNICATIONS PLC. may at their sole discretion vary the conditions of entry without notice.

COMPETITION RULES

1. Each entry shall be made separately on the official form and every question must be answered.
2. Competition Application Forms must be received by the stated closing date.

LATE ENTRIES WILL ONLY BE ACCEPTED AT THE DISCRETION OF THE ORGANISERS.

3. Competitors must state on their form the following:
   (a) Insured value of their model.
   (b) The exhibit is their own work and property.
   (c) Parts or kits purchased.
   (d) Parts not the outcome of their own work.
   (e) The origin of the design, in the case of a model that has been made by more than one person.

NOTE: Entry in the competition can only be made by one of the parties and only their work will be eligible for judging.

4. Models will be insured for the period during which they are in the custody of HIGHBURY HOUSE COMMUNICATIONS PLC
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8. Entry into the competition sections is not permitted by:
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   (b) Anyone who has a financial interest in the direct supply of materials and designs to the public.

NOTE: If unsure, please contact the Competition organisers, prior to the show.

9. The judges' decision is final. All awards are at the discretion of the judges and no correspondence regarding the awards will be entered into.
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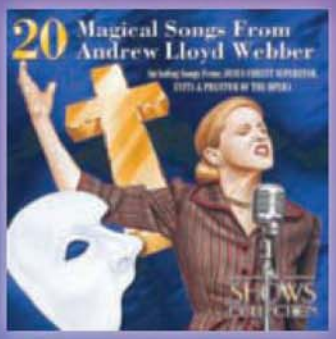

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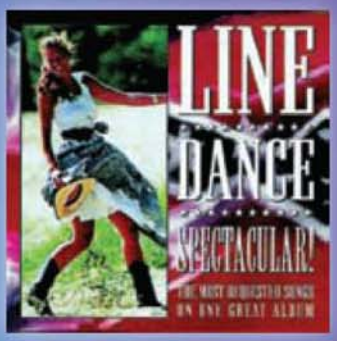

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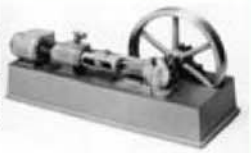

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