MODEL ENGINEER

NEW YEAR GREETINGS TO ALL OUR READERS EVERYWHERE

Vol. 189 No. 4185

27 December 2002 - 9 January 2003 £2.20

LE RHONE ROTARY ENGINE
1:3 scale miniature

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Working replica

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Calculations supported

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THE MODEL ENGINEER EXHIBITION
29 - 31 DECEMBER 2002 AT SANDOWN PARK, ESHER, SURREY

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IN THIS ISSUE

Vol. 189 No. 4185 27 December 2002

On the cover ...

This fine $7^1/_4$in. gauge BR Standard 4-6-0 locomotive No. 73082, Camelot *was built by John Cousins of Harrow & Wembley SME on whose Roxbourne Park track it is a regular and reliable passenger hauler. It is seen here at the 71st Model Engineer Exhibition at Sandown Park where the judges and visitors alike could examine and appreciate the attention to detail and quality of workmanship which earned for it a Silver Medal and the Crebbin Memorial Trophy. See it again at this year's M.E. Exhibition.*

(Photograph by Mike Chrisp)

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Happy New Year Reading (and Viewing)!

Soldering, Brazing & Welding - a Manual of Techniques [Pritchard] £16.94

Very good book on all ways of joining metal together. Covered are all ways of soldering and brazing, albeit slightly briefly and then, in much greater detail, Oxy-Acetylene, MMA, MIG and TIG welding. Most of the instructions refer to welding steel, but welding other materials and distortion control are covered in separate chapters, as is quality in welding. Recommended for those taking up welding, or as a reference book if you have some experience. 160 pages full of drawings, diagrams and photographs. Larger format paperback.

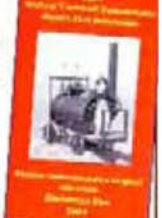
Finding and Restoring Longcase Clocks [Ells] £21.39

This starts with 19 pages of history and good advice on buying a Longcase Clock - this section alone could pay for the cost of the book many times over. Two chapters on the Time and Strike Trains follow and then it is into 70 pages on restoration full of excellent instruction. To finish there is a chapter on making your own clock case. Good, solid information. 144 pages. 100s of B & W photos and 8 pages of colour. Hardbound.

The Artist Blacksmith Design and Techniques [Parkinson] £22.95

This really is a cracking good book! As its title implies it is about modern blacksmithing and making interesting shapes and designs, of which it shows plenty of examples. But it also has a heck of a lot more, on equipment, materials, safety and the various techniques required to produce all sorts of types of work. 160 pages crammed with colour photographs and (B & W) diagrams and drawings. Larger format hardback.

VIDEO! Richard Trevithick s Replica Automobile - Christmas Eve 2001 (App. 54 mins) £15.60



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SMOKE RINGS
With the Editors

H. D. (Bert) Bickley

It is with much regret and great sadness that we have to report the death on 21 November of Bert Bickley, a knowledgeable and supportive Consultant to the editors of this magazine for over twenty years.

Bert's special contribution to the editorial peace of mind was mainly concerned with electrical and electronic engineering principles and practices. Appointed to the panel of Consultants by former editor Laurie Lawrence following a chance conversation in Hemel Hempstead market, Bert's advice was authoritative and dealt with many aspects concerning a wide range of subjects. It may be of interest to note that prior to taking on the editorship of *Model Engineer,* Laurie too had retired from the telecommunications sector of the GPO.

Together with colleague Graham Balcombe, Bert's first major GPO project concerned the long wave radio transmission mast at Rugby. A treasured photograph shows Bert and Graham both in handstand mode at the top of the mast on its completion. Bert's wife Maureen is an accomplished mathematician and it was her expertise which ensured the validity and accuracy of some of the more convoluted mathematics published in these pages.

An accomplished model engineer, Bert built a fine 2in. Clayton wagon and, some years later, a hot air engine powered Ky-Ko fan. But his main interest was in electronic projects and he much enjoyed listening to the radiogram which he designed and built long before 'hi-fi' became commonplace. As a long-time owner of a BMW car, he was also rather pleased with himself when he was able to determine and repair an electronic fault in the vehicle's system without calling upon the services of an authorised repair workshop, thereby saving himself a not inconsiderable repair bill.

Following a heart attack some years ago from which he made a full recovery, Bert heeded his doctor's advice, took up cycling and joined a group of colleagues who met regularly to enjoy a brisk cycle ride around the countryside byways of Hertfordshire, rounding off their outing with a well earned lunch in a suitable country pub.

Bert's contribution will be very much missed and our condolences go to his wife Maureen and their family at this sad time.

Ferris wheel clock: Designer at MEX 2002

We are well aware that a significant number of readers are currently engaged on the construction of this unique and intriguing clock. We also realise that certain of its features are of a somewhat challenging nature. It is therefore with particular pleasure that we can announce that Dr. Richard Stephen will be present on the SMEE stand on Monday 30 December to discuss the design and construction of this fascinating timepiece with builders and interested visitors alike.

We are grateful to both Dr. Stephen and the Society of Model & Experimental Engineers for making this opportunity possible.

Thomas the Tank Engine and Friends Big Live Tour

Our photograph shows *Thomas* with many of the folk involved with his creation together with *Percy, James, Gordon* and other characters from Rev'd Awdry's timeless tales.

Chris Reynolds (with a firm grip of *Thomas'* buffer) heads up the skilful and imaginative group who built *Thomas* and his friends. Many of the team are model engineers and are also responsible for BBC TV's *Robot Wars* house robots.

Thomas and Friends will be at an arena near you after Christmas, opening at Birmingham NIA on Boxing day. Check the national press or call the **Ticket Hotline: 0870-010-8449** for further information and to book your tickets.

Happy New Year!

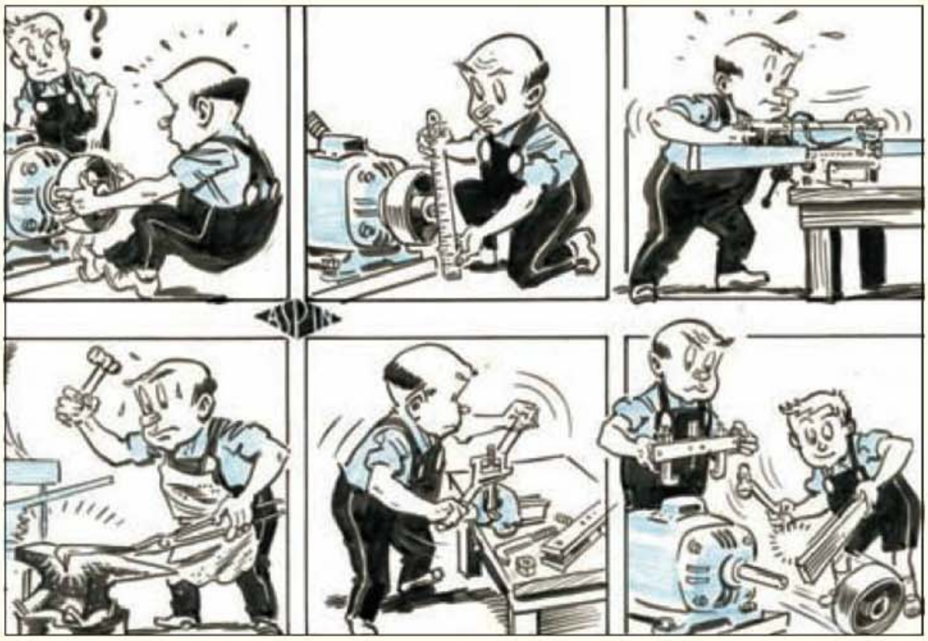
As we await the end of 2002 and the start of 2003 it is appropriate to pause and reflect on the events of the past year and our aspirations for the new one. The coming year will be the 105th year of continuous publication for *Model Engineer* over which time there have been many social and political changes. Through it all the magazine has attempted to serve its readers with a mix of features and articles that help sustain the hobby and encourage workers of all abilities to get the most out of their pastime. The fact that you are still buying the magazine shows that we have at least succeeded to some degree.

The passing year has not been easy for many people in the world. Acts of war, terrorism, strikes and economic uncertainty have all played their part in adding to the worries of life. Nevertheless, as we have travelled up and down the country it has been encouraging to meet members of model engineering clubs and societies, as well as individual workers, who are making time to use their workshops and enjoy the fruits of their labours at various different events and venues.

No one can tell what 2003 will bring. One thing is certain, every one of us will have 24 hours in each day in which to work, eat, enjoy our hobbies and sleep. If anyone has found a way of extending that amount of time perhaps they will let us all know how. Management seminars often tell delegates that they should prioritise their activities in order to make the best use of time. Dare we suggest that making some time to enjoy your hobby would not be a bad New Year's resolution for 2003.

The editorial team wish all our readers prosperity and peace in the coming year.

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



POST BAG

The ignition circuits as discussed by Mr. Toms.

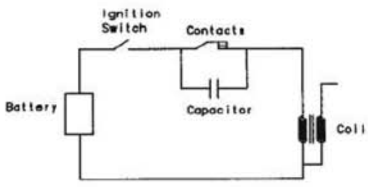


Figure 1

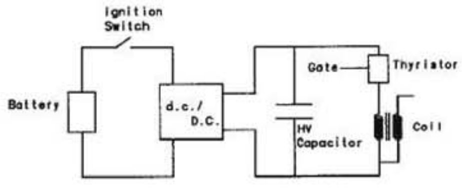


Figure 2

Coil ignition systems

SIRS, - I refer to part XI of Mr. Rowland Lowe's series describing the construction of the Gnome rotary aero engine published in *M.E.* 4181, 1 November 2002. In particular I wish to comment on the section relating to coil ignition systems. All such systems depend on having a capacitor connected across the contact breaker points. In a simple system, contact closure supplies current to the primary coil winding, storing energy by virtue of its inductance. When the contacts open, the capacitor, battery and primary winding of the coil are placed in series forming a resonant circuit that oscillates. This oscillating current induces a high voltage in the secondary winding of the coil. When the spark gap in the plug breaks down, the stored inductive energy is transferred to heat in the spark.

The energy stored in the magnetic circuit of the coil is proportional to the square of the current in the primary windings; i.e. a 10% increase in current causes an increase of 20% in stored energy. Thus it is important that the 'dwell' time of the contact is as long as possible. A conventional 4-cylinder coil ignition system, as fitted to 1970s petrol engines, having a 4-lobe distributor cam running at half engine speed of 3000rpm and having a 'dwell' angle of, say 50deg. will have its contacts closed for 5.6ms (milliseconds) each spark 'episode'.

My **fig 1** shows such a simple coil ignition system. My own measured values on an early 1970 Hillman Minx were an oscillation frequency of 20kHz and a peak voltage of 300V across the capacitor as the contacts opened.

The transistor assisted ignition circuit shown in fig 21 of the article serves only to reduce the current broken by the contact and does not increase the stored energy. To do this, a capacitor discharge ignition system was devised in the 1970s in which a free running oscillator supplied current to a step-up transformer whose secondary voltage was rectified and used to charge a high voltage capacitor. Contact opening provided a firing pulse for a thyristor which dumped the stored capacitor energy into the primary of the ignition coil. I built and ran such a system for several years. Its contacts showed no arc damage and engine misfiring disappeared. My **fig 2** shows such a system schematic.

In my opinion, a satisfactory simple spark ignition circuit could be provided as shown in fig 1 where the capacitor shown is a low-loss item of about 0.1μF rated at 500V and needs to be kept cool.

J. E. Toms, Chester.

Mils

SIRS, - With reference to P. J. King's interesting letter (*M.E.* 4179, 4 October 2002) Ian V. Hogg's *The Illustrated Encyclopedia of Artillery* states: *"MIL, A unit of angular measure used by artillery for aiming and survey purposes. One Mil is 1/6400th part of a circle; it is loosely derived from radian measure but the derivation has been adjusted so that one mil is the angle subtended by one unit of distance at 1000 units range. Thus, two stakes 1 metre (3.28 feet) apart, planted 1,000 metres (3,280 feet) from an observer, will measure an angle of one mil between them. It is equivalent of 17.7778 minutes of arc."*

Concerning cap squares on the 7in. Armstrong RBL, in his letter (*M.E.* 4178, 20 September 2002) D. A. Wilcox states that Ian's books do not tell the whole story. This, of course, is true, however they are a first class read and contain masses of good information.

Ken Stoat, Mid Glamorgan.

Danger UXB!

SIRS, - Having been model making for over 70 years now, I thought the following notes might be of interest to your readers.

During the war I was a member of the Croydon Model Engineering Club at which time members were discussing the problems of making small I.C. engines, bearing in mind that supplies at that time were almost non-existent. Thinking to go one better, I decided to make my engine of magnesium. Problem: where to find some magnesium!

I had a brainwave, being wartime, I decided to wait for a heavy air raid. I did not have long to wait for soon we had a heavy fire-bomb raid during which I put on my father's tin hat and went out to see what I could pick up. I soon found an incendiary bomb that hadn't gone off.

I took it home, took it into my shed and cut off the tail fins, only to find that I had missed a detonator by just 1/8 inch! Then I unscrewed the nose cap and took out the Thermite primer; now I had my source of magnesium. My next job was to cut the casing into small pieces in order to melt them down in my ladle on the gas stove in our kitchen. I had the idea that if I covered the magnesium with Borax I could melt it down okay. I had made a Plaster of Paris mould and was nearly ready to cast my first engine!

At this point things got very interesting. I now had a ladle full of molten magnesium, but as soon as I began to pour the metal, air got to it, and the whole ladle became a blazing inferno. Not only that but the metal that had entered the mould went straight through and burnt a large hole in the top of the cast iron stove. By this time I thought I had better take action of some kind so I quickly opened the kitchen door and threw the burning ladle into the fire bucket which was full of water. There was a very loud bang just as my father returned from a shopping trip.

The fire on the stove had burnt itself out, but the kitchen was full of white smoke. My father was a most wonderful man; all he said was *"I hope you have learned something from your experiment!"*

Something else which interested me occurred when I was out walking one Sunday afternoon and a flying bomb landed not far away from me. It must have been faulty because it did a belly landing on the grass field nearby without exploding. I thought to myself that this was an opportunity not to be missed, so I went over to it to see how it was made!

Enough of the silly things young men do! Now I have a query: I am trying to make a hydraulic drive system and have made the pump, but so far I have not made a motor that works. Can anyone please help with a suitable design? The motor should be reversible and no more than 2in. diameter.

Les Gibbs, East Sussex.

Cruquius pumping engine

SIRS, - I read with interest in *M.E.* 4179, 4 October 2002, the correspondence regarding the annular compound Cruquius Pumping engine, situated at the Haarlemer Mere in the Netherlands. If Messrs. Olsen and Wallis care to consult my article on this particular engine (*M.E.* 3795, 20 February 1987) many of the points upon which they speculate will be revealed.

Mr. Olsen suggests in his letter that all three engines, viz.: Leeghwater, Cruquius and Lijnden were identical. This is not correct as the first of the machines, Leeghwater, certainly as built, differed in a significant number of respects to the subsequent engines. Whereas Leeghwater had eleven radially mounted beams and pumps of 63in. dia., the later engines were equipped with only eight beams and had pumps of 73in. diameter. Experience with the Leeghwater engine revealed that the method of beam attachment to the heavy crosshead, or 'great cap', as it was called, was unsatisfactory in a number of respects, some dangerously so, and a revised design was incorporated in the Cruquius and Lijnden engines. The subsequent engines also had modifications to their air pumps.

In operation, steam at boiler pressure was admitted to the underside of the high-pressure inner piston, and with vacuum above, the engine steamed on the *upstroke;* the exact reverse of normal Cornish pumping engine practice. The cut-off point was about 50%. The large annular low-pressure piston, by virtue of both ends of its cylinder being connected to the condenser, moved upwards *in vacuo.*

To hold the 'great cap' in the raised position, and thus allow all the pump valves to close correctly, a device called the 'hydraulic' was employed. This was basically a unit comprising two hydraulic rams positioned diametrically either side of the steam case, whose upper ends were attached to the 'great cap'. By creating a hydraulic lock, the length of pause at the raised position could be sustained and regulated by the cataract, a form of water clock. Steam at reduced pressure was then re-used above both high and low-pressure pistons to assist the downward pumping stroke. The underside of the annular, low-pressure cylinder was always open to the condenser and thus the advantage of vacuum was obtained at all times.

The first and last machines were largely built by Harveys of Hayle, with the second supplied by the

The LMS battery electric locomotive under construction by Peter Leedell as mentioned by Mr. Ivan Smith.

Members of Markham Main Colliery Band and South Milford Brass enjoyed a social event at Stockholes Farm Miniature Railway as described by Mr. Ivan Smith.

Perran Foundry of Perranarworthal. However, the casting of the huge 144in. diameter low-pressure cylinder was beyond the capacity of the Perran and the Copperhouse Foundry at Hayle was entrusted with this important operation. Copperhouse apparently completed this task without difficulty, in stark contrast to the first attempt by Harveys, which resulted in a miscast, 'wastrel' cylinder. This was the cylinder that appeared in the many photographs that Mr. Olsen mentions in his letter.

Thus the three major Cornish foundries, to a greater or lesser extent, all had a hand in the construction of the 'largest steam engines in the world'. It should be stated for completeness that the engine houses, boilers, and engine beams were supplied by the Dutch. A magnificent achievement by all those concerned in the undertaking.

J. Willock, Warwickshire.

LMS battery electric locomotive

SIRS, - A few months ago I wrote to you concerning information for an LMS battery electric locomotive that one of our members wished to build. Following publication of the request for details in *Model Engineer* we received a number of responses, the most positive advising that one of these locomotives has been preserved.

My photograph shows Peter Leedell's efforts to date. Due to the small size and shape of the body it is planned to mount the battery in the driving truck.

In addition to developing the railway here at Stockholes Farm, Barbara and I play in a couple of local brass bands in our spare time (Markham Main Colliery Band and South Milford Brass). We recently hosted a joint social and barbecue for both bands. Before the barbecue started and the trains ran they gave a short joint concert for the benefit of relatives and friends who had also been invited. I include a photograph to record the event.

After the concert Barbara and I sat on the driving seats of our locomotives standing in platforms 2 and 3 at Stockholes Central and invited all the band members to join us. The locomotive on the right is *Duchess of Sutherland* and that on the left *Royal Scot*.

Ivan Smith, Doncaster.

Hot air engines

SIRS, - Further to my earlier letter on this subject, I note a degree of confusion about the thermodynamics of steam and hot air engines in the correspondence from Bob Margolis and in Mike Thurgood's reply *(M.E.* 4179, 4 October 2002)

The most fundamental difference between the functioning of the steam engine and hot air engine is the thermodynamic cycles on which they operate. Hot air engines operate on the Stirling or Ericsson cycle, both of which can be made thermodynamically reversible by the use of regenerators. Steam plant operates on the Rankine cycle, which is not reversible and differs from air (or gas) cycles in that the working substance changes state during the cycle due to evaporation and condensation. The working substance for the Rankine cycle must, therefore, be a vapour, not a gas.

Note that reversibility in thermodynamic terms is not the same as mechanical reversibility and has nothing to do with the direction of rotation of the machine. The theoretical efficiency of a thermodynamically reversible cycle (of which, to the best of my knowledge, there are only three) can be shown to be $(T_2 - T_1) / T_2$ where T_2 is the absolute temperature of the heat source and T_1 is the absolute temperature of the heat sink. This is generally referred to as the Carnot efficiency after the Carnot cycle. The Carnot efficiency is the highest efficiency that can be obtained by any thermodynamic cycle, but unfortunately it is impossible to build an engine to employ the Carnot cycle! Thus, if a quantity of heat H is available for conversion to work, the greatest quantity of work that can be obtained from the most efficient engine will be given by $H(T_2 - T_1) / T_2$.

Thermodynamic reversibility is, of course, a theoretical concept only. The mechanical and geometric considerations of an actual engine only allow an approximation to the thermodynamic processes making up the theoretical cycles. The Carnot efficiency still provides a benchmark for comparing the thermal efficiency of different engines and provides a basis for optimising the operating parameters within the physical restraints of the real world. It is clear that the lower the cold end temperature (T_1) the higher will be the efficiency of the engine. Mike Thurgood comments that his engine runs best when the cold end has become noticeably warm. Clearly this is not because the engine becomes more thermodynamically efficient — i.e. converts more of the available heat to mechanical work, since the temperature of the cold end of the displacer cylinder should be as low as possible for maximum efficiency.

Neither is the better running due to a reduction in viscosity of the gas as suggested. Quite apart from the fact that the effects of viscous drag in the gas are negligibly small, the viscosity of all common gases *increases* with increasing temperature. This only leaves the reduction in viscosity of the lubricating oil in the power cylinder as a possible explanation of the better running observed. This cylinder will take up some sort of mean temperature between the hot and cold ends of the engine. Surely the most effective approach would be to use a lubricant with a lower viscosity and keep the cold end temperature as low as possible!

The reference to the characteristic equation for the gas in the engine is not quite accurate. As applied to hot air engine operation, the equation should read $pv = mRT$ where m is the mass of gas contained in the system and which remains constant during operation. The units used in the equation do not have to be ISO units. Any units are acceptable *provided they are consistent.* The characteristic equation relates pressure, volume and temperature of the gas in the system but gives no information about how work might be done by it in the engine. This depends on the expansion processes employed.

Mr. Thurgood seems to miss the point that the hot air engine, like every other type of engine, makes use of the expansion of the working fluid as its pressure falls in order to generate power. The expansion (and subsequent compression) of the gas (air) in the Stirling or Ericsson cycles takes place isothermally (i.e. at constant temperature). The expansion of steam in a steam engine cylinder (and the gas in most other engine cycles such as the Otto cycle) takes place adiabatically (i.e. no heat is added or removed from the fluid during the expansion process).

Finally, the idea that small steam engines do not benefit from the expansion characteristics of the steam is totally wrong — why otherwise do we 'notch up' our locomotives to economise in steam consumption?

Norman Barber, Essex.

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The Author's superb model is in competition for the Duke of Edinburgh Challenge Trophy in MEX 2002.

LE RHONE 80HP ROTARY ENGINE in 1:3 scale

Alfred Nash
describes his remarkable model of this complex aero engine which was awarded a Gold Medal and the Bradbury-Winter Memorial Challenge Cup at the 71st Model Engineer Exhibition.

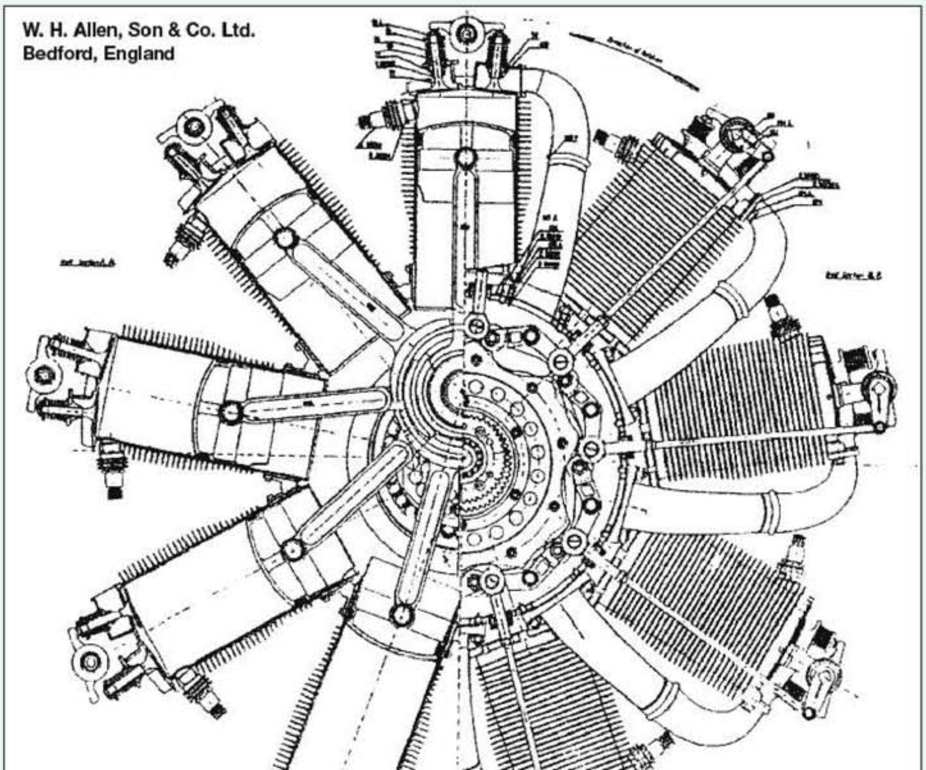
Having built the Bentley BR2 rotary engine to 1:4 scale, which gained me the Sir Henry Royce Trophy for the Pursuit of Excellence, this opened the door to my next project, which turned out to be the Le Rhone 80hp rotary engine. A friend gave me access to his original full size Le Rhone engine which, to my delight, was stripped down completely for overhaul in his workshops. This enabled me to measure components and photograph all the items required to make a start and decide what scale to make the model. I was also lucky enough to be handed a near complete set of works drawings and engine strip-down instruction manual. Armed with all this information I started drawing different ideas with respect to a working model rotary engine.

Several schemes indicated that 1:3 scale, although tight, would give the necessary freedom for assembly of scale components in the crankcase. The Manley Balzter big end or connecting rod compression block was a challenge in precision turning. Final blue bedding and fitting was necessary to overcome con-rod heel locking with neighbouring rods within the three circular grooves of the block (see photo). When this component was completed and all the high spots honed out, the engine turned over with a silk-like smoothness.

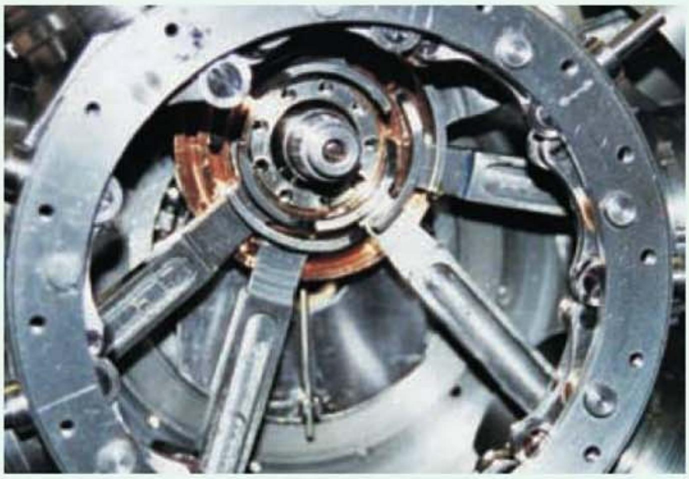
It is interesting to note that this classic big end was designed to eliminate the inequalities in piston acceleration that result from a conventional arrangement of master slave rods. The push-pull action of the passing cam roller when tracking the curves of the rotating cams only clear each other by 0.0015 inch. Spark plugs were made as small as possible to allow extraction, there only being enough room between the copper inlet manifolds and spark plug tip to withdraw the plugs from cylinder heads.

One of the high points of conversation at recent exhibitions concerns the copper inlet tubular manifolds. A technique for the electroforming of copper for producing small components is outlined in an article by R. H. Mapplebeck in *M.E.* 2774, 22 July 1954. I followed his directions and achieved success. The induction pipes that came out of my plating vat were a delight to behold. I would recommend this process to others who have a problem with producing numbers of identical components. For my application, it proved to be an ideal solution to a very difficult item to make with compound tight bends, etc.

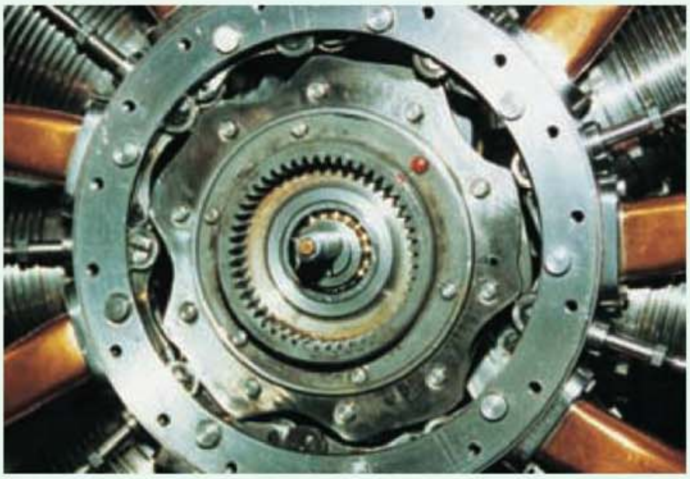
In all electroplating, cleanliness is of paramount importance if the best results are to be obtained. Filtering the plating solution and maintaining a constant temperature with a change of solution after about 250 hours is important. Once the process is started it is advisable not to remove the article from the solution or handle it until the required thickness has been achieved, otherwise an inferior plating or a spongy deposition of the



Transverse section of 80HP Le Rhone Engine

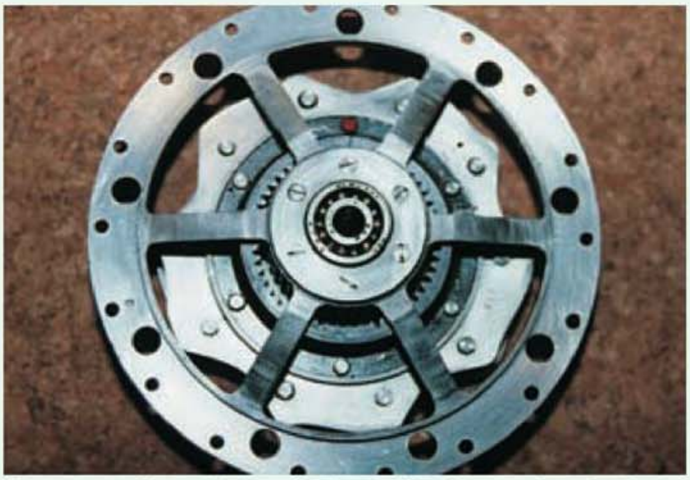


This view inside the model Le Rhone aero engine was taken during the build. Note the partly assembled Manley Baltzer big end and some details of the valve actuator mechanism.



Here the assembly sequence is further advanced and the cam rings, complete with internal toothed drive gear, have been added. The prominent copper manifolds are also in place.

A view of the partly assembled Manley Baltzer big emd assembly. Some hand-fittin was necessary to get this unit to turn smoothly without the connecting rod heels locking



The cams are driven with the engine but at 90% of its speed, a reduction which is achieved by means of this spider and gear assembly.

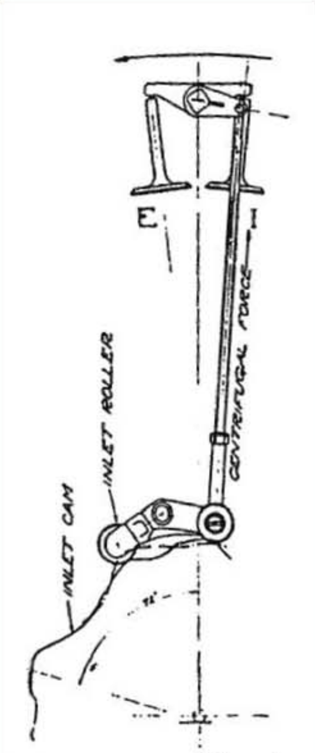
copper will result. This will not be apparent on removal from the vat; only when the component is heated to silver-soldering temperatures will the blistering and delaminating be apparent.

And so it turned out, that after 2$^1/_2$ years work, and some serious headscratching, the day came to run the engine. A period of some 10 hours was necessary to initially run the engine, mainly for piston ring bedding, using a $^1/_4$HP electric motor.

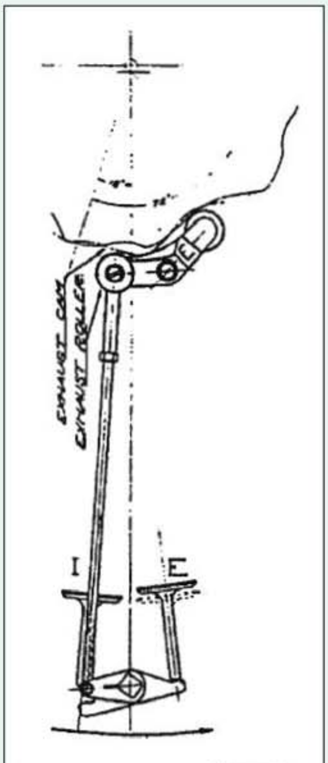
It is interesting to note that 18 complete turns of the propeller are required to pull the petrol from the block tube carburettor through the long hollow crankshaft into the crankcase and up along the copper induction manifolds just prior to ignition switch on. A quarter turn on the 34in. propeller is all that is required, and the fruits of success are only known to those model engineers who have painstakingly completed such a thrilling engine. At 1200rpm we are transported back in time to the pilots who risked their lives over Western Front in the Great War.

Some of the parts needed to build the model rotary engine. Shown are the nine cylinders, pistons and connecting rods together with the Manley Balzter big end parts.

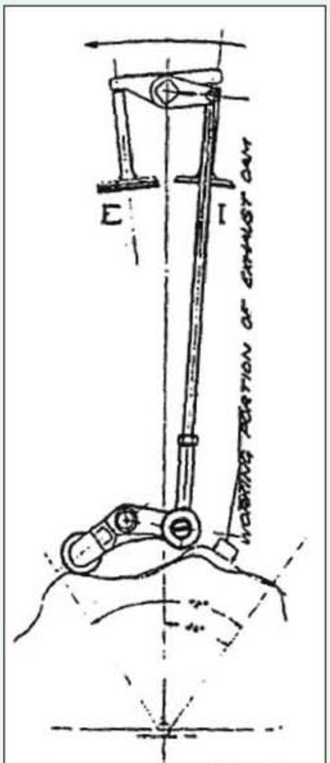
Note valve actuation rod, copper inlet manifold and minimal clearance between it and spark plug.



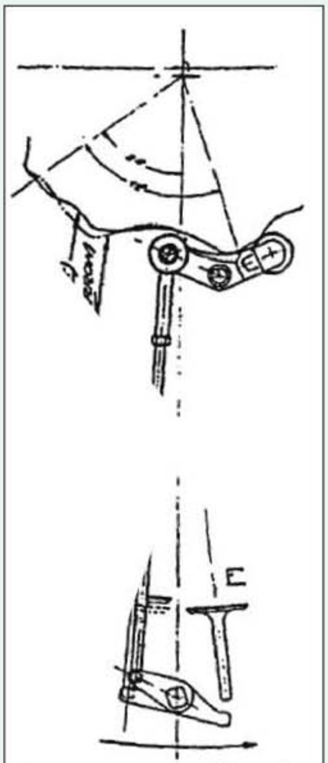
© Figure 1



© Figure 2



© Figure 3



© Figure 4

Valve action

The following information is extracted from the instruction manual for the 80HP Le Rhone rotary engine compiled by the Pittsburgh District Office Production Department Bureau of Aircraft Production, Pittsburgh, PA circa 1910.

"To understand the valve action of the Rhone engine it is necessary to keep in mind two facts: first, the valve rod is constantly pulled outward by centrifugal force; second, the cam movement relative to the cylinders is what actuates the valves. The outward pull of centrifugal force on the valve rod holds the inlet roller against the inlet cam.

"The inlet cam profile represents five complete cycles of valve actuation (four strokes per cycle) or ten revolutions of the engine. It is therefore evident that the cam must move one-tenth of a revolution relative to the roller for each revolution of the cylinder around the crankshaft. If the cam stood still, the roller would go all the way around it at each revolution of the engine. If the cam moved with the cylinder, it would have no movement relative to the roller.

"The cam must therefore go faster or slower than the cylinders to accomplish the desired result. On Le Rhone engines the cam is geared to revolve in the same direction as the cylinders, but at nine-tenths of the cylinder speed. Thus the cam drops back one-tenth of a revolution or 36deg. for each revolution of the cylinders.

*"**Figure 1** shows the positions of cam, rocker, and valves at top centre, beginning the explosion stroke. Both valves are closed and the inlet roller is held against the inlet cam by the outward pull of centrifugal force on the valve rod. It is in this position that valve stem clearances are measured.*

*"The next half revolution of the cylinder brings us to the end of the explosion stroke (**fig 2**) and it is seen that the cam has moved 18deg. less than the cylinder. The cam has therefore moved 18deg. relative to the cam rocker. For each 180deg. that the cylinders move relative to the crankshaft, the cam moves 18deg. relative to the cylinders*

"One degree on the cam represents 10deg. of engine rotation. The complete cycle (inlet, compression, explosion, and exhaust) is repeated every 72deg. on the cam. This 72deg. represents 720deg. of engine rotation, or two complete revolutions. The inlet roller bears upon the inlet cam all the way around except at the point of exhaust opening, when a positive outward push is required to open the exhaust valve against the pressure in the cylinder. The exhaust valve opens 45deg. to 55deg. ahead of bottom dead centre, when the exhaust cam pushes outward on the exhaust roller.

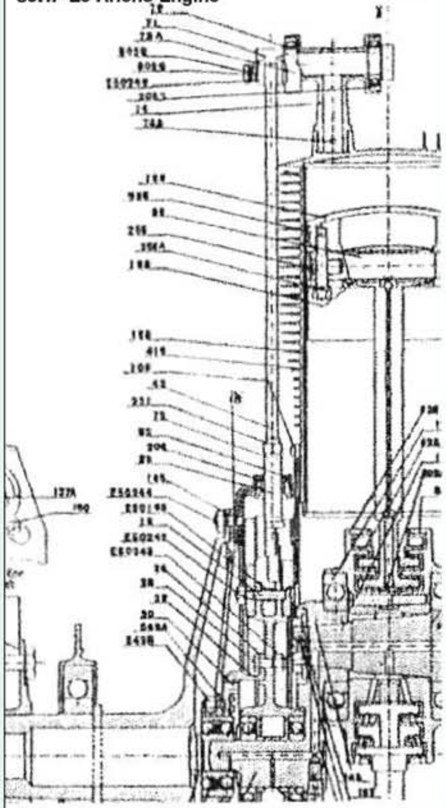
*"**Figure 2** shows the end of explosion stroke with exhaust valve partially open. At this point the internal pressure acting on the exhaust valve has diminished until centrifugal force is again holding the inlet roller in contact with the inlet cam. The point of exhaust valve opening is on the exhaust cam, while the maximum opening of exhaust valve and the point at which it closes are determined by the inlet cam contour. All inlet valve operations are controlled by the inlet cam.*

*"**Figure 3** shows the cylinder one half revolution after figure 2, during which time the cam has moved one-twentieth revolution or 18deg. in relation to the cylinder. The exhaust valve is being held open by the action of centrifugal force on the valve rod, but is nearing the closing point.*

*"Another half revolution (540deg. in all) brings us to the end of the intake stroke (**fig 4**), showing a total relative movement of 54deg. backward on the part of the cam. The inlet valve is held open positively by the cam and is within 40deg. of its closing point (4deg. on the cam).*

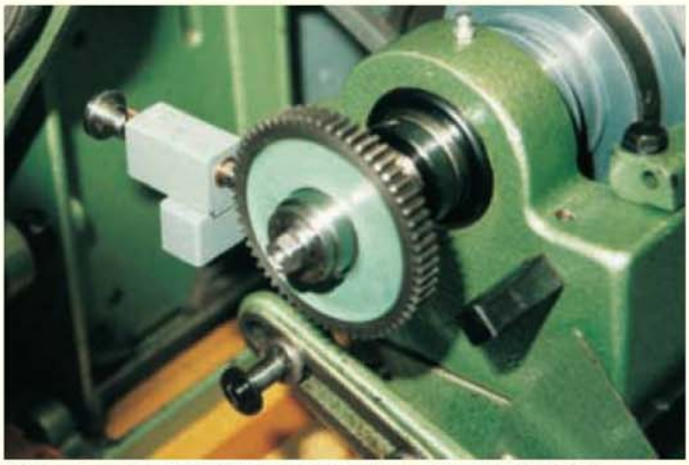
"Another half revolution completes the cycle of four strokes (two revolutions), bringing the valve action back to the position shown in figure 1, but on the next segment of the cam. The inlet roller has moved 72deg. around the cam. Each operation will be repeated as here described on every 72deg. of the cam. The engine must make 10 complete revolutions to bring the cam back to its original position, and in the meantime, each cylinder goes through its cycle of operations 5 times."

Longitudinal part-section of 80HP Le Rhone Engine ©



Cam drive

"The cam is driven and its speed is regulated by a gear on false nose. The gear holds back on the cam, which tends to go with the cylinders. This gear is concentric with the engine while the cam and an internally cut gear are slightly off centre. The gear on false nose has 45 teeth while the gear on cam has 50 teeth. The result is that cam makes nine-tenths of a revolution for each revolution of the cylinders."



Of simple design, the dividing attachment uses standard Myford change wheels secured to the rear of the spindle by way of an expanding mandrel.

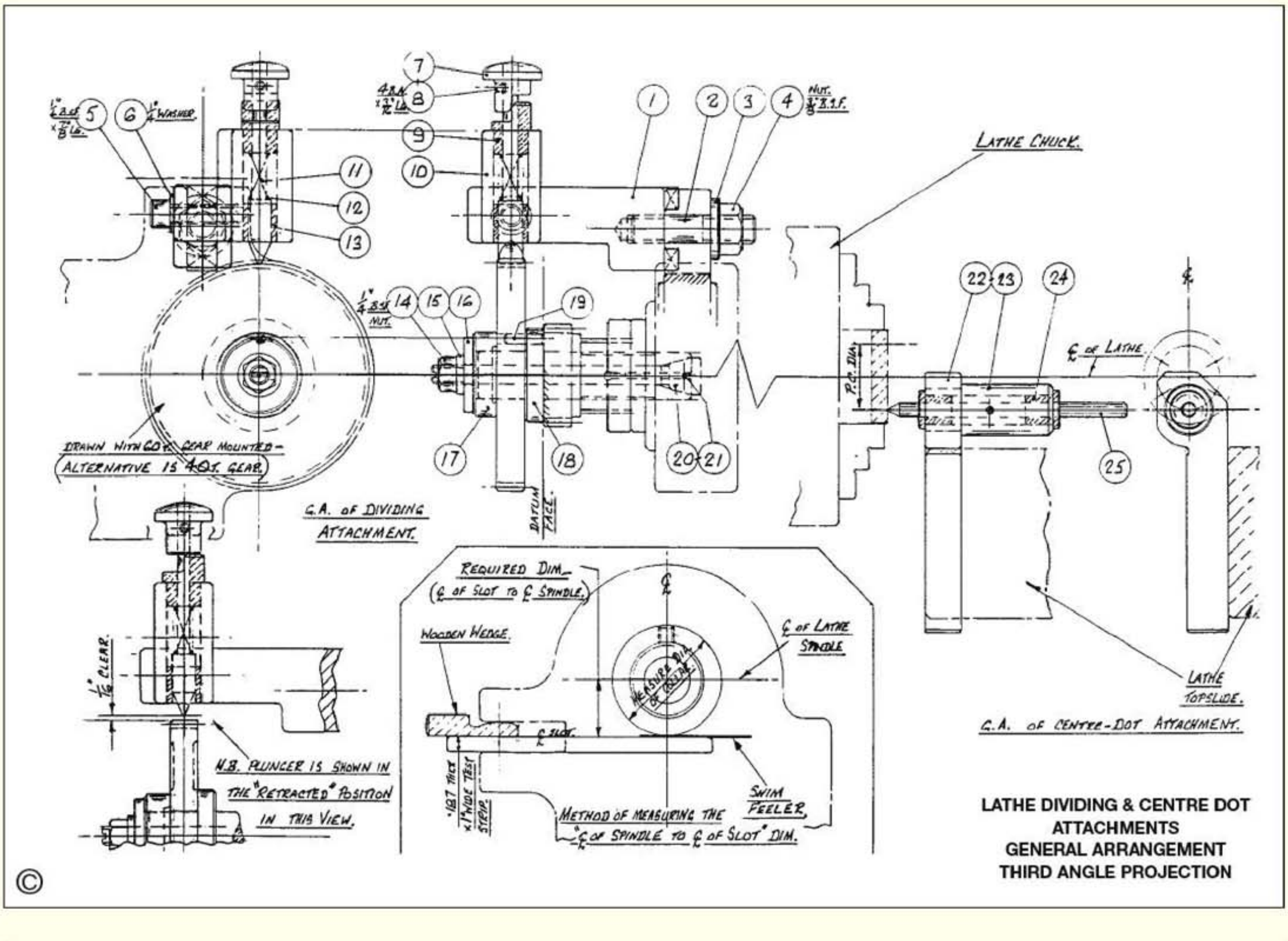
The centre dotting attachment is shown here mounted in the Author's lathe toolpost. Simplicity and ease of setting up were primary objectives.

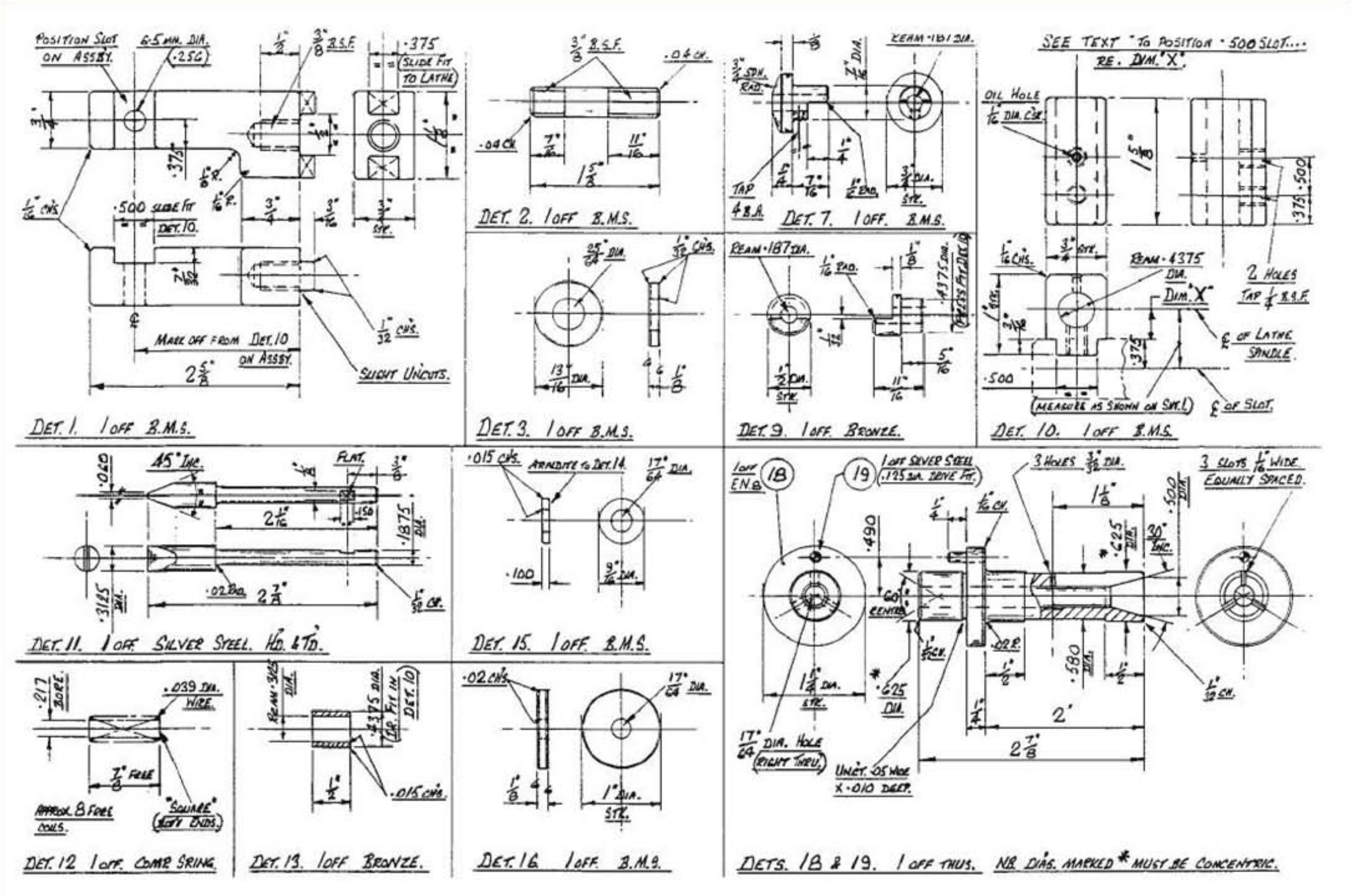
DIVIDING & CENTRE DOT ATTACHMENTS
for Myford ML10/Speed 10 lathes

Len Walker
describes two simple accessories to extend the versatility of this popular lathe or any other of similar size and type.

These two very simple attachments enable ordinary 'run of the mill' dividing and centre dotting to be carried out.

Making use of the substantial machined lug on the rear headstock bearing (normally used for reverse feeds), the dividing attachment simply slides into place and is clamped by half a turn of the securing nut. The chosen change wheel (40 or 60 teeth) plus its expanding collet arbor, is inserted into the rear of the lathe mandrel, a nip on the 1/4in. BSF clamping nut, and you are in business for dividing.





©

LATHE DIVIDING & CENTRE DOT ATTACHMENTS - DETAIL SHEET 1 - THIRD ANGLE PROJECTION

Using a 60 tooth change wheel will provide 2, 3, 4, 5, 6, 10, 12, 15, 20, 30 and 60 divisions, while the 40 tooth wheel will give 2, 4, 5, 8, 10, 20 and 40 divisions. This provides a useful range for ordinary dividing including spacing bolt holes on cylinder flanges and the like.

The centre dot attachment is clamped to the top slide and set square to the lathe centre line. This is easily done by nipping a stiff 12in. steel rule between the face of the lathe chuck and the adjacent face of the attachment. With the flange on the work already turned *in situ*, the required pitch circle diameter can be set outwards from the centre using the cross-slide index. A *gentle* tap with a light marking-out hammer will give a clear dot which can be enlarged as required after removing the work for drilling.

I have admired the beautiful and complicated dividing set-ups often seen at model engineering exhibitions but felt that for ordinary jobs, something much more basic is required. By utilising the existing lug on the rear of the Myford headstock, I was able to design these simple devices. They are made from stock materials and can be mounted in under a couple of minutes — even on a Friday evening! Construction is straightforward, but a few notes along the way may help someone out there.

Dividing head arm (Detail 1)

This first component is made from 1 1/2 x 3/4in. bright mild steel (BMS)

1: Mill or file the ends square and to length, then mark off the position of the 3/8in. BSF tapped hole.

2: Pack the work up to centre height and clamp it to the cross-slide, aligning the centre of the hole with a lathe centre. Set the work parallel to the saddle travel with a DTI (dial test indicator). Centre drill, drill and tap as shown from the 3-jaw chuck. This method will ensure that the tapped thread is true.

3: Mill the 0.375in. wide lugs central with the tapped hole. Use a portion of a 3/8in. BSF stud in the hole as a guide.

4: Mark out and mill to profile.

N.B. Do not mill the 0.500in. wide slot at this stage.

Detent knob (Detail 7)

Make from 3/4in. dia. BMS.

1: Cut, say 3/4in. over-length to provide a chucking piece.

2: Turn and ream, leaving a 3/8in. dia. shank on the radiused end.

3: Grip in a bench vice, and file the 1/4in. step and the 1/16in. radius. Polish.

4: Mark off, drill and tap the 4BA hole.

5: Cut off the shank and finish the 3/4in. spherical radius in the lathe.

Detent housing (Detail 10)

As a preliminary, measure the distance from the centre line of the Myford slot to the centre line of the lathe spindle. The method I used is shown on Detail Sheet 1. The slot is 0.375in. wide so that the top face of a test strip (0.1875 in. thick x say 1in. wide) will lie on the centre line of the slot.

Measure and record the outside diameter of the Myford screwed spindle adjusting collar.

N.B. avoid the locking grub screw D.

With the test strip in position and secured by means of a small hardwood wedge shaped as shown (see G.A.) swing the strip under the Myford collar, then use feelers to measure the small remaining gap. Half the diameter of the screwed collar plus the thickness of the feelers gives the required dimension. No sweat! On my own lathe this dimension was 0.752in. but there may be some variation so check yours. It is so easy to do.

Make this component from 1 x 3/4in. BMS.

1: Mill or file the ends square and to length.

2: Mark off the position of all the holes and centre dot. The height of the 0.4375in. dia. hole is your own measured dimension minus half of detail 1, i.e. 0.375 inch.

3: Pack the block (on its side) up to centre height and parallel to the saddle travel. Clamp it securely to the cross-slide, then line up the 0.4375in. dia. hole with a centre in the headstock. Lock the cross-slide. Centre drill, drill, bore and finally ream right through,

4: Using the same centre height packing, turn the block parallel to the chuck face, drill and tap the two 1/4in. BSF holes using the cross-slide index. The position and pitch of these tapped holes is dictated by the 1.000in. difference in the pitch circle diameters of the 60 tooth and 40 tooth change wheels used for dividing. With a small three-square scraper, remove the burrs from the main bore.

5: Drill and countersink the oil hole and add 1/16in. chamfers.

N.B. Don't mill the 0.500in. tenon at this stage.

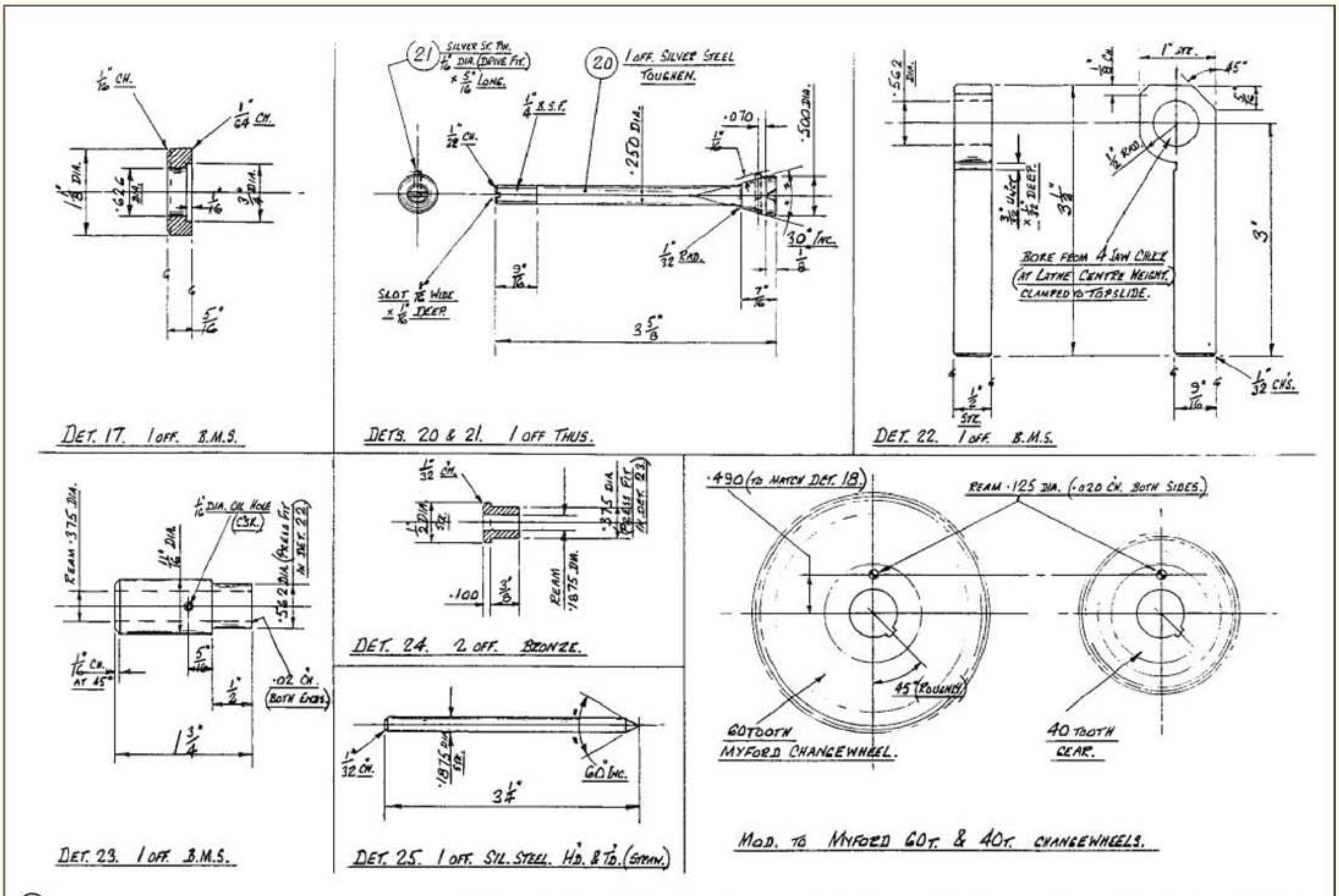
Detent (Detail 11)

Make from 11/32in. dia. silver-steel.

1: Part off a blank, leaving 1/16in. over-length.

2: Centre both ends using a BS2 centre drill (with 1/16in. dia. drill point).

3: Mount between centres and, with a sharply honed tool, carefully turn the 0.3125in. and 0.1875in. diameters. Take your time and use plenty of cutting oil. Leave the excess length at the indexing end.



LATHE DIVIDING & CENTRE DOT ATTACHMENTS - DETAIL SHEET 2 - THIRD ANGLE PROJECTION

4: Grip in a 3-jaw chuck and face off the 0.3125in. dia. to length. This should leave a shallow 1/16in. dia. hole which acts as a guide to centralise the 45deg. included form.

5: Mill the 45deg. included angle. I used a simple holding block made from a piece of 5/8in. square BMS about 1 1/2in. long, drilled out at lathe centre height to suit the 5/16in. and 3/16in. diameters. A 4BA grub screw prevented movement. With the work at centre height and set to the correct angle, clamp to the top-slide and mill the flats using a 3/8in. dia. end mill in the chuck. This method ensures that the indexing faces are true to each other, and to the spindle.

6: Add a small flat for the grub screw.

7: Harden and temper to pale straw at the 45deg. angle end. Lightly polish using oiled 600 grit, wet or dry paper.

Make the change wheel mandrel (detail 18) from 1 1/4in. dia. EN 8. I suggest you use the following machining sequence:

1: Mount in the 3-jaw chuck, set true and carefully face one end.

2: Centre drill, then drill 17/64in. dia. to a depth of 1 1/2 inch. Bore the 30deg. included angle taper as shown, by setting over the top-slide. Also bore a small 60deg. included angle centre 0.030in. to 0.040in. wide for tailstock support.

3: Rough turn to 0.650in. dia. for a length of 1.980in., using tailstock centre support.

4: Reverse in chuck and rough turn the short end to 0.650in. dia., again leaving, say 0.020in. to clean up on the flange face. Centre drill, then drill 17/64in. dia. right through. Using a 5/16in. dia. centre drill, form a true 60deg. centre for tailstock support.

5: Mount between centres and, using a sharp, freshly honed tool, skim all the diameters and faces true and to size.

6: Drill 3 equi-spaced holes, 3/32in. dia., as shown and mill (or neatly hacksaw) 3 slots, 1/16in. wide.

7: Accurately mark off and drill for the 1/8in. dia. hole. A 3.1mm dia. drill (0.122in.) at this stage will enable you to drill/ream through the flange and indexing change wheel later.

8: Toughen by heating to red, quenching and then tempering to light blue. Don't fit the 1/8in. dia. pin yet.

Draw bolt (Detail 20)

Make from 1/2in. dia. silver steel x 4 1/2in. long (including a chucking piece).

1: In the 3-jaw chuck, face and centre one end.

2: Pull out 3 7/8in. from the chuck and, using tailstock support, use the top-slide to turn the 30deg. included angle taper. Next, gently turn the 0.250in. dia. using light cuts, a sharp tool, and plenty of cutting oil.

3: Part off to length remembering to disengage the tailstock centre before actual separation.

4: Reverse in the 3-jaw chuck, chamfer and then thread 1/4in. BSF as shown, using a tailstock die holder.

5: Saw the screwdriver slot.

6: Drill the hole for the 1/16in. dia. pin.

7: Toughen.

8: Fit the pin (detail 21) as shown. I made this detail the other way round to normal which, because of the angular setting of the top slide, left the work more accessible.

Centre dotting attachment body (Detail 22)

Make this component from 1 x 1/2in. BMS.

1: Mark out and mill or file to profile. The position of the 0.562in. dia. hole can be scribed using a 1/4in. dia. silver-steel 'centre', turned *in situ*, with the part clamped to the top slide.

2: Ensure that the sides are parallel and at 90deg. to the base. Clamp the part securely to the top slide, in a normal tool position. Set the leading face parallel to the chuck face using a stiff 12in. steel rule nipped between the chuck face and the front face of detail 22.

3: Line up the hole position using your turned *in situ* silver-steel centre. Check, clamp, and lock the cross-slide.

4: Centre drill, drill out (in steps) to near size then bore to finished size from the headstock. A boring bit held in the 4-jaw chuck will do the job if you do not have a boring head. Remove the burrs with a small scraper and ensure that the faces are flat.

Punch guide (Detail 23)

Make from 3/4in. dia. BMS.

1: Face the blank to length.

2: Turn the 0.562in. dia. to a light press fit in detail 22.

3: Centre drill, drill, bore and ream 0.375in. dia. right through.

4: Reverse in the chuck, hold on the 0.562in. dia. and turn the 11/16in. dia. and 1/16in. chamfer.

5: Drill and countersink the 1/16in. dia. oil hole.

Press detail 23 into detail 22 using a strong bench vice. A light press fit is all that is required and if the first, say 3/16in. of the 0.562in. dia. on detail 23 is eased slightly, it will help matters. Now carefully press in the two bronze bushes (detail 24).

Punch (Detail 25)

Make from 3/16in. dia. silver-steel.

1: Face to length.

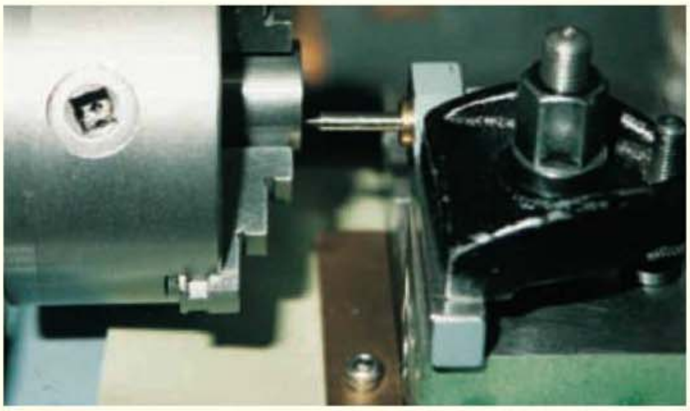
2: Set to run true in a 4-jaw chuck using a DTI.

3: Set over the top-slide and turn an accurate ▶

60deg. included angle. Use top speed and cutting oil. Polish with oiled 600 grit wet or dry paper.

4: Harden out and temper to a light straw colour.

This item completes the centre dot attachment.



This view reveals the simplicity of the centre dotting attachment which is shown clamped under the standard Myford toolpost and is set with the shank parallel with the chuck face by means of a stiff steel rule.

Modifications to the 60 tooth and 40 tooth Myford change wheels

Remove any burrs and run a small scraper around the bores to form a slight chamfer.

1: Assemble detail 18 to the 60 tooth change wheel (collet end up) with the keyway in the gear approximately as shown i.e., well clear of the 1/8in. dia. pin.

2: Using a 3.1mm (0.122in.) dia. drill in a short extension holder and the flange in detail 18 as a drill jig, transfer the hole right through the gear. Rest the gear on parallels for this operation. Repeat for the 40 tooth change wheel. Separate, and open up the holes in both gears to 0.125in. dia. and lightly countersink both sides.

To determine the position of the 0.500in. wide slot in detail 1, i.e. to line up the indexing plunger with the Myford change wheels:

1: Assemble details 1, 2, 3 and 4 to the Myford slot. File small flats on the top and bottom of the stud, detail 2, to allow the tenons to locate freely.

2: Assemble details 14, 15, 16, 17 plus the 60 tooth gear and also details 18, 19, 20 and 21 to the rear of lathe spindle. Tap gently into position and nip up the collet nut, detail 14.

3: Offer up the index plunger unit, less the spring (detail 12), with details 7, 8, 9, 10, 11 and 13. Position detail 10 flush with detail 1 as shown, and set square. Adjust the position to centre the index plunger on the change wheel and then clamp the unit to detail 1. Scribe a line onto detail 1, either side of detail 10, and then scribe a central line. This gives the centre line of the 0.500in. wide slot.

4: Mill the slot in detail 1 and drill the 6.5mm dia. hole in the slot centre and 0.375in. from the edge, as shown on the drawing. The tenon on detail 10 can now be milled to match, using your dimension 'X' also shown. Replace the index spring, detail 12 — well oiled! Assemble the cap head screw, detail 5, and washer, detail 6. This completes both attachments.

Operation

In use, set the index plunger in the retracted position 1/16in. clear of the outer diameter of the change wheel in use as shown on the G.A. Sheet 1.

I have held to my brief: to design a simple set-up. Obviously, the centre dot punch could be replaced by a twist drill, running in hardened bushes and driven by a portable drill, plus a flexible drive. Further, a neat motorised version comes to mind — you can go on and on, far beyond my modest and basic approach.

Truly, all this seems to have taken much longer to write up than to do the job. It really is a simple tool to make. I have expanded on some of the methods I used, in the hope of encouraging someone out there to have a go.

Good luck and work safely.

RUSHDEN CAVALCADE 2002

G. Wooley's 1926 Super Sentinel braves the muddy conditions! This wagon was one of a number of full-size steam driven vehicles on display.

The author's chosen conveyance to and, gratifyingly, home again from the event. It is a 1922, 2 3/4HP (350cc) Raleigh Popular.

Neil Read reports on this popular annual Northamptonshire event which is organised by the Rushden Historical Transport Society.

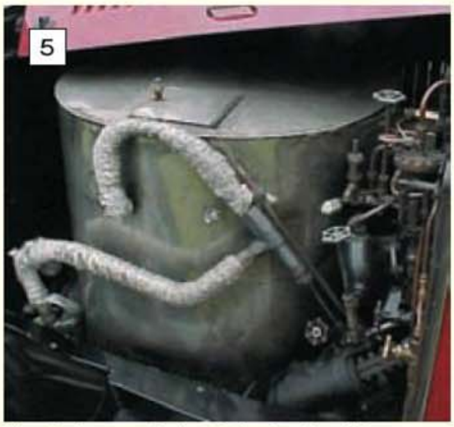
Following some disruption to the organisation of this event last year due to the foot and mouth epidemic, this year saw it back firmly in its traditional spot of the May Day Bank Holiday (4-6 May). This year's event was the 24th and was held at the usual venue of Lancaster Farm just outside Higham Ferrers.

The Cavalcade is sometimes advertised as *"the big one that starts the season."* Well, it is certainly big, so no argument there, but being held at the start of the season in a country where the weather is a favourite topic of conversation means that climatic conditions can vary somewhat. Over the years the event has seen weather ranging from grilling sun to cold, biting winds to driving rain and sleet. This year, heavy rain fell just prior to and during the event and, despite the preceding weeks being relatively dry, this did give some problems. The going was what the horse racing fraternity might call 'soft' which did restrict the movement of some of the heavier exhibits. It also provided exhibitors arriving with cars and motor cycles with an impromptu trial course.

Despite this, the event remains popular with visitors of all ages. I put this down to the variety of the exhibits and the friendliness of the organisers. The Cavalcade is efficiently but unobtrusively marshalled by a dedicated team who never forget that exhibitors and visitors alike are there to enjoy themselves. For example, those of us who arrive on two wheels (**photo 2**) are provided with a flat piece of wood on which to park their machines so that the stand feet do not sink into the soft turf. Secure storage for helmets and riding gear is also always provided. The attention paid to details like this makes you feel welcome whatever the weather.

An Allchin agricultural traction engine in steam under cloudy skies. Allchins were built at Globe Works near South Bridge in Northampton.

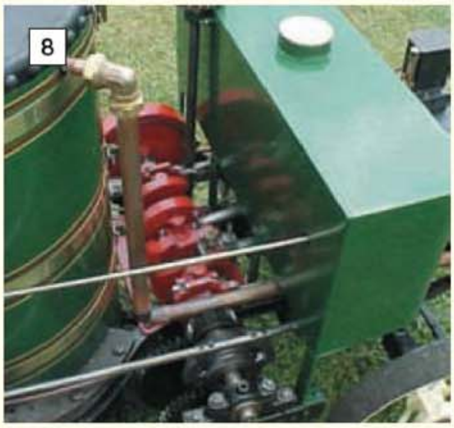
Mr. Rochester's 1923 Stanley 740 Tourer steam car. This motor car has been beautifully restored and appeared to be in first class order.



The flash steam boiler of the Stanley. What appears to be a radiator to the front of the boiler is a condenser designed to conserve water.

This 4in. scale DCC Burrell road locomotive was built by Mr. Todd and was one of a number of fine models in steam on the rally field.

Eddie Lancaster's model 1898 Burrell traction engine fitted with a vertical boiler. It looks as if driver comfort was a priority for the builder.



A close view of the novel Burrell showing the water tank and the position of the crankshaft in the chassis. The engine is a compound unit.

In addition to the transport-related exhibits, ranging from full-size traction engines and steam wagons, through heavy commercial vehicles powered by petrol and diesel engines and to cars and motorcycles, the Cavalcade also has strong support from local model engineers and model makers, tractor owners and stationary engine enthusiasts. Add to this the usual attractions of a country show and a fun fair and you have an event that appeals to whole families.

Several of the exhibits noted at this year's event may be of interest to readers of *Model Engineer*. It was particularly pleasing to see an Allchin agricultural traction engine (**photo 3**) so close to its place of manufacture. Allchins were built near South Bridge in Northampton and this example, works number 1499, left the works in 1912. It is owned by Jane Eaton of Northampton. It is certainly possible to see the family resemblance to *Royal Chester*, which must be one of the most celebrated and popular model traction engine designs of all time.

This well detailed model of the 1907 battleship HMS Superb was one of several models displayed by the Anglia Marine Model Club.

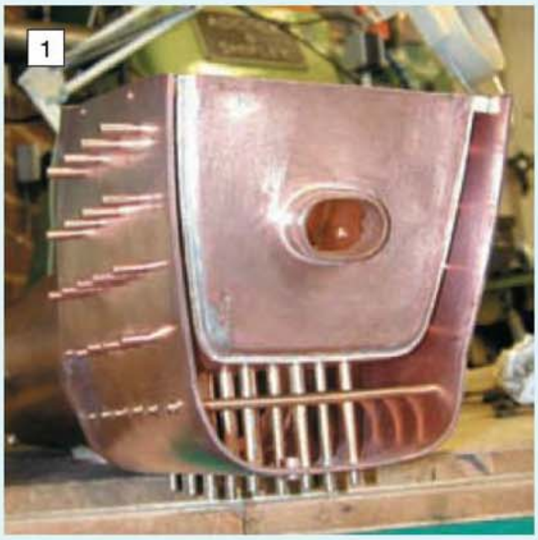
Steam cars were always relatively rare on the roads of the UK and there can be very few examples remaining in use. The 1923 Stanley 740 Tourer (**photos 4** and **5**) owned by Mr. J. Rochester was therefore a most welcome sight. The engine of this car has two double acting cylinders with diameters of 4in. and strokes of 5 inch. These are coupled directly to the rear axle and there is no clutch or gears. The operating boiler pressure is 600psi and the petrol/paraffin fuel is consumed at a rate of 10 miles to the gallon. Top speed is 50mph but the car is happiest cruising at 30 miles per hour. The large 'radiator' at the front of the car is really a condenser which gives the car a range of 100 miles before fresh water is required.

There is always a strong contingent from the miniature traction engine fraternity at the Cavalcade and, since I arrived early, I was able to infiltrate their camp in a corner of the rally field and enjoy their antics as steam was raised in preparations for the day's events. Space does not permit full coverage of the 20 odd exhibits, but a couple of examples should provide a flavour. Mr. Todd's 4in scale, DCC Burrell (**photo 6**) looked splendid in the weak spring sunshine and was built from castings and parts supplied by Live Steam Models. The general appearance and sound engineering displayed on this model does the builder much credit. Eddie Lancaster of Wollaston exhibited a very unusual engine (**photos 7** and **8**). This was a 4in. scale model of a Burrell traction engine built in 1898. The original vehicle was unusual in that it departed from what was by then established traction engine practice by having a vertical boiler with the compound engine mounted low down. What made Burrell choose this layout is not known but Eddie reckons they did use the technology for some later steam wagons so the prototype may have been a mobile test bed. Whatever the reason behind it, the design does result in a very compact engine.

The organisers of the event provide a large marquee for smaller models and those less adapted to an outdoor life. One of the displays in the marquee was by the Anglia Marine Model Club and some most impressive ship models were on display. One that caught my eye was that of the 1907 battleship HMS *Superb* (**photo 9**). *Superb* was a virtual copy of her more famous sister ship *Dreadnought* with the addition of a second tripod mast. The model captured the powerful menace of the original vessel and reflected a time when Britannia really did rule the waves.

Why not make a note in your diaries to give Rushden Cavalcade a try next year?

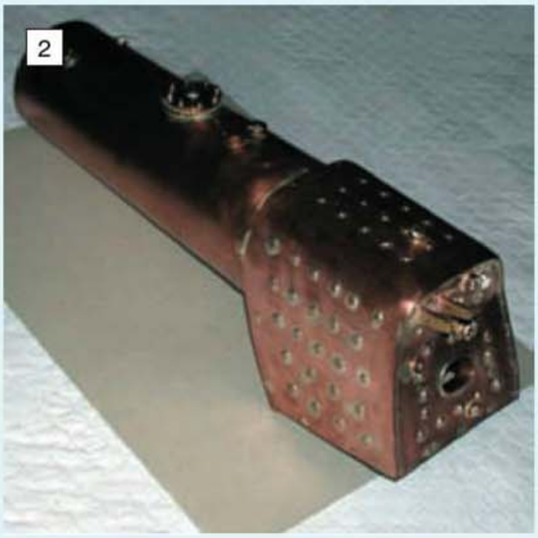
BRITANNIA BOILER TEST

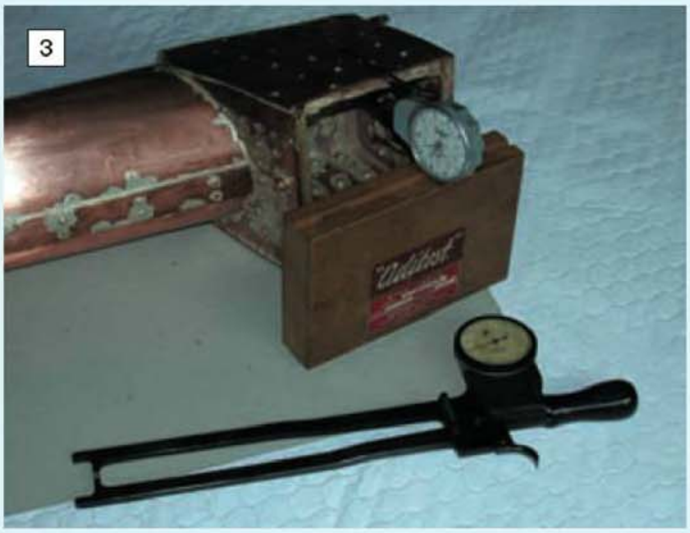


Left: one of the modifications to the Author's 3[1]/2in. gauge Britannia *boiler concerned the firebox. This view shows very clearly the* $^3/_{16}$*in. dia. copper rod stays used to reinforce the firebox.*

Right: The silver-soldered copper boiler with blanking plates and plugs fitted and awaiting the hydraulic test.

Below: during the hydraulic test, firebox plate deflections were measured using an 'Oditest' caliper, seen here. A similar instrument with a longer reach is also shown but was not used during the test on this boiler.





Don Broadley follows his series on the design and construction of miniature boilers, and his recent *Coda*, by reporting a successful test on one of his own boilers.

At about the time I wrote the short series *Principles of Model Boiler Design*, published 12 January 2001 – 9 March 2001, I bought a $3^1/_2$in. gauge *Britannia* chassis that belonged to a very good friend who had sadly passed away. The design by LBSC continues rightly to be very popular and the chassis came with a boiler that had unfortunately suffered leaks in the combustion chamber and was effectively scrap. In hindsight, it was a mistake for me to take on a second project to the 5in. gauge 'Jubilee' that I am building, but I took it on and decided to take time out to make a boiler for the little *Brit.* I decided to deviate from the published design and followed modern all silver-soldered practice rather than the screwed and nutted design of the original. Chiefly then the firebox needed to be re-designed, including a stayed crown rather than girder stays, no surprise for this change if you followed my original article.

A kit was purchased from Blackgates in which the tubeplates were flanged and the copper cut to approximate size, all at very little extra cost to the materials themselves. I am very fortunate in having two club friends who have vastly more experience in silver-soldering than I, and it was to them that I turned for help in this department; I thank them both. I decided to include the combustion chamber of the original design, this is without doubt a major complication as is also the sloping firebox throatplate. I am however led to believe that the combustion chamber is important for the prototypical wide fireboxes of the *Britannia* design.

It was during the re-design of the firebox that information was emerging on the design of flat firebox sides, the subject of my *Coda*, published in *M.E.* 4181, 1 November 2002. Here then was an opportunity to put some of my findings into practice and eventually to carry out tests on the completed boiler. As I explained at the time, space constraints demanded that not all the Finite Element Analysis (FEA) results could be given in the *Coda*, but in fact detailed deflections of the computer model are available. It was indeed a big surprise to me that despite the relatively large stay spacing that I chose, at least with regard to the original design and some authorities, the calculated deflections were very small.

Prior to this I had received correspondence suggesting that, given the empirical way in which traditional formulae were put forward, an experimental derivation of the behaviour of flat plates should be explored. Easy enough to say but near impossible to achieve given the very local nature of the stresses involved as shown by the FEAs presented in the *Coda*. In my professional experience, such experiments, without reasonable theoretical backing, lead from one experiment to another, to another, *ad infinitum*. Indeed I doubt that the very local stresses around the stays from the FEA analyses could be researched by anything other than photo-elasticity modelling, that in itself, given the strain hardening nature of copper, would give rise to serious doubts about its validity. However, it would be relatively easy to make deflection measurements across the firebox wall and compare them with the FEA results, the experimental deflections being taken at mid-plate span, a span where the stay spacing was reasonably regular, i.e. square.

The major design changes were making a strap connection between the barrel and the top of the outer wrapper, the rod stayed firebox crown and the fully silver-soldered firebox sides. Plate thicknesses were unchanged and the tapered barrel was strapped externally prior to silver-soldering. Firebox rivets were $^3/_{16}$in., increased from $^1/_8$in. at about 1in. spacing instead of $^5/_8$in. for the screwed stays. The firebox, prior to silver-soldering is shown in **photo 1** and the completed boiler is shown in **photo 2**. In my view, it is imperative that the relevant boiler inspector should be taken along with any boiler re-design and in that respect I am grateful for the agreement of Neil Counsell from the Urmston DMES to the modified design.

I claim no rocket science in the way that the test was carried out. The firebox deflections were measured quite simply using an 'Oditest' calliper with a DTI reading in 0.001in. (0.0254mm). The instruments and its deployment is shown in **photo 3**. The larger instrument shown was purchased at an excellent model show in Fleetwood, staged by Fylde MES earlier this year, and has an enormous reach but was more difficult to deploy accurately and was not used live in the test.

180psig hydraulic test results

After what seemed an age, the DTI needle finally started to move off its stop at 90psig, prediction 0.00093in., assuming no yield. The maximum deflection was 0.00125in., prediction 0.001083in. at the final test pressure of 180psig. The actual measurement was of course twice this value taking into account both inner and outer wrappers.

From the outset *all* the **code** formulae that I have been able to find, including the old Board of Trade formula, are based on mid-stay bending of the form:

$f_{(\text{mid-plate stress})} = K \times pc^2/t^2$ Equ 13 in the original article

where K = constant
p = design pressure
c = stay spacing
t = plate thickness

The test conditions were only slightly different to the FEA calculations reported in the *Coda* in which the mid-plate stress was 2,000lbf./in.^{2} at a working pressure of 90psig. Working back, this modest stress gives a value for **K of a little under 0.2**, i.e. half that of some authorities using a design stress almost twice as large as that experienced here, i.e. gives an even lower value for **K**.

I have some reservations bearing in mind that you only get one chance on a test like this with the copper in its fully annealed state and, in hindsight, I would have tried to make more measurements than I did. However as new boilers come along for test we hope to carry out further tests and it would be useful if others would do the same. Indeed it would be even better if different geometry was calculated by FEA followed by test measurements to gain a wider appreciation of stayed surface behaviour.

This simple test supports the FEA results and therefore supports the view that current assessments and code formulae based on mid-plate stress are in error and overestimate the stresses involved by a significant margin. It is unfortunate that peak stresses around stays cannot be measured directly but I doubt that it is possible, at least with apparatus available to the home workshop. Given that appreciable strain hardening takes place, hardness measurements around the stays might be feasible.

Despite the *caveats* I am reasonably satisfied that we now have a better appreciation of firebox stayed wrapper behaviour in our model copper boilers. I am even more pleased that all the indications are that current rules and procedures are conservative.

A TAPPING AID

G. McLatchie

describes a simple aid to tapping in the lathe or drilling machine.

The device about to be described can be used in the lathe or drilling machine and is designed to keep the tap perpendicular to the surface of the work. It may therefore be of help to the less experienced worker. To keep the design simple the tap is held in a dedicated holder with a clamp screw. More than one holder may therefore be required depending on the range of taps you plan to use. However, since these are quick and easy to make this is no great hardship.

Body

This is designed to fit in a lathe or drill chuck and has a 7/16in. dia. shank. Chuck a suitable length of 1in. dia. bar in the 3-jaw and turn the 7/16in dia. shank. Drill the 5mm screw clearance hole. Reverse in the chuck and face to length. Drill and ream the 1/2in. dia. hole 1in. deep using a machine reamer. If you do not have a machine reamer, the hole can be finish bored to size or you could use a D-bit. It is not important that the finished hole is exactly to the size stated as the tap holder can be made to suit.

Tap holder

Chuck a suitable piece of bar, face and turn the 1/2in. dia. shank to a nice sliding fit in the body hole. Drill and tap the M5 hole. Reverse in the jaws and face to length. Drill for the tap shank. Mark out, drill and tap the holes for the handles and clamp screw. If you wish you can make the tap holder out of 3/4in. hexagon bar. This would make the drilling and tapping of the holes for the handles and clamp screw potentially easier. The clamp screw hole does not have to be at 90deg. to the handles.

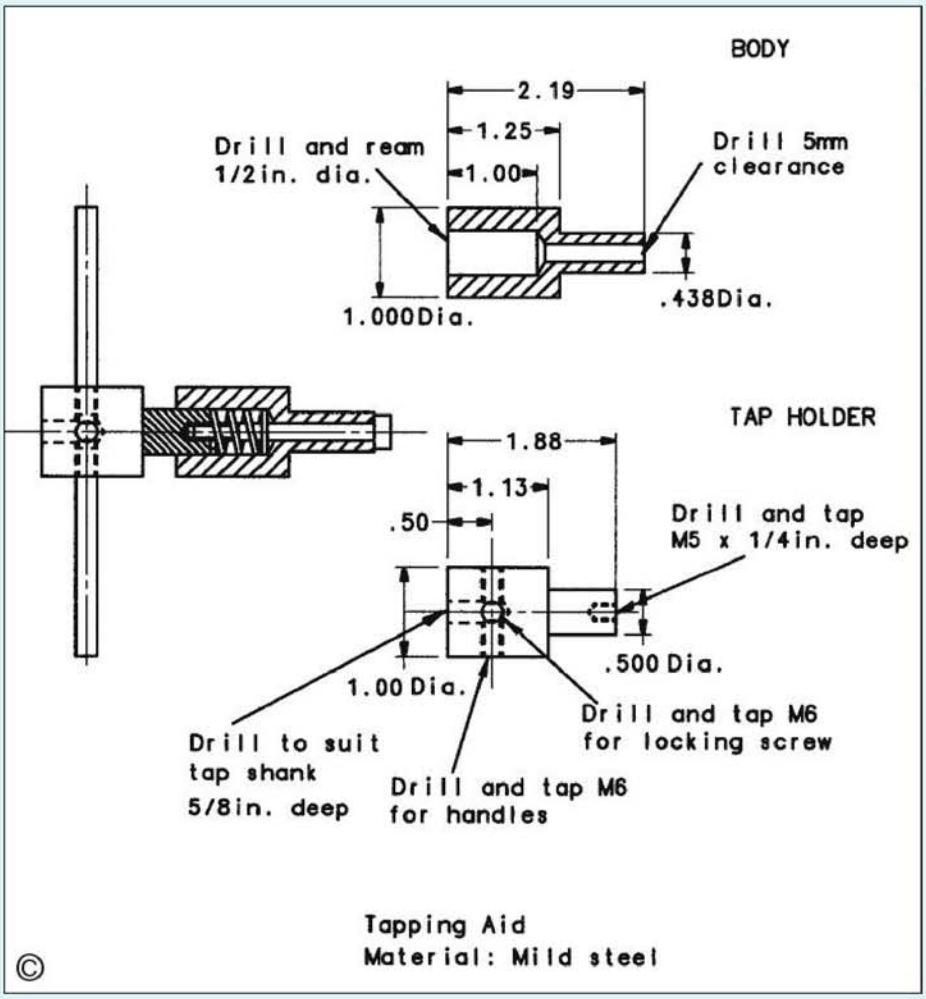
Handles

These can be made from 6mm dia. bar. I used M6 studding fitted on the ends with plastic knobs. The length and style is something that you can chose for yourself to personalise your tool.

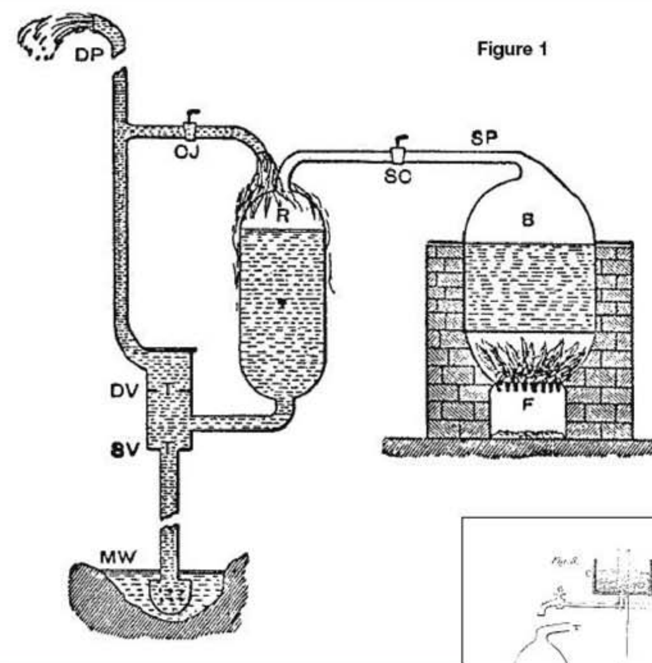
Assembly and use

The two main halves of the tool are held together with an M5 x 50mm cap head or cheese head screw. I placed a light spring between the tap holder and body as I find this makes the tool easier to use. Try it both ways to see which suits you better.

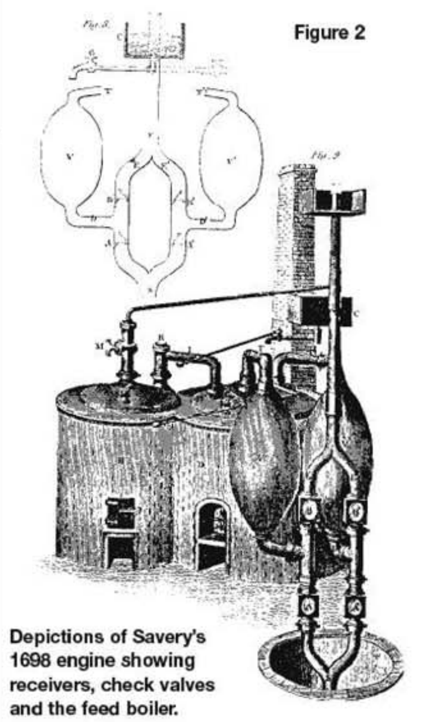
In use, I bring the tap into contact with the work and apply enough drilling machine quill or tailstock barrel feed to compress the spring fully. The quill or barrel is then locked. The tap can then be turned to tap the hole, reversing occasionally to break the swarf. On long holes the length of travel of the device may not be sufficient and it may be necessary to finish the tapping operation in the vice.



The Author's finished model of Savery's 1698 engine.



The principle of the Savery Engine was to alternately fill and drain the receiver. Total lift was limited to about 50 feet. (from Jamieson)



Depictions of Savery's 1698 engine showing receivers, check valves and the feed boiler.

A FURTHER STEP BACKWARDS

Chris Leggo in California, discusses the design and construction of his working model of Thomas Savery's steam engine of 1698.

With the successful completion of the Newcomen engine, (*M.E.* 4152 & 4154, 10 August & 7 September 2001) the next logical step was to take a further step backward and make a model of the progenitor, the Savery engine.

In 1698, the force of steam under pressure was known as well as the force of the atmosphere acting on a vacuum, but it was Thomas Savery who utilised both principles in his pump of that year and was granted a patent for 'Raising water by the force of fire'. The scope of this patent was so wide that Newcomen was forced to take him as a partner in 1712.

The basis of Savery's machine was a boiler, a receiver, two check valves, suction and delivery pipes, and a spigot for cooling water (**fig 1**). In operation, the receiver was filled with steam of sufficient pressure to force the water within up the delivery pipe. The steam was then shut off and the receiver cooled by a stream of cold water so that the steam was condensed within, forming a vacuum in the receiver which sucked water from the sump. One man could operate the pump, operating the valves as well as firing the boiler, and could maintain a pumping rate of about six cycles per minute (**fig 2**).

This was the first successful attempt to remove water from mines by means other than man or horse power. With standing water preventing further work in the mines, pumping was one of the great needs of the day. The pump was located down in the shaft of the mine at a position where the pressure available in the boiler was enough to force water to the surface and close enough to the sump for the vacuum to pull up the water into the receiver. Since both these heights had a practical limit of about 25ft., the 'engine' had limited usefulness. The model, of course, would be within these limits, and interestingly enough, caused problems in making it work, but more on that later.

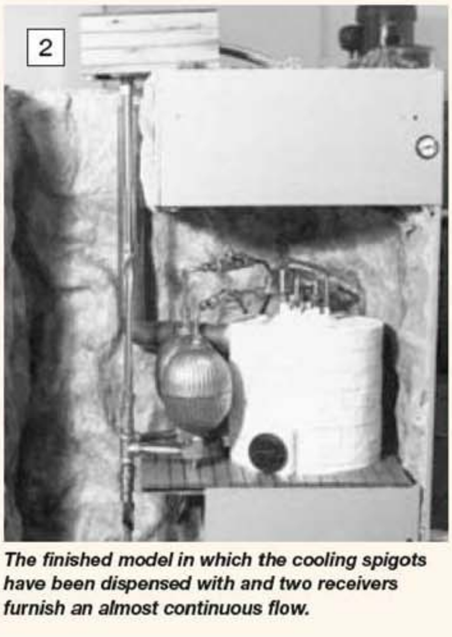
The first set-up of the model (**photo 1**) was with one receiver only and was equipped with a pressure gauge for the boiler and a combination pressure-vacuum gauge in the line to the receiver. The sump was a plastic pan about 15in. below the receiver and the surface was simulated with a stainless steel 'cistern' draining into a paint tray which would be decorated later to look like a ditch. A drain on the paint tray ran back into the sump.

The cycle was started at a pressure of about 2psi and when steam was emitted at the cistern

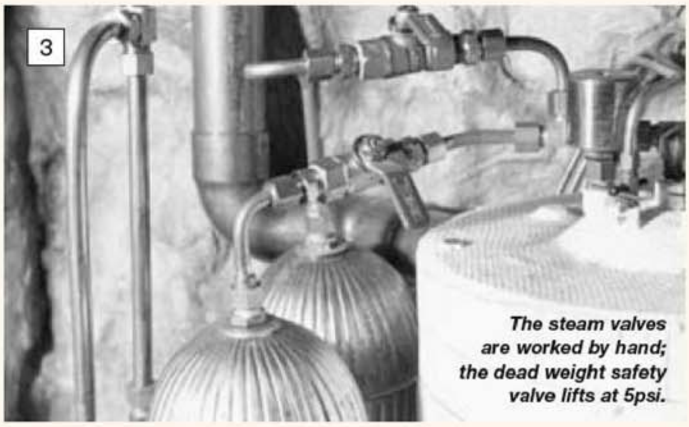
1

This first assembly of the model was used to test the system. Suction in the receiver was immediate and spectacular!

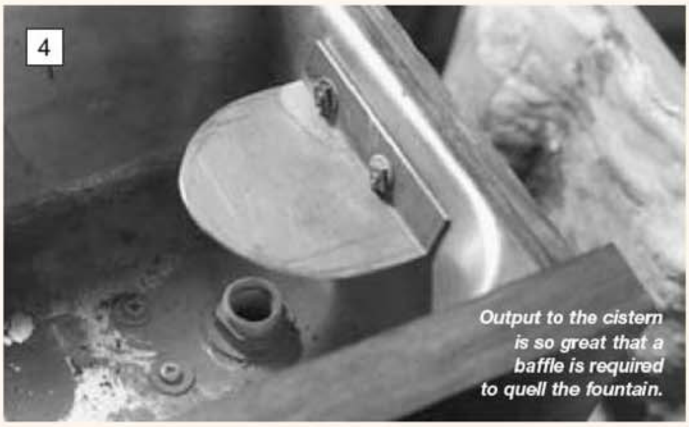
2



The finished model in which the cooling spigots have been dispensed with and two receivers furnish an almost continuous flow.



The steam valves are worked by hand; the dead weight safety valve lifts at 5psi.



Output to the cistern is so great that a baffle is required to quell the fountain.

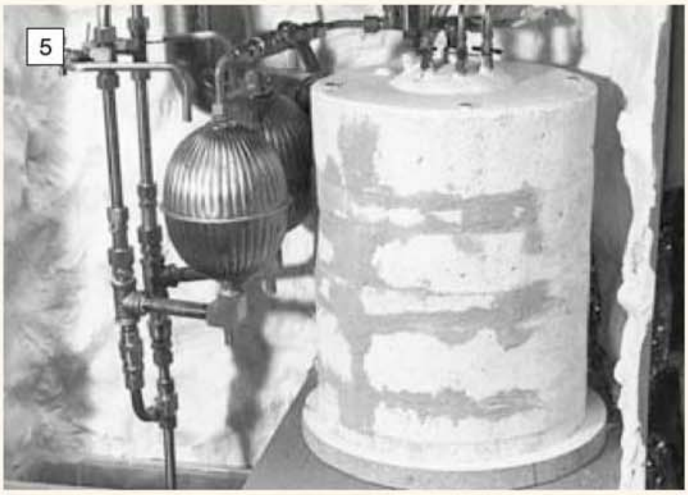
up at the 'ground' level, the steam was turned off. Before cooling water could be turned on, there was a great sucking sound and the receiver filled from the 'sump'. The 'receiver' is made from a copper toilet float which is only 0.008in. thick and the heat transfer is so great that a stream of cooling water was not necessary. The action of the vacuum gauge was to go to 25in. immediately, then taper off slowly to zero. Still, all this takes place in about 8 seconds.

The finished model (**photo 2**) is contained in a plywood cabinet about 3ft. in height. The boiler is fired from the rear and feeds each receiver through a 1/4in. cock (**photo 3**). When the steam cocks are opened, the force of the stream is such that water will shoot high in the air if it were not for the baffle in the cistern tank (**photo 4**). In an intermediate form (**photo 5**), two jets were fitted to cool the receivers which were discarded in the final form.

The copper toilet float was an almost perfect vessel for the receiver, although it required some modification. The 1/4in.-20 tapped brass bushing had to be removed, which was the greatest problem. It is crimped through a steel washer on the inside. Drilling the bushing out was not a problem, but removing the steel washer was, as it was twice the diameter of required hole. Its removal was finally accomplished by grasping it with some needle nose pliers and hacking away at it with a grinding disc on a hand-held motor tool. The other end was drilled without difficulty. Fittings were then made to take the 1/8in. pipe tap at the top and the 1/4in. pipe tap at the bottom. These fittings had to have flanges that span the whole flat on the ends of the float to give some strength. The fittings are soft soldered onto the ball float, care being taken not to overheat the copper and take the hardness out of it.

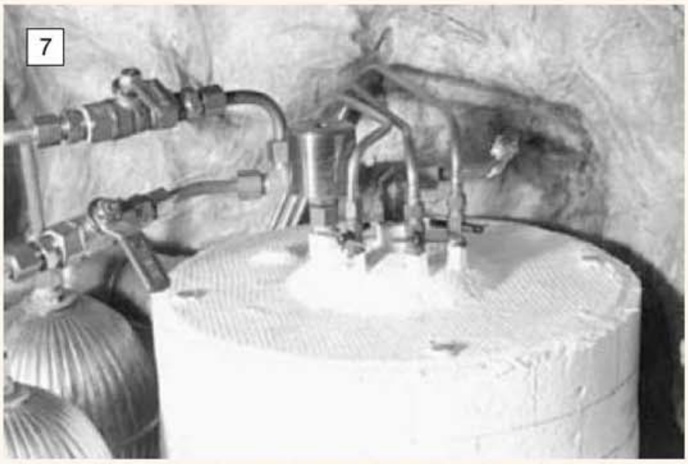
The check valves (**photo 6**) were made to fit into commercial fittings. The rest of the fittings are as purchased. The cabinet was covered with wrinkled door screen and then plastered over with Plaster of Paris. An artist friend did the decoration based on photographs of a mine in Cornwall.

The boiler is a simple pot boiler, a vertical 4in. copper tube about 5in. high with a dished bottom, a domed top, and silver-soldered. There are three try cocks and a dead weight safety valve (**photo 7**). The boiler is fired with propane from a bottle mounted on the back of the cabinet, ▶



This view of the engine shows it fitted with two receivers and cooling jets; the boiler casing is made of lightweight fire brick.

Fittings above and below the tees enclose check valves; the dummy furnace door is pasted onto the firebrick cladding.

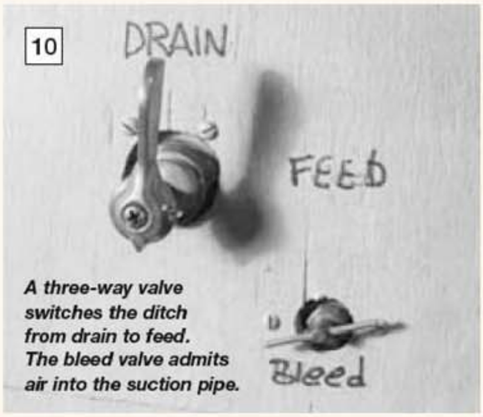


The boiler fittings include try cocks, a dead weight safety valve, and combination steam outlet and feed line.

A propane bottle at the rear of the cabinet feeds a small burner at a pressure of about 5psi.

9

At the top of the cabinet the cistern spills into a 'ditch' which drains back into the 'sump'.

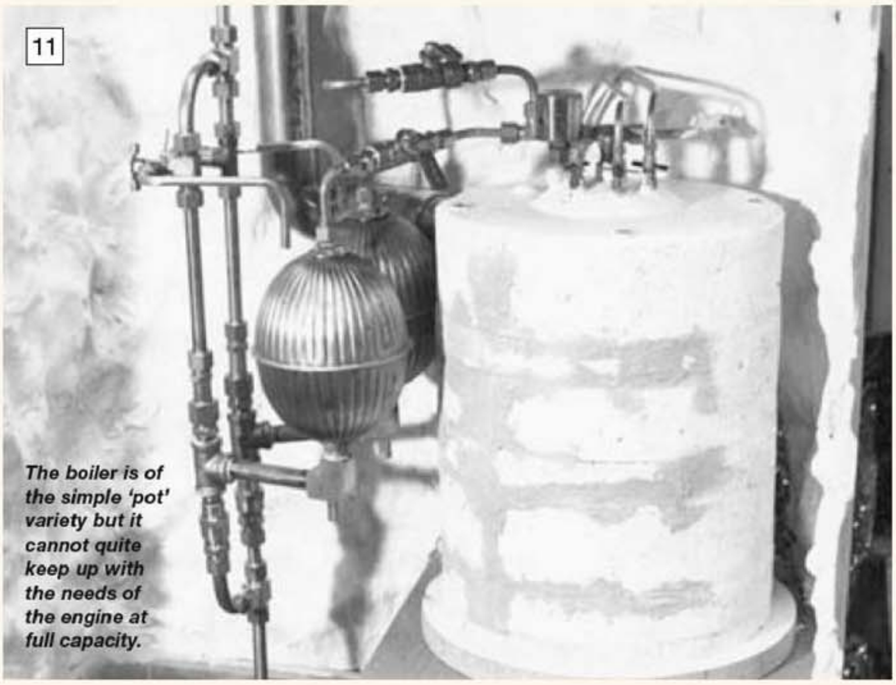


10

A three-way valve switches the ditch from drain to feed. The bleed valve admits air into the suction pipe.

Figure 3

The Pulsometer, a direct descendant of the Savery pump, is self-contained, automatic in operation, and useful in pumping fluids containing matter which would clog the valves of ordinary pumps.



11

The boiler is of the simple 'pot' variety but it cannot quite keep up with the needs of the engine at full capacity.

(**photo 8**). The burner came from a small water heater and is barely enough to maintain a steam pressure of 5psi when the pump is working at capacity. The collection tray at the 'surface' is decorated to resemble a ditch for the water to empty (**photo 9**). The drain goes directly back to the mine sump but with a three-way valve for the boiler to be fed from the ditch (**photo 10**). The boiler casing is made from a lightweight 2300deg.F fire brick which is easily cut and glues together nicely with kiln cement (**photo 11**). There are two baffles in the casing to direct the gases on their way to the chimney.

Savery had a clever way to feed the boiler. You may notice from fig 2 that there looks to be two boilers. The main boiler (on the right) fed the engine, the water being boiled away as steam was used. While the engines were running, the fireman stoked the smaller boiler to a pressure greater than that of the main boiler. At that point a valve was opened which fed from the bottom of the feed boiler to the bottom of the main boiler thus supplying it with hot water and refilling it. This accomplished, the fireman let down the fire in the feed boiler and refilled it with cold water from a cistern in the delivery pipe. When filled, he rebuilt the fire and brought the pressure up past that of the main boiler and the cycle was repeated. In this way, there was never any let-down in pressure or temperature in the boiler due to feeding. It is probable that *"he did better than he knowed."*

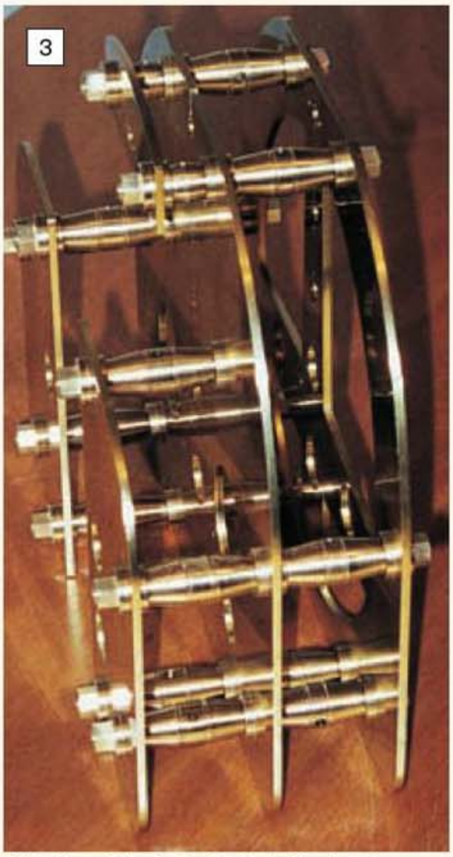
The model had only a 12in. draw and condensation was sufficiently complete to entirely fill the receiver vessel. Steam entering the vessel was immediately condensed and no pressure would develop to pump the water out until the water became hot enough so that it no longer condensed the steam. Of course, this was not the way the Savery pump worked and would not do for the model. At this point, I almost gave up the project. A model of the Savery engine would not work!

In the engine built by Savery in 1698, the draw was enough so that the vessel would not completely fill. There was always space above the water, either a vacuum or air which had leaked into the system To make the model work, it was necessary to find some way to leave a space above the water. An experiment was tried involving the fitting of a hose to the suction line and withdrawing it from the sump before the receiver was filled; it worked. The steam began to pump the water out immediately. There was hope to save the model if some simple way could be found to introduce enough air so that the vessel did not completely fill.

To accomplish this, a bleed pipe was inserted into the bottom of the suction pipe and the valve on the bleed pipe was closed until an optimum air space was supplied. Vacuum in the vessel was of the order of 25in. mercury and the valve had to be almost completely closed before water in the vessel came close to its capacity. A mock-up of the bleed valve can be seen in photo 1. As finished, the valve was mounted remotely (photo 10).

Bleed air was used by subsequent makers of the Savery type engine to furnish a heat barrier between the steam and the water. Keir, in his engine of 1793, deliberately let air into the pumping vessel. (*A Steam Chimea, Transaction of the Newcomen Society*, 1986-87) Further study also revealed that the Pulsometer (**fig 3**) had a deliberate air bleed to furnish a layer of air between the water and the steam.

What would I have done differently had I known then what I know now? The $^3/_8$in. drain from the ditch back to the sump is not quite large enough. With the sump working to capacity, the $^3/_8$in. pipe can't carry away the water as fast as the engine pumps. Other than that, the engine is all that can be desired.



Side view of the Author's clock showing the plates assembled with the pillars, nuts and washers described in the accompanying text.

MONTH-GOING REGULATOR CLOCK

Peter Heimann

describes the pillars, nuts and washers before moving on to the wheels.

●*Part II continued from page 532 (M.E. 4183, 29 November 2002)*

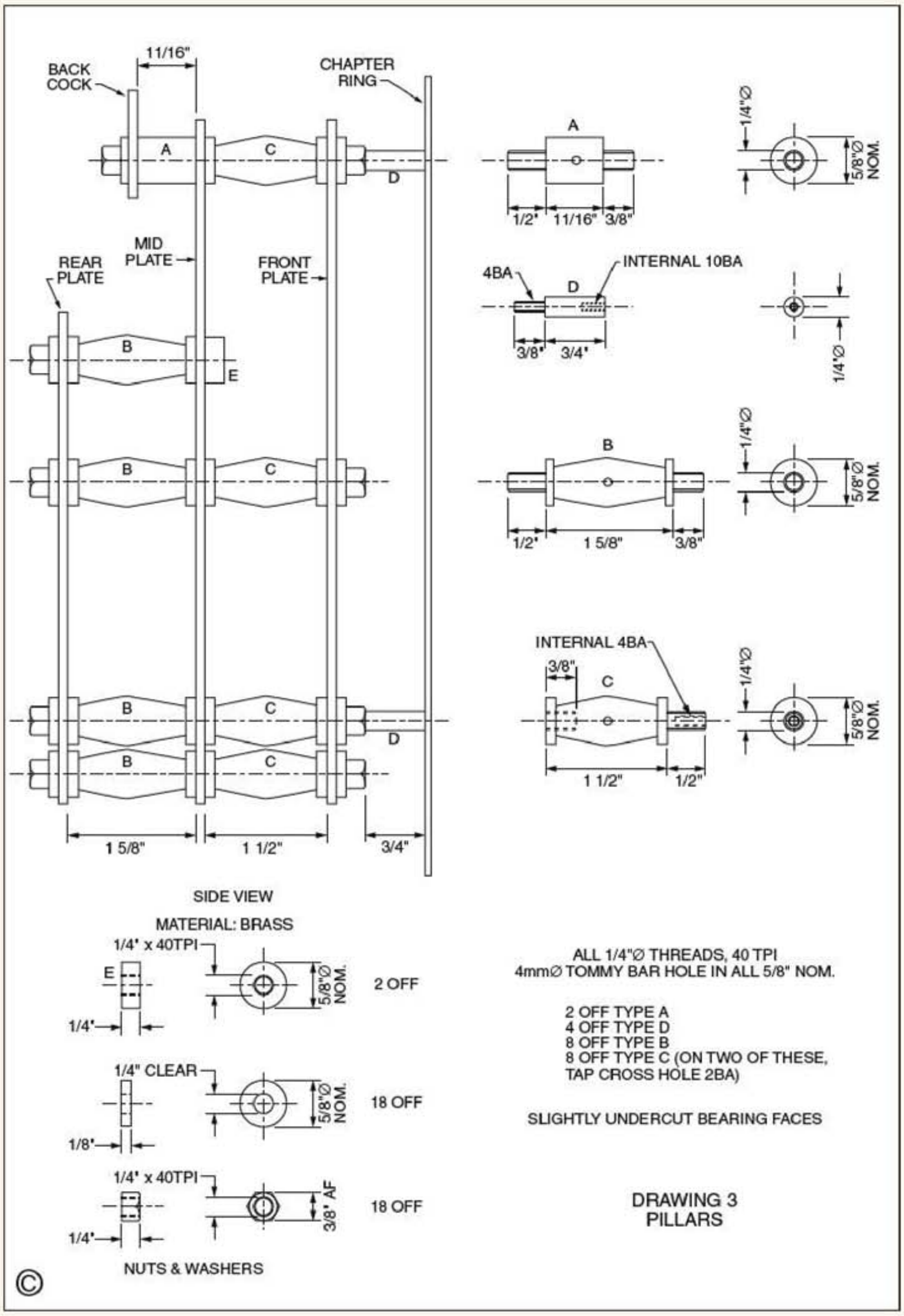
By way of a change, the next phase involves a bit of mass production on the lathe. **Drawing 3** shows all the pillars, nuts and washers that will enable us to assemble the plates into a rigid chassis. Although I have specified brass, mild steel is completely suitable and much cheaper. It would require polishing to a high finish and 'bluing' by heating in special dissolved salts. The choice here is yours, as is the shape of the pillars. However, I advise that you do not make these too fancy and do not increase the 5/8in. diameter. The important point is consistency in length shoulder to shoulder as well as concentricity of the spigots relative to one another.

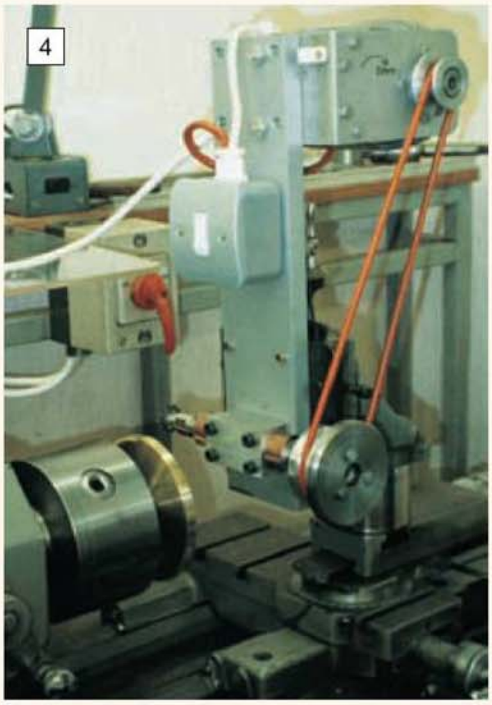
All pillars, with the exception of type 'D', have a 4mm dia. tommy bar hole right through. On the two lowest type 'C' pillars, these holes are also tapped 2BA for locating screws. The faces of the shoulders on all pillars should be slightly undercut to ensure a true fit when clamped. Drawing 3 and **photo 3** show side views of the assembly and how it fits together. The four type 'D' pillars will eventually support the chapter ring. It is important that the bottom edges of the completed chassis are all true and that it will stand on a flat surface without any shakes. If necessary, any slight adjustment should be done now. There is still considerable work to be carried out on the plate assembly at a later stage but at least we now have something to show for our efforts.

Machining methods

Before dealing with the wheels and pinions, I promised to describe my method for machining these. **Photograph 4** shows my own set-up for gear cutting and **photo 5** shows the same rig turned through 90deg. for drilling the pinion spools. The gear blank is mounted on a mandrel and held in the lathe chuck. The pinion spool is held directly in the chuck. My homemade direct division plate is located at the outer end of the lathe mandrel by the usual expanding spigot. As previously mentioned, 120, 96, 90 and 64 hole circles in the plate will cover all the divisions required for this clock.

When gear cutting (photo 4), the motorised 'milling spindle' (also homemade) is fixed to a vertical slide as shown. Vertical movement on this takes care of height adjustment. With the saddle locked, the cross-slide will control centre or offset as required, while the compound slide is used for feed. The wheel shown being cut in the photo is for another clock wheel — 144 teeth and





The Author's milling attachment mounted on the lathe top-slide and arranged for gear cutting.

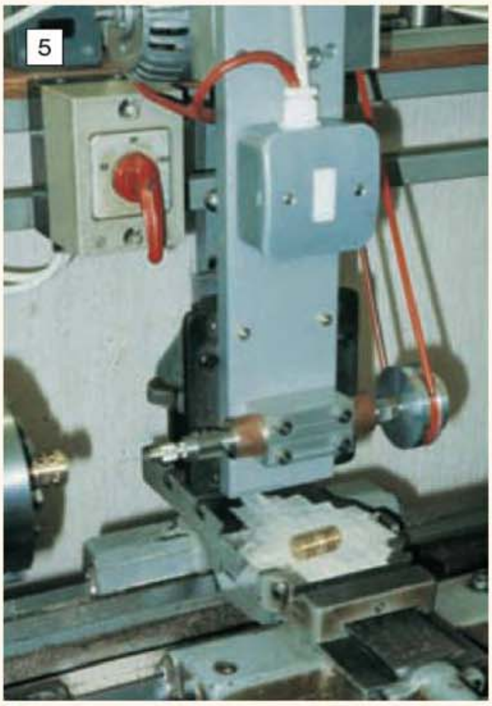
nearly 5in. diameter.

Photograph 5 shows a pinion spool being drilled. Here the top-slide has been removed. Note the temporary covering to keep swarf away from the leadscrew. The vertical slide is bolted directly to the cross-slide table. Feed is by saddle movement. The spindle end is arranged to hold either 3/8in. dia. x 2BA stub mandrels for Thornton gear cutters, or a 3/8in. mandrel for fly cutters. It can also accommodate a 3/8in. shank pin chuck, or even a small Jacobs drill chuck. Its plain bearings are phosphor bronze. With frequent oiling during operation, I have not experienced any problems over many years use.

The nameplate on the Parvalux motor says 1.6A, 1/3HP at 12,800rpm. I cannot vouch for this speed but, within reason, I believe that the higher the better for cutting brass. Of course, there are many other methods, including using a proper wheel cutting engine or mounting the workpiece directly onto a dividing head with the cutter in the lathe or milling machine.

Wheels

Drawing 4 shows all dimensions for the wheels apart from those for the motion work, which we will deal with later. For the escape wheel, a hardened and tempered silver-steel fly cutter has to be made, and we also need a second cutter for the ratchet wheels. These are dimensioned on drawing 4. The other wheels have cycloidal tooth profiles. Here I recommend investing in Thornton wheel cutters. Module 0.8 and module 0.6 are required. These may not be cheap but they will last a lifetime. By co-operating and sharing with other builders, the cost can be minimised. As a point of interest, the pitch circle diameter in millimetres of all wheels is given by the product (number of teeth x module).

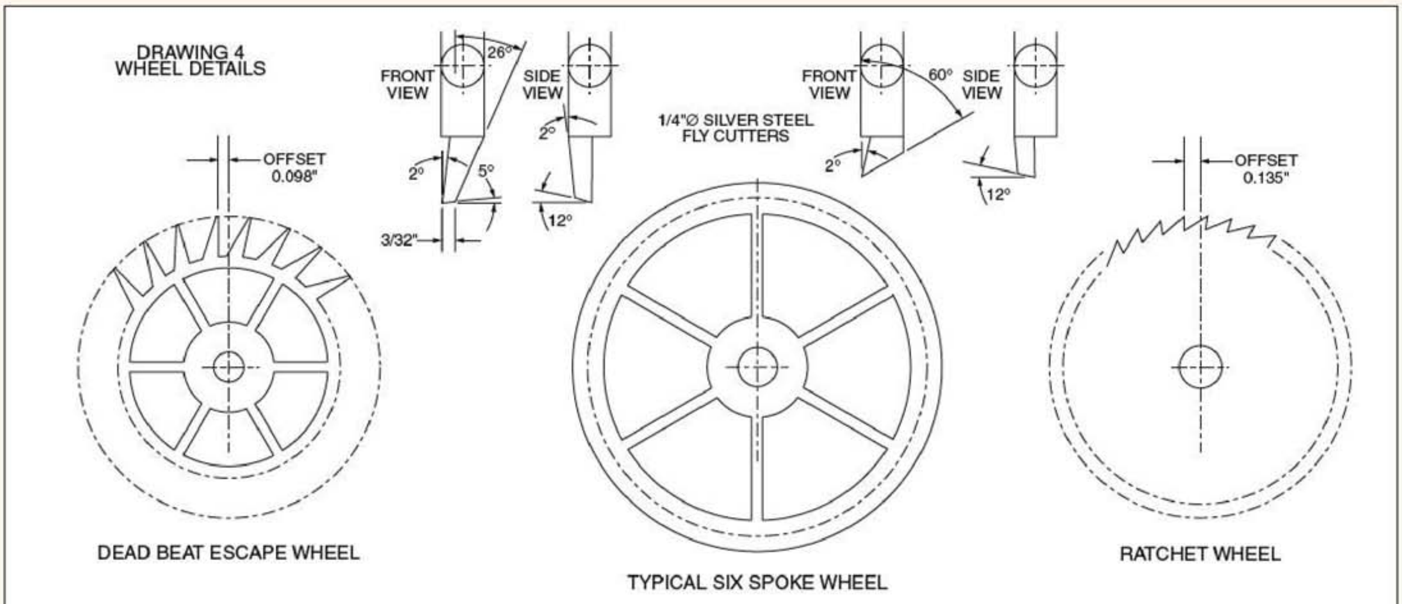


The milling attachment is seen mounted on the lathe cross-slide for pinion spool drilling.

For the blank diameter, one adds on addendum allowance of 2.76 to the number of teeth. So, for example, for a 120 tooth, module 0.8 wheel:

Outer dia. = (120 + 2.76) x 0.8
= 98.208mm
= (98.208 ÷ 25.4)in.
= 3.866in.

Diametrical pitch (DP) = (25.4 ÷ module)



	QUANTITY	P.C.D.	BLANK Ø	THICKNESS	MODULE	OFFSET	NUMBER OF TEETH	BORE	SPOKES (WIDTH)	RIM FROM ROOT OF TEETH	BOSS Ø
GREAT	2 OFF	3.780"	3.866"	3/16"	0.8		120	6mm/1/4"	NONE		
INTERMEDIATE	1 OFF	2.835"	2.900"	1/8"	0.6		120	3/8"	6 x 1/8"	3/16"	15/16"
RATCHET	2 OFF		1.875"	3/16"		0.135"	48	3/8"	NONE		
CENTRE	1 OFF	2.268"	2.333"	1/16"	0.6		96	3/16"	6 x 1/8"	1/8"	5/8"
THIRD	1 OFF	2.126"	2.191"	1/16"	0.6		90	3/16"	6 x 1/16"	5/64"	5/8"
ESCAPE	1 OFF		1.875"	1/16"		0.098"	30	3/16"	6 x 1/16"	1/16"	9/16"

Clearly, all the wheel blanks require a reamed centre hole for mounting on a machining mandrel and, later on, to their collets. The sizes are listed on the drawing under 'bore'. However, the two great wheels will fit directly onto their arbors. You must therefore now determine the size of ball race to be used: eight off, either metric 6 x 18mm or imperial 1/4 x 3/4in. will be required. A telephone call to your local bearing stockists will soon establish the best buy, enabling you to proceed with the preparation of the wheel blanks. At the same time, enquire about the availability of two only races of 3/8 O/D x 1/8in. bore which will be required for the centre arbor. I feel sure there will not be a problem here. However, if a metric race has to be substituted, a 3mm bore size should be chosen. This would affect the bore of the centre lantern pinion which we will discuss presently.

The 3/16in. and 1/8in. thick wheels can be mounted on their respective specially made mandrels for machining with a somewhat smaller backing washer behind. The 1/16in. thick blanks are best backed by a full diameter hardwood or plywood disc machined at the same time as the outer diameter of the blank.

This precaution is particularly important for the rather delicate escape wheel. The cycloidal teeth are cut so that the 'gothic arch' tips leave no witness but also that the outside diameter of the wheel remains full blank size. The trick is to very gradually lower the cutter on adjoining teeth till the witness just disappears, but no more. One can then lock and proceed right round the wheel in the knowledge that the PCD will also be correct.

Obviously, with ordinary wheels it is vital that the cutter is set truly on the centre line. When cutting the ratchet wheel, the very tip of the fly cutter is *deliberately* offset 0.135in. from the centre line; when cutting the escape wheel teeth an offset of 0.098in. is introduced, as per drawing 4. On the escape wheel, which clearly performs a very different function to the other wheels, we in fact want a witness on the tips of approximately 0.010in., to avoid the pallet impulse faces sliding across a knife-edge.

I have allowed for a spare blank in the material list and suggest that, when turning the outside diameter of 1.875in., two blanks are mounted on the mandrel. One of these is then removed while experimenting with depths to achieve the desired witness at the tips. When satisfied, the pristine blank is substituted and cut in one pass only. In my experience, a cleaner and truer shape is produced in one full depth pass rather than by having two bites at the cherry. Obviously, on all wheels, any burrs on the outside of the cuts are removed by rubbing on fine wet and dry paper on a flat surface but, on no account, be tempted to show a file to any teeth on new wheels.

Crossing out

Only the intermediate, the centre, the third and the escape wheel require crossing out to the six spoke design shown. Coat one surface of the wheels with layout blue but avoid, as much as possible, getting this into the teeth. Fix a block of square metal into the tool post on the lathe and drill and ream a 3/16in. hole right through lengthwise. Make a 3/16in. hardened silver-steel scriber with an accurate point to be a sliding fit in the block. Use the dividing setup and the same wheel mandrels for the workpiece. On the 1/8in. spoke width insert 1/16in. packing under the block and, with slight finger pressure on the scriber set 90deg. to the face of the wheel, mark right across six times with the cross-slide. Likewise, for 1/16in. wide spokes, use 1/32in. packing.

Obviously, the circumference of the boss and that of the rim are marked by turning the chuck by hand against the scriber point. Crossing out for such a small number of wheels is best done by hand using a piercing saw. Have the teeth of the blade facing towards the closed end of the saw frame so that you are cutting down the line towards yourself. The wood table, with a generous 'V' opening, should be clamped to the bench at a comfortable height. Personally, I mount this on an upright gripped in the bench vice, so that I can work standing up.

In the olden days, there were specialists in the trade who spent their entire days just crossing out clock wheels. Needless to say, they became so accurate at sawing that there was little filing to do afterwards. You won't quite reach that standard so obtain good quality files, 'crossing out', '3-square (triangular)', 'barrette' and 'knife'. Do not be averse to grinding safe edges on these where necessary.

Incidentally, for entering the saw blade only one hole of, say 5/64in. dia. in each segment need be removed. Drill these freehand away from the edges and corners. The operation is not as tedious as it sounds and really is worth doing well with all edges nicely finished and burnished. Remember that this is a skeleton clock where the wheels are an important feature and in full view.

Goodacre Engraving Ltd.

Buckinghamshire reader Roger Casle-Smith has written to inform us that the information supplied in Part I of this series for Goodacre Engraving Ltd. is no longer valid. Builders should note that the current address for this company is The Dial House, 120 Main Street, Sutton Bonington, Leicestershire LE12 5PF; tel: 01509-673082.

●*To be continued.*

FOR YOUR BOOKSHELF

Building Stirling 1
A One Piston Hot Air Engine
by E. T. (Ted) Warbrooke
ISBN 0-9536523-4-3
£7.20 post paid (UK) from
Camden Miniature Steam Services

Attend any exhibition, rally or other event at which hot air engines are on show and you may be certain that the display will be well patronised by interested visitors of all ages and abilities. The builders of these intriguing power plants are enthusiastic and invariably pleased to discuss their fascinating engines with those seeking explanations.

Many versions, types and varieties of hot air engine have been devised and their construction described in the pages of this magazine and elsewhere. *Stirling 1* is a most unusual hot air engine in that it requires no displacer and runs with a single piston. So far as we are aware, discussions concerning its method of operation have not yet reached a conclusion but this does not detract from the fact that it does work, and works well.

With so few moving parts — just a piston and connecting rod, crankshaft and flywheel, *Stirling 1* could be one of the simplest prime movers. Its construction may therefore suit the newcomer to model engineering who wants something which can be made fairly quickly and which really works when finished.

Ted Warbrooke's book, now available from Camden Miniature Steam Services, sets out in detail and easy stages, the construction of *Stirling 1* with uncomplicated descriptions and clear drawings so that anyone who wishes to do so could build one of these remarkable little engines. The book also shows variations on the theme and offers different layout configurations.

Stirling 1 requires no castings, can be largely made from bits and pieces from the scrap box, and requires only a little simple, accurate turning, some hand work and soldering. Experienced builders and experimenters will doubtless expand and extend the basic design since the possibilities for experimentation are considerable.

Ted Warbrooke's book is a great 'ideas book' for novices and experienced model engineers alike. Paperback, 36 pages, A4 vertical format and printed on good quality coated paper, *Building Stirling 1* by Ted Warbrooke is available from **Camden Miniature Steam Services, Freepost (BA1502) Barrow Farm, Rode, Frome, Somerset BA11 6UB; tel: 01373-830151, fax: 01373-830516; www.camdenmin.co.uk** price £7.20 (UK) post paid.

See also the Camden Miniature Steam Services advertisement on page 628 in this issue.

LETTERS TO A GRANDSON

M. J. H. Ellis

explains why he fell under the spell of the 'Bugatti mystique' before returning to his appreciation of telegraphic transmission systems.

●*Part XLVI continued from page 545 (M.E. 4183, 29 November 2002)*

> ***"The ability to think original thoughts is one of the most valuable, if not the most valued, gifts with which a man may be endowed."***

Dear Adrian, so you think that Grandpa can't catch you with tall stories about Bugatti cars, do you? Well, wise guy, get a load of this! I have written to people who ought to know whether or not grinding in the valves had to start with taking out the rear axle — the Bugatti Trust, at Prescott Hill, Gotherington, near Cheltenham. Their Curator, Richard Day, has been very helpful, and the following is a composite précis of his reply to me, and material which is taken from the Trust's brochure which he kindly sent me.

"In order to grind in the valves of certain Bugatti models, it really was necessary to start by taking out the rear axle. In 1923 Ettore Bugatti patented a new method of constructing an engine. The concept was to produce a single iron casting for a bank of cylinders, and for the main crankshaft bearing caps to be bolted directly to the underside of the casting. As was usual with Bugatti engines, the cylinder head, water jacketing, ports, and plug bosses were also integral parts of the casting. Items such as engine bearers were bolted to the main casting, and the aluminium crankcase was simply an oil container. This arrangement obviated many studs and mating flanges, and saved weight and space."

The disadvantage of difficult access to the upper cylinder area (crankshafts have to be removed before pistons) would not have been thought too serious. Perhaps it even added to the mystique surrounding the marque. However, I was mistaken in one respect. Mr. Day continued:

"Ettore Bugatti (1881-1947) was born in Milan and was Italian. In 1909 he set up a small factory in Molsheim, Alsace, which became part of France at the end of the First World War. There, he invented, designed and produced with awesome variety cars which ranged from his tiny racing car in 1911 to the gran turismo *cars of the 20s and 30s.*

Bugatti was not formally trained in engineering, but all his work is marked by an uncompromising design integrity, allied to a simple and logical use of materials. He described his work as 'thoroughbred'."

Your dad may have his limitations, but he knows a good car when he sees it, and I think that when he next comes to England he should make the effort to visit the Bugatti Trust's permanent exhibition, demonstrating as it does the 'artistry and individuality' which characterise the Bugatti story. If I was disrespectful to him, I now apologise, having fallen under the spell of the 'Bugatti mystique'. As for you, you now have another virtuoso engineer to emulate.

Differential duplex

I don't think that my digression could be called valueless, but in this letter I was supposed to be going on to describe Edison's Differential Duplex. Telegraph engineers were wont to say that whereas the bridge duplex depended on equal potential, the differential duplex worked by means of equal currents. The basic circuit is shown here in **fig 1**.

The operation of this system is even easier to understand than that of the bridge duplex. When neither key is depressed, no battery is connected to line, and no current flows in it.

Suppose that the key at station 'A' is depressed, while that at 'B' remains unoperated. The differential relay 'R' has two identical coils, which we can designate as '1' and '2'. 'C' is an artificial line, or 'compensation circuit' and its resistance is adjusted to be equal to that of the line plus coil 1 of the relay at 'B' and the earth return. The current therefore divides equally between coils 1 and 2 of the relay at 'A', and as the effect of the two coils is equal and opposite, the relay does not operate, and 'A's' sounder makes no signal. At 'B', however, the current flows through coil 1 of the relay, but no current goes through coil 2, which is short-circuited by the back contact of the key. As a result, the relay operates and a marking signal is made by 'B's sounder.

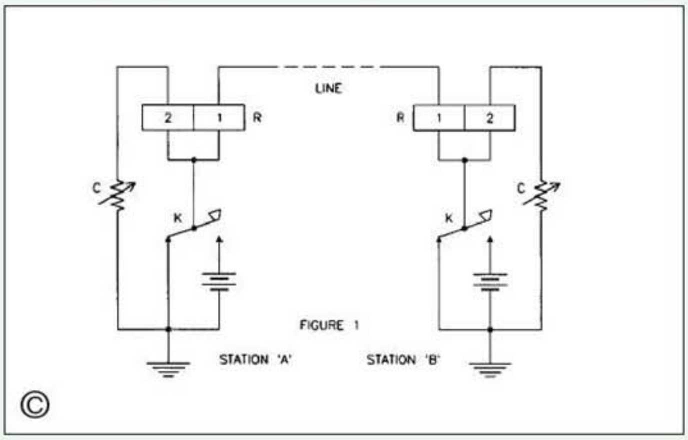
Now we can see how the duplexing works. If both keys are depressed at the same time, a battery is connected to both ends of the line, so that the two batteries balance one another, and no line current flows. Coil 1 of both relays is not energised, but current from the local battery flows through and energises coil 2 of both relays, the circuits being completed via the compensation circuits. Each key, it may be said, makes a marking signal at its own station on behalf of the other.

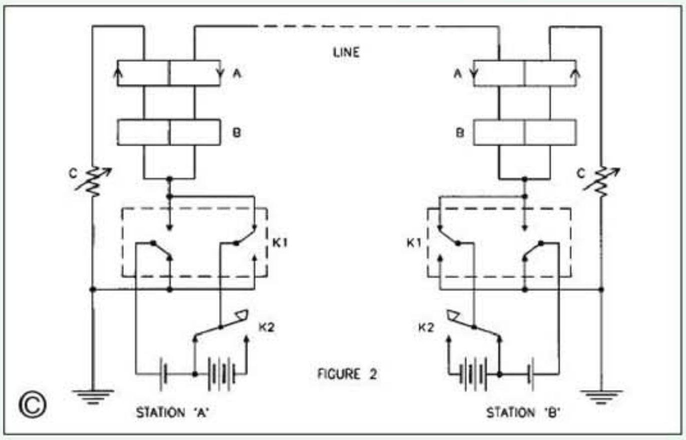
Post Office pattern glass top polarised differential relay and sounder. (Photograph: Author's collection)

Quadruplex

I see no need to say any more on the subject of duplexes, and the ground is now cleared for us to contemplate what Edison is said to have considered the most elegant of all his inventions, the Quadruplex.

Before moving on, however, I would say that with all due respect to their inventors, it surprises me that it took as long as it did to bring the duplex systems to fruition. Bearing in mind the comparative complexity of the now largely superseded electro-mechanical automatic telephone exchanges, the telegraph circuits seem almost childishly simple; just as Watt's separate condenser for the Newcomen engine appeared to me, as





a schoolboy, an 'obvious' improvement. The facts of the matter are, it seems to me, that every generation stands on the shoulders of the preceding one, and the ability to think original thoughts is one of the most valuable, if not the most valued, gifts with which a man may be endowed. Try to cultivate it.

In principle, telegraphy depends on turning a direct current on and off. But when a current is flowing, it has two characteristics, first its direction, secondly, its strength. Edison realised that these two things could be varied independently of one another, and both could be utilised as the means of transmitting a signal. Once the way was found to do this, an already proven system of duplexing could be used for doing it in both directions at the same time.

It was therefore necessary to introduce a key of a different type which would reverse the direction of the current sent to line. The older kind of key, with one back and one front contact, could still be used for augmenting the battery power. On the receiving side, two kinds of relay would also be needed. One of these would be a 'polarised' relay, which would respond to a current (of whatever strength) in one direction, but not to one in the opposite direction. The other would be 'marginal' that is to say, it would not be affected by a weak current, but would operate to the stronger one sent out when the battery power was increased. A further point is, that battery (normally of low power) would have to be connected to line whenever the circuit was open for traffic whether or not any message was in course of transmission. Obviously, you can't reverse the direction of a current if there is no current to reverse.

Figure 2 shows the elements of the Quadruplex. In the British Post Office, the view was held that the battery power used to send a 'strong' current should not be less than three times greater than that required for a 'weak' current.

Embarrassment!

Having come this far, I think it would be better if I defer an explanation of how the circuit works until my next letter. So how can I usefully fill the little space which remains? I have it. Never take what you are told for granted. A friend once asked me to look at his car dynamo, which was not charging. *"Are you sure the belt is not slipping?"* I asked. He assured me that it was tight. Only after I had taken off the generator, tested it, and found all in order, did I realise that he was mistaken. I put the dynamo back, made sure that the belt was tight, and all was well. Apart, that is, from someone having a red face!

Your affectionate Grandpa.

●*To be continued.*

The Author's caliper mounted in place on the head of his mill/drill.

QUILL HEIGHT INDICATOR

Peter Parks

describes a simple and reliable accurate milling machine quill movement indicator.

Several readers have expressed dissatisfaction with the quill indexing on the relatively inexpensive but very popular mill/drill machines. The problem is that the index ring on the quill height control is insufficiently accurate because the ring and its pointer are too far apart and because the ring slips on its mounting. To overcome this problem I fitted a modified dial caliper onto the front of the head of the machine to indicate the rise and fall of the quill.

Readers wishing to carry out this modification may proceed as follows. On the bottom of the quill is a threaded ring which retains a large O-ring that prevents the quill from lifting too far. Mark the edge of this ring central with the front face of the head, i.e. facing towards you. Then unscrew the ring. Caution! It has a left-handed thread.

Next, make up an angle bracket as shown in the accompanying drawing, and drill the two mounting holes 4BA clearance. This is followed by the clamping strip, which will hold the bottom of the caliper height probe. This strip is drilled 4BA clearance and the bracket is drilled and tapped 4BA to suit.

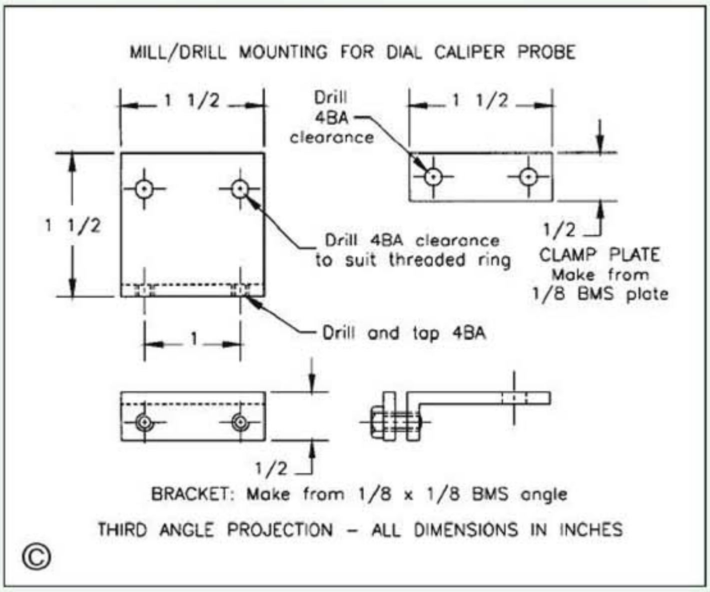
Drill the ring, tap 4BA, and fit the bracket to it. Screw the ring back onto the bottom of the quill and when it is tight, the clamp and bracket should be at the front of the machine.

Next, purchase a 6in. dial caliper and modify it in the following way. Drill a 2BA clearance hole in the fixed jaw as shown in the accompanying photograph. The position is not critical as it serves only to hold the jaw to the head of the machine. Some difficulty may be experienced here as the caliper head is made from hardened stainless steel.

Next drill and tap the casting of the machine 2BA in the position shown in the photograph. Temporarily fit the caliper and mark off the length needed for the clamp to hold the bottom of the depth probe. Saw off the body and probe of the caliper to length. All that remains now is to fit it to the machine. It will then record vertical quill movements as accurately as the caliper is capable. I have no problem milling to an accuracy of 0.001 inch.

I do not disconnect the caliper when the machine is used for drilling, but since only three screws hold it in place, there is no reason why it should not be removed for drilling and then replaced for use in the milling mode.

Dimension may vary with different machines, mine is a very early one which I purchased second-hand. I obtained my caliper from Tracy Tools at 2 Mayor's Avenue, Dartmouth, South Devon TQ6 9NF. It was not expensive!



Whitmore over-wind and over-speed gear (centre left green pillar).

The 'Slow banker' allowed slower winding speeds when hauling men up and down the shaft.

Modified crank to drive valve gear.

Ed Cloutman continues his fascinating account of the rise and fall of a fine steam engine installed in the Rhondda Valley in 1875.

●*Part II continued from page 548 (M.E. 4175, 9 August 2002)*

THE HETTY WINDING ENGINE

Hugh Bramwell, chief engineer of the Great Western Colliery Company and responsible for the Hetty winding engine modernisation programme, designed a drum that would allow the rope to wind back on itself, the first of its type in the UK. A new steam brake by King of Nailsworth, Gloucester was installed and Whitmore patent over-wind and over-speed gear made by Fraser and Chalmers of Erith, Kent — this is the vertical green pillar seen in the centre left of **photo 10**. A 'slow banker' (**photo 11**), was also installed. This was coupled to the over-wind and over-speed gear so that the latter could operate at the slower winding speeds required when winding men up and down the shaft. The modifications required the valve gear and eccentrics to be moved outboard of the main cranks, hence the need for the separate cranks to drive them (**photo 12**).

The Hetty engine continued in this modified form for a further 21 years, raising some 5,000,000 tons of coal, but its life as a coal winder ended in 1926 when movement of the geological strata caused a 'kink' in the Hetty and the adjacent No. 2 shaft. A new shaft had to be sunk about 1/4 mile away and the new workings became the Ty Mawr colliery. The new workings were linked to the old, and the Hetty shaft became an emergency shaft. The new Ty Mawr pit was completely electrified, thus it was not economic to keep the large boilers in steam solely for the Hetty engine, nor was it worth replacing the engine with electric winders. So the Hetty engine was converted to run on compressed air, which required no mechanical alterations, only the use of thinner oil.

The Hetty engine continued for the next 60 years until the closure of the Ty Mawr colliery in 1983. It was run a few times each day and regularly maintained. Bright metal parts began to rust since the conversion from steam to compressed air so they were painted in Great Western locomotive green and red. Part of the engine was repainted in the 1970s in a lighter shade of green and red, the colour that is seen in the accompanying photographs.

One of the most interesting features of this engine is that when modifications took place, the original gear was disconnected and left in place. Thus a more or less complete record of the engine's history is present. For example, two governors remain, each from a different era, and the remains of the 1928 electric bell signalling system and the previous mechanical hammer-and-plate signals are present. Replacing the Whitmore over-wind and over-speed gear is a 'Lilly' controller (**photo 13**) which is coupled to the steam brake via a solenoid. This upgrade was carried out in the 1950s.

The present condition of the engine house can be seen in **photo 14** with the pit head gear still intact. In front of the engine house is the fan duct-

This 'Lilly' controller was installed in the 1950s and replaced the Whitmore over-wind and over-speed gear.

The Engine house as it appears today.

Twin cylinder steam driven capstan engine.

ing which ventilated the workings. The Hetty shaft acted as an up-cast ventilator, using a Sirocco fan to draw air up the shaft and out of the workings.

On the way up to the engine house, you pass the old capstan engine (**photo 15**). This twin cylinder steam engine was used to raise and lower cages or equipment during maintenance of the shaft. This type of engine was also used during shaft sinking, but this engine is thought to be of about 1900 vintage.

Once inside the engine house you can see the more recent panel of interlocking safety switches and indicator lights (**photo 16**) and the driving platform (**photo 17**) with the maker's name clearly visible, cast into the frame. The beautiful cast steps, leading to the platform can be seen in **photo 18**, and the two main controls in **photo 19**. The lever on the right is the reverser, and on the left is the regulator which is coupled to the main steam valve (**photo 20**) located immediately beneath the platform. The drum brake pedal can just be seen at the bottom of the photograph. **Photographs 21** and **22** show details of the cross-head and mechanical lubricator, respectively. Another feature of interest is that in the 1970s, parts of the engine had to be crack-tested, and this can be identified by the white paint seen on some of the parts, such as the bracket which holds the cage indicator mechanism (photo 11).

The engine is well worth a visit and you can be sure of a friendly and informative reception from Brian and his volunteers. You can visit the engine by contacting Brian at Pontypridd Museum on 01443-490748. On certain days the engine is run on compressed air, and hopefully, in the future, a boiler will be installed, allowing steam operation.

●*To be continued.*

Safety switches and indicator light panel.

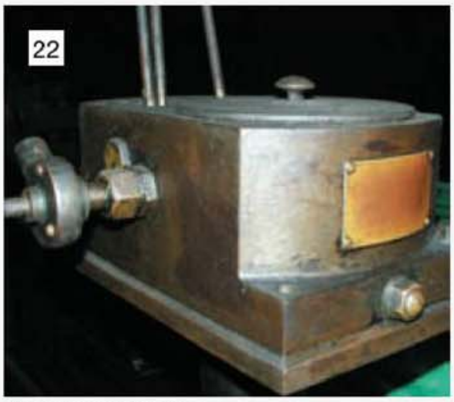
Driving platform with cast maker's name.

Cast-iron steps to driving platform.

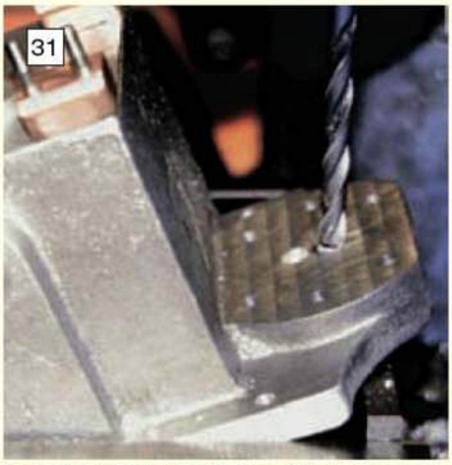
Regulator, reverser and brake controls.

Main steam valve beneath platform.

Cross-head detail.



Mechanical lubricator.



Twin air inlet/outlet ports were drilled at an angle to the base as discussed in the accompanying text. Note the A-frame raiser with its stainless steel studs; all four have been fitted.

The cast iron cylinder liner as delivered. The large protrusion on the base was the remains of the pouring sprue which was cut off with a hacksaw before machining started.

The set up used to machine the base of the power cylinder flat. The large diameter revolving tailstock centre sits in a 60deg. chamfer filed into the bore as described in the text.

A HEINRICI HOT AIR ENGINE

Mike Thurgood in South Africa, finishes the body and starts on the power cylinder.

●*Part VI continued from page 541 (M.E. 4183, 29 November 2002)*

Up to this stage the air ports to the power cylinder (see fig 5, p329 *M.E.* 4179, 4 October 2002) had not been drilled into the transverse air passage, the latter having been drilled previously. Although it is convenient to introduce this task at this point, it should be noted that it is not in the original chronological sequence.

The body was set at an angle of 25deg. on the mill/drill table for drilling through (**photo 31**). Why at an angle and why drill two holes when the drawing shows only one? Well, there was no more significance in this than my thoughts which eventually converged on the possibility that both features might assist with the back-and-forth flow of air into the power cylinder.

Two holes could be drilled in line, of course, to increase the gas transfer area. There was nothing to be gained by drilling one hole larger than the diameter of the transverse hole. In the event, I have no answer as to whether what I did was advantageous, not having any control against which to make any comparison.

Power cylinder

Next came the cast iron power cylinder, which is shown in the as-received state in **photo 32**. What I chose to do next is most likely reflecting a purely personal idiosyncrasy, but at least it worked for me. In order to machine the bore, I needed to clean up the base of this casting so that it would sit perpendicular on the mill/drill table.

I found that I could get a satisfactory mounting in the lathe to machine the base by a combination of holding the head of the casting in a 3-jaw, self-centring chuck and, by judicious filing, fitting a large diameter revolving lathe centre into the bore. Filing was continued until the casting was 'acceptably concentric'. **Photograph 33** shows the casting as mounted, and its machined base can be seen in **photo 34** on which the residual ridge stands out clearly; obviously I could not machine right up to the tailstock centre. However, this did not present a problem here because the ridge was smaller in diameter than the finished bore and which therefore disappeared as boring progressed.

Perhaps I should explain what I consider to be 'acceptably concentric'. Only under extremely carefully controlled conditions are castings really accurate. A particular pattern may be truly cylindrical when made but, by the time it has been split centrally, holes drilled and pegs fitted, this may no longer be the case.

Castings made using sand moulds are not always truly round. For example, differences in the homogeneity of the mould sand and variations in its dampness can result in differential flow rates for the metal during pouring, accompanied by differential cooling. These are some of the factors that can result in cylindrical castings being uneven.

There are also other factors, commonly associated with the join between the two halves of cylindrical patterns. For example, the two halves of the pattern may not be perfectly aligned, even with their locating spigots, so that the two halves of the mould do not match perfectly. Possibly the core in the casting may not have been placed truly concentric to the outer diameter. Bearing these factors in mind when setting up a casting, achieving the most concentric mounting becomes an exercise in compromise. The power cylinder casting was a case in point: its base was well cast, but it did tend to run out somewhat at its top.

I would not wish these comments be interpreted as a criticism of the numerous suppliers of castings for our models and accessories, without whom we would have really serious problems on our hands. Making castings is a very tricky art. To make absolutely flawless, consistent castings is well nigh impossible except under the most stringently controlled conditions and, for which purpose, totally flawless patterns are essential. But they would then be extremely expensive. No, I most certainly am not criticising our suppliers, I am only offering my comments as they relate to what I have actually found in practice with numerous castings imported from the UK over the years.

I should add that, so far, I have never come across one which I had to reject for being too far out of shape, or for having a serious flaw. In any case our suppliers are generally only too willing to replace a casting that is found to have one or more serious flaws such as blow hole voids or porosity.

Photograph 35 shows the power cylinder casting mounted on the mill/drill table set for machining the bore. It was raised up on 3mm thick brass plates to permit the boring tool to emerge from the bottom face of the cylinder. I machined the bore to a slightly larger diameter than that shown on the original drawing. In fact, I worked to the largest diameter that could be safely accommodated with the wall thickness available, and taking into account the maximum piston diameter that could be machined from the supplied casting. The bore was then finished by honing.

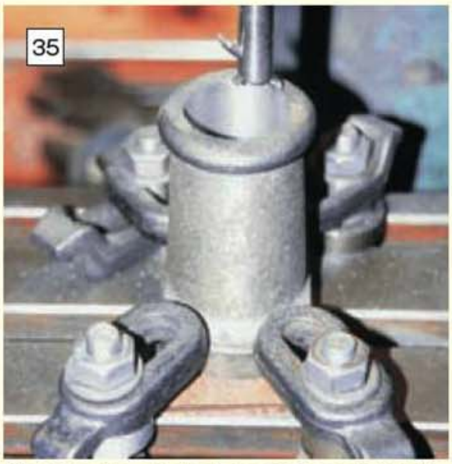
This is a typical situation where a specific dimension given on a drawing is not a critical one. I am sure that the engine did not really mind its power cylinder being slightly larger! In any case, both the displacer cylinder and piston were 3mm larger in diameter than shown on the original drawing, as was dictated by the tube diameters available, so here was some compensation for that change to the design.

When this task was finished, the top surface of the power cylinder needed to be squared off. This was partly to make it look tidy but, principally, because the cylinder later needed to be remounted upside down on the mill/drill table to drill and tap its six 4 BA mounting holes.

Squaring off this surface considerably facilitated true vertical mounting in a machine vice, particularly as the cylinder is tapered; i.e. it has the form of a truncated cone. This task was completed in the lathe, mounting the cylinder bore on a turned aluminium alloy mandrel machined to give a light interference fit. The power cylinder casting was then 'wrung' on to this mandrel for the relatively light turning operation to be carried out. The mandrel can just be discerned in the chuck jaws in **photo 36**.

The cylinder was then removed from the mandrel and remounted upside down in a machine vice on the mill/drill table for drilling and

The casting after facing the base. The ridge left adjacent to the chamfer was removed by the subsequent boring operation (see text).



Machining the cylinder bore which was finished by honing (see text). Note the packing to lift the casting clear of the mill/ drill table.

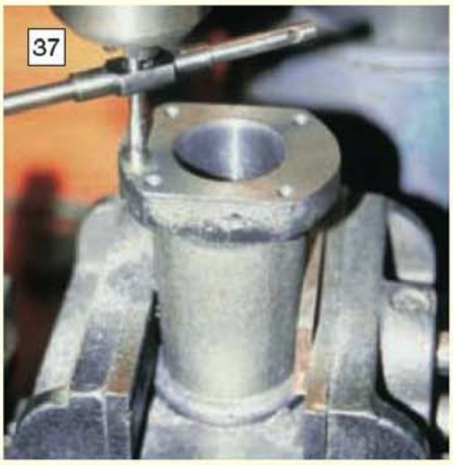
A carbide tool was used to face the cylinder top surface with the casting wrung onto a mandrel finshed in the 3-jaw chuck (see text).

tapping the mounting holes (**photo 37**). But before actually starting on this task some thought had to be given on the best way to mount the cylinder on its register surface on the body casting.

The original Westbury drawing for the model shows only two mounting studs, which are screwed up from underneath the body casting. I considered the possibility of screwing down through the cast iron cylinder flange into the aluminium alloy body; all six mounting screws would thereby be accessible. However, I rejected this idea as being impracticable with the limited flange width available on the former part and effective inaccessibility of the tooling past the top flange and along the length of the casting for drilling and counterboring through the bottom flange.

But I was concerned that two mounting studs would not be inadequate, the main reason being my intention was to use a thin (0.75mm) Klingerite gasket between the mating faces of the aluminium alloy body and cast iron power cylinder to provide a good gas seal. This gasket also contributes towards good thermal insulation and prevents too much heat being conducted from the aluminium alloy body into the power piston at temperature equilibrium, not that this would really have created any running problems.

But on the matter of the running temperature of the power cylinder I found, in the case of the Robinson hot air engine, that it runs most efficiently when the former is fairly warm. However, it does not get excessively hot.



The mill/ drill was used to drill and tap the six bottom flange mounting holes.

When I attached the Robinson power cylinder to its 'entablature', i.e. the combined water jacket and mounting casting, I used a Klingerite gasket at the joint, although there was no mention in Alyn Foundry's construction notes that this was required or even necessary. But, because it worked in this case, I decided to use a gasket with the Heinrici engine. Certainly the brilliant performance of the latter did not indicate that the gasket had been a mistake. But I have no control against which to make any comparison. Maybe without it would have run super-brilliantly!

There was also another thought with the Heinrici engine. Whereas the power cylinder and mounting entablature for the Robinson are both cast iron, in the Heinrici the former is cast iron and the latter aluminium alloy. Suppose there was a possibility of metal warping due to the temperature gradients and differential expansion? So, with this in mind, I decided to drill and tap *six* mounting holes in the bottom flange of the power cylinder, the fifth hole of a total of six is shown being tapped in photo 37.

As I have already mentioned, two of these mounting screws are not accessible for checking their tightness once the assembly is mounted on the firebox/stand, but I had to accept this as a minor disadvantage. I can only hope that the apparent soundness of this arrangement is borne out in practice.

●*To be continued.*

SHAPER ALIGNMENT

Checking that the vice jaws are parallel to the shaper ram axis.

The shaping machine is almost extinct in industry and has also ceased to be popular in the amateur's workshop. For this reason I hesitate before offering this tip. However, there may be a few fellow shaping machine enthusiasts out there to make it worthwhile — in any case I have not seen this idea in print before.

One of the chores all shaping machine users must perform from time to time is realigning the vice jaws with the ram axis. This is done by running a dial indicator along a parallel held in the vice. However it is not easy to find room for a 'clock' and its associated paraphernalia on the traditional shaper clapper box set up. Years ago I made a tool clamp piece with an integral 1/4in. dia. rod. A Verdict indicator slips straight onto this without disturbing the tool or anything else on the machine. The top hat shape of the clamp piece stops it falling out of the lantern tool post when a tool change is required. No drawings of this device are offered as it must be adapted to suit the reader's own machine. *Neil Read.*

Dismantled tool clamp piece showing the rod for the dti and its clamping arrangements.

The station area of Palmerston North MEC during the 2002 MEANZ Convention. On the left David Giles offers some advice to a guest driver of his yellow 'Phantom', on the right Ross Nicholls prepares to drive off behind Old Eli.

NEW ZEALAND UPDATE

Alan Bibby brings us another glimpse of model engineering on the other side of the world.

●*Part I*

Once again, our roving reporter attended the biennial gathering of the Model Engineers' Association of New Zealand in January 2002 and took the opportunity to visit a number of other clubs and places and people of interest throughout the country, including a man who is building a Stuart beam engine in remote Stewart Island with its population of 390 souls and an hour by catamaran south of South Island.

This year the convention, named MODEX 2002, was hosted by Palmerston North Model Engineering Club at their Marriner Reserve Railway tracksite half a mile out of the university city of Palmerston North. The site is smaller than other sites hosting the convention in recent years but is attractively laid out in a public park or reserve and offers 465 metres of 3½, 5 and 7¼in. track in a folded figure of eight configuration with excellent steaming bay facilities, turntable and off-loading arrangements.

MEANZ conventions usually include an exhibition of models and this was no exception: on this occasion the exhibition was mounted in the Science Centre in the city, organised very capably by Bruce Geange on behalf of the host club in conjunction with Science Centre staff. The exhibition was of excellent quality covering locomotives and rolling stock in various gauges, traction engines, stationary, portable, marine and aero engines, boats, tools, and other equipment.

The club is currently developing plans for a ground level track on a big new development at the Agricultural and Pastoral Showground a few blocks from their present site, and is hoping to host the 2006 MEANZ Convention. When completed, the new site will be one of the best in New Zealand.

Steam Tractor Challenge

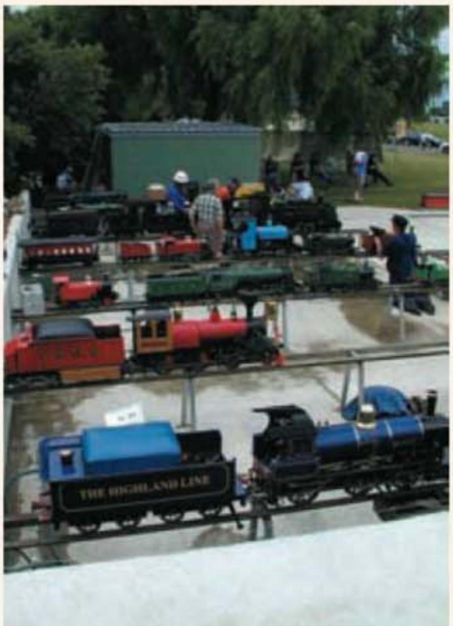
During the previous convention a challenge was thrown out to clubs to construct a working steam tractor using castings supplied and conforming to a defined set of rules. No less than 15 clubs responded to the challenge including two (both from the USA and involving some collusion, we understand) who built their tractors as hot air engines. Other variations on the theme included a showman's engine and a three wheeler. Judging was done under six headings: effort, compliance, aesthetics, ingenuity, performance and endurance. Marks were awarded under each heading and the overall first place went to the Hawkes Bay club for their 3-wheeler. The booby prize for the runt of the pack was a spade to bury it with; rather unkind, we thought!

●*To be continued.*

Canterbury SMEE's new club loco, a BR 08 diesel shunter, employs a novel transmission using 'V' belts, not unlike the old Myford Tri-Leva mechanism with some refinements including the provision of forward and reverse gear and braking. Motive power is a Briggs and Stratton 4-stroke petrol engine with centrifugal clutch.

Old Eli, *a Phantom recently completed by Ross Nicholls, was awarded the Phantom trophy sponsored by designer David Giles. As David said, "a Phantom only looks like that once in its lifetime; when it is fresh from the workshop and steamed for the first time". It took Ross five years to build* Old Eli.

Peter Jones' Owain Glyndwr (Maidstone club) was awarded the MBM prize for 'Best in Show', chosen by popular ballot.



The steaming bays at Palmerston North MEC's Marriner Reserve Railway, host to the 2002 MEANZ convention.

Rowan Little and Mike Orange look on as Jim Woods of Dunedin fettles his 5in. gauge Beyer Peacock 2-4-0 Mona of the Isle of Man Railways.

Above: a selection of the fifteen models entered in the Steam Tractor Chellange, won this year by the Hawkes Bay club.

Right: this tiny donkey pump, seen in the exhibition, probably went unnoticed by many. Very nicely made, it is of the two-cylinder type with the piston rod of one side operating the valve rod of the other. Although difficult to photograph under glass, the quality of the workmanship is clear enough. Now owned by Bruce Geange, the pump was made by Don Sanders.

Another example of the Phantom design; this one is owned and built by Ken McIntyre and named Southern Belle. Here we see inside the cockpit; simpler than the Eurofighter maybe, but not much! Ken hails from Blenheim.

The Canterbury trophy for best static exhibit was awarded on this occasion to this fine Burrell showman's tractor by Geoff Armistead of the New Plymouth club.

KEITH'S COLUMN

LOGGER & SLOGGER

AMERICAN TYPE 2-8-2 LOCOMOTIVES for 5in. and 7¹/₄in. gauges

Keith Wilson
discusses pony truck side control and other matters of interest.

●*Part XXII continued from page 551. (M.E. 4183, 29 November 2002)*

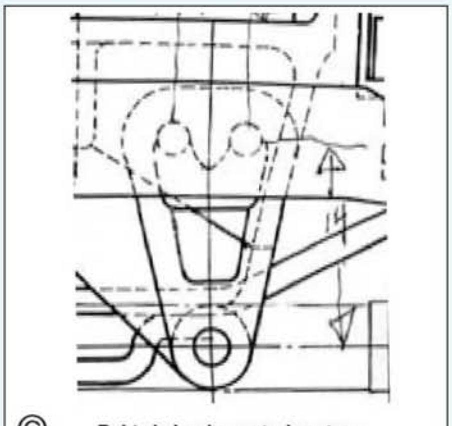
The task of getting details nearly right for these designs is proving very difficult in some aspects, for the Baldwin assembly drawings are somewhat sketchy (understatement) and deciding exactly how they were made is just guesswork for some items. Now, I have some very helpful friends 'over there' who are only too willing to visit the prototype and report back, but it is still a tricky, time-consuming process and you will realise that time, tide, and publishing deadlines wait for no man.

So there are not many parts to make this time, but I hope to get a lot more ready for the next article.

The two lifting levers present no problems, but there is a minor drawing error on them, which I noticed after (naturally!) posting off the said drawings. It will not affect manufacture however but may cause the odd raised eyebrow; it is the broken line at the right-hand end of the drawing of the lifting lever. I put it in thinking that a boss on the big end was advisable. If you want to put one in and then reduce thickness of the rest of the lever then it's up to you, but I cannot see any sign of such on the numerous photographs kindly e-mailed by the above-mentioned friends. If they are reamed to size and the shaft ends made to match, a press fit is ideal, then said press fit plus a pin should prove adequate. If preferred, silver-brazing the joint is excellent, but don't forget to put the weighshaft lever on before completing the operation!

This lever is intentionally drawn a bit longer than required for it has to be joggled. I do not know by how much, for although it shows quite clearly as such in photographs, how much is another matter and at present I cannot answer this question.

I have drawn the bearings fairly close to the original, but they are probably easier made from chunks of brass, held to their frameworks by studs rather than bolts and nuts as per original. In case it is not obvious, they are half-bearings or cap bearings. An exceptionally fine fit on the shaft is not required. If cut from solid, then be blowed to the fillet-work 'twixt base and bearing.



© Baldwin bogie control system

Pony truck side control

My 'Over The Pond' friends have looked under the front end, and a certain amount of side control is provided by the swinging link principle. Basically, this means that there is a pair of links under the pony, one to each side. The links are double at one end, (see crude photo of part of Baldwin drawing) and a little thought will explain how it works. I do not believe, however, that it would be of any use in our sizes. I would mention that the picture is of the rear pony truck, it did not necessarily follow that the front was exactly the same but it was certainly likely.

William Dean, one of the Swindon CME giants, used a similar system on many of his bogies, both locomotive and carriage. The famous City class had the bogie attached by 4 swinging links plus a central sliding-block pivot to allow sideways movement but not longitudinal movement. The link pivot points were not vertical in the sideways plane, but were so in the fore-and-aft plane. Look at this rather crude explanatory diagram:

A-A represents the tops of the links, D-D the lower ends. The links themselves are represented by A-D, A-D. If D-D moves sideways relative to A-A, clearly it will tilt downwards towards the opposite side. But if it cannot tilt, then A-A will be forced to tilt the opposite way. Thus it will be seen that the engine will tilt downwards towards the inside of the curve. This in turn produces a certain amount of side control, plus a definite increase of pressure on the outside rail. The advantage of these should be obvious, steering the engine into the curve and reducing the chances of the bogie wheels climbing over the outside rail.

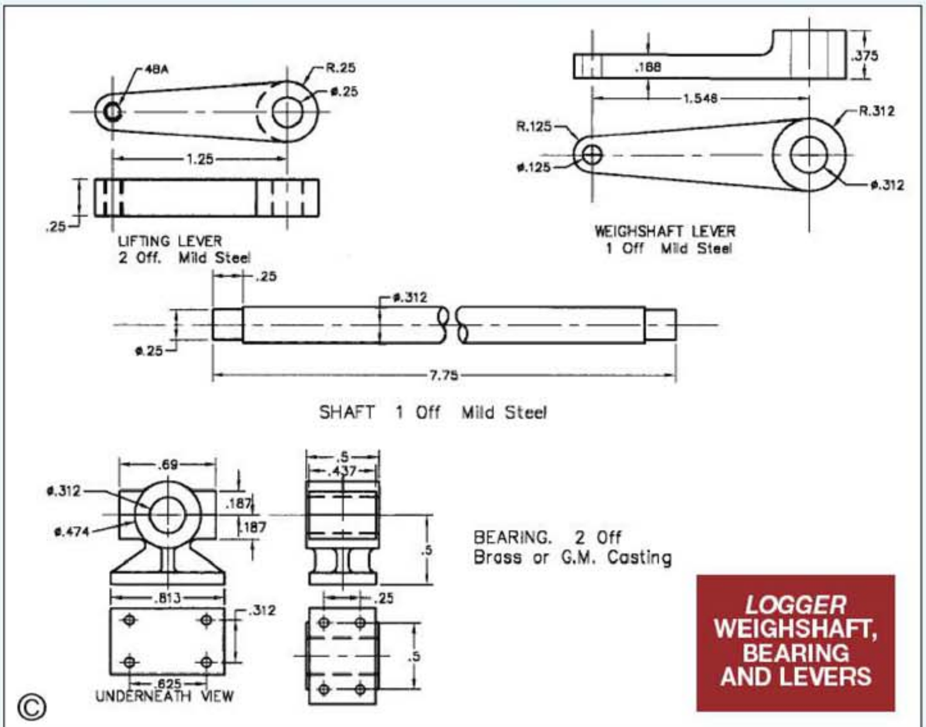
In the case of carriages, so-called centrifugal force will cause the body of the carriage to move outwards, this in turn tilting said carriage inwards and producing the effect of super-elevation. Thus passenger comfort is improved.

Later

By one of those things called coincidences, since writing the above I happened to pick up (from a collection loaned by a friend) a report on *Bogies and Radial Wheel Bases* by one Albert G. Cresser. The report was to the Junior Engineering Society of Swindon. It may therefore be taken with some authority.

Briefly, it confirms what was written above but of course with far more detail.

By good luck my camera managed a reason-



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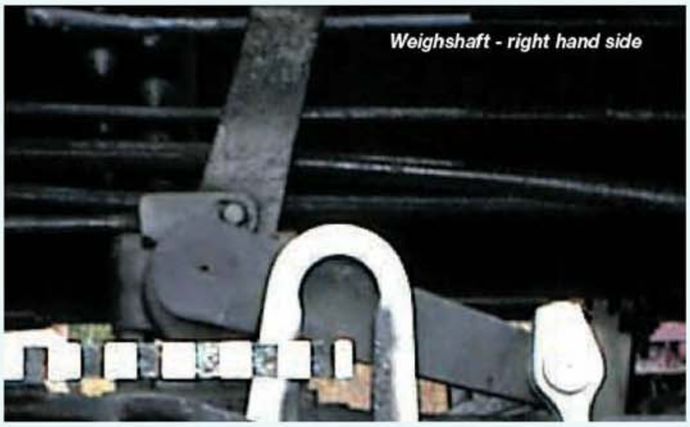


Weighshaft - right hand side

Weighshaft - left hand side

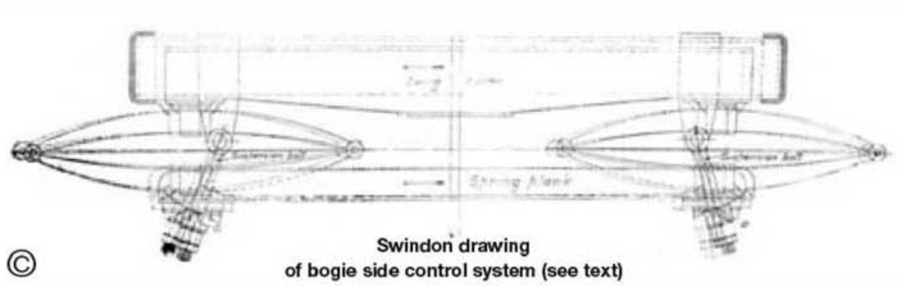
able copy of the diagram, note the basic similarity 'twixt the two.

The two verticals are at steeper angles than might be expected, they are certainly steeper than I recall seeing on the City bogie drawing. The reason is probably that the driving wheels would provide some limiting guidance in the case of the locomotive; this would not apply to carriages. Also, too much tilt would not be appreciated. A point that I missed when writing above was that the shifting sideways must not be sufficient to make the inner 'pivot' pass the vertical, although come to think of it it's obvious — kerrrrunchhh! I have no doubt but that limiting blocks or stops were provided.

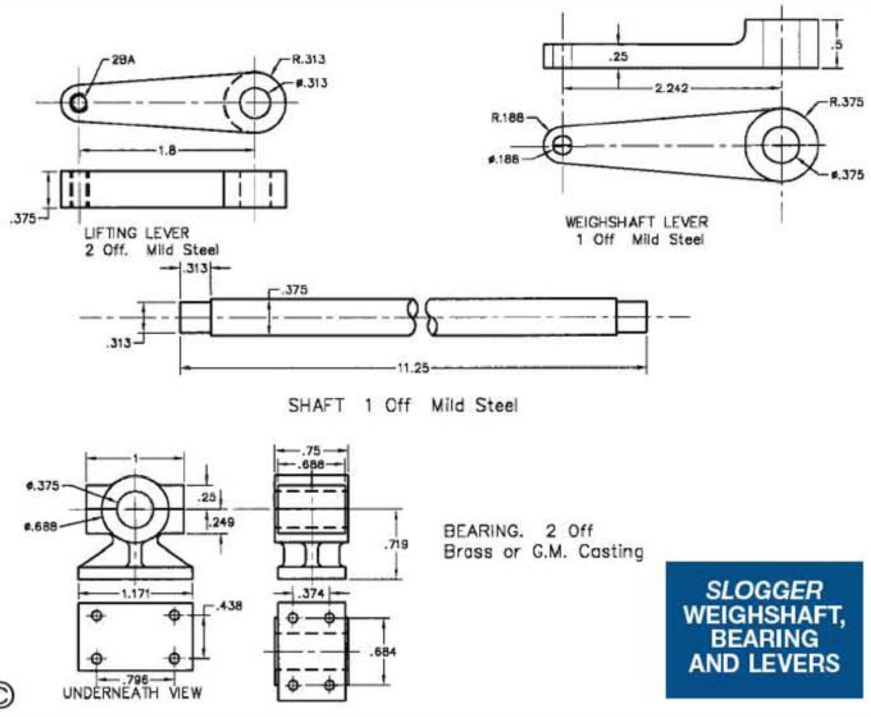
Weighshaft - left hand side, showing lifting lever.

A point of which I was not previously aware is that if the pivot point of each bogie is put nearer to the rearmost axle, the leading axle of the bogie is nearer to a true radial aspect to the rails. It is clearly beneficial for this to happen, and there is a point within the axles of the bogie where the leading axle is exactly radial. With strictly radial axles, clearly the wheels will run more 'cleanly' and wear on both tyres and rails is reduced. This of course applies to our sizes as well as to full-size.

As I have remarked before, our track curves are horribly sharper than prototype. To the best of my knowledge, old pal Brunel had no curves sharper than about 3 miles radius once clear of Paddington, this scales to a mere 2031 feet for us in $7^{1}/4$in. gauge. Lovely thought! Therefore there is much to be gained by following full-size practice in just about every possible circumstance.



© Swindon drawing of bogie side control system (see text)



©

SLOGGER WEIGHSHAFT, BEARING AND LEVERS

Much to be learnt from learners

As might well be expected, not infrequently I get requests from future model engineers to make a particular part for them. I always refuse, offering instead the use of my workshop to help the new friend make it himself under my supervision, if desired. This has many advantages, some less obvious than others. For example:

You tell me — I forget.
You show me — I remember.
I do it myself — I understand.

I believe we owe this to Confuscius, but am not certain.

The newcomer is looking at things from an inexperienced viewpoint, often an entirely fresh viewpoint. It therefore follows that things hitherto unknown or unsuspected can come to light, be they good, bad, or indifferent. Thus it frequently happens that we both learn something.

This reminds me of the time I was working with a nerd as chief draughtsman, a right know-all who appeared to think himself all-wise and truth-sacred. He told me point-blank to ignore any advice from the shop floor. I was just to tell them what to do and that was that. I deliberately ignored this claptrap, on the self-evident grounds that the chaps on the shop floor had more practical experience, plus the simple fact that they were seeing the job in 3 dimensions, whereas I saw it in 2.

Thus only a week ago (time of writing) I left a friend silver-brazing girder-type crownstays to a firebox while I had dinner. Returning, I met with a sorry-looking job that would have difficulty in holding itself together. Puzzled, I questioned as to what had occurred. Heat was not in question, ▶

for we use a fairly hefty oxy-acetylene torch consisting of a hexagonal array of very small jets, equivalent to a No. 25 single jet. Thus there is heat and to spare, but a 'softer' flame, less likely to overheat locally, and a darned sight quieter! The job gets hot enough to silver-braze very quickly, thus gas used is less than might at first be thought. So I had to look elsewhere.

"Flux?" queried I.

"Yes." came the reply. So more puzzlement, for a time. I had been doing some soft-soldering, caulking up a tender body, and the flux-tin was prominent. Alas, he had noted the splendid way the soft-solder flashed though the joints with this flux, and had applied reasonable quantities thereof to the firebox top. No harm was done, lessons were learnt, and application of the correct Easiflo flux mixed to thick cream with water plus re-application of heat made a job that would be hard to fault.

Easiflo is Johnson-Matthey's trade name for a particular specification of silver-brazing alloy, and identical materials can be obtained from other sources than Johnson-Matthey, so if it is not actually called 'Easiflo' on the label, then no need for panic. It is by far the best all-round material for virtually every high-temperature fixing job we need, and while some may like using a bronze-welding process, note that although the material is cheaper, you need higher temperatures, to some extent cancelling out this cheapness. Also, the flux is high in sodium content, unlike the Easiflo types. This gives a very strong flame colouration, making goggles compulsory in order to see what is going on.

I referred to soft-solder above, not to be confused with electrician's solder, the flux-cored type. This melts at about boiler pressure, not that we would use it on a boiler. I hope! The solder for sticking our sheet brasswork together, sealing tanks, tenders etc. is plumber's solder which becomes soft at the temperature corresponding to 150psi.

By far the greatest

I was quite pleased with the results of the *Greatest Briton* debate recently run on UK television. For those who didn't watch it, the first two were Churchill and Brunel, if memory is correct the third was Diana, Princess of Wales. To me, the first two were obvious (and foreseen!), but even allowing for my well-known impartiality (oh yeah?) in matters Great Western, Brunel was undoubtedly supreme amongst civil engineers.

When you think of the time he did his stuff and the technology and materials available to him, there is little room for doubt. For example, I have stood on the Tamar road bridge just beside the famous Royal Albert Bridge and looked down, not figuratively but literally, on the latter, and let my thoughts roam whithersoever, etc. The Tamar bridge dwarfs the other by sheer size and grace; but there is something about the Albert's quiet patient dignity, I can put it no other way, that not only defies description but also stands supreme. *"I were 'ere first!"*

Again, the Albert Bridge could be put under the Forth Bridge and almost be missed to casual inspection, but considering that by the Forth's time mild steel had been invented (or discovered!) there is little doubt which was the greater achievement. For I think it is generally known that in metallurgical terms, Brunel had nothing 'greater' than cast iron plus malleable iron.

But, strangely enough, as well as being the world's greatest civil engineer, he was undoubtedly the worst locomotive engineer! I will not go into full details, but his idea of a three-unit locomotive consisting of works (cylinders, driving wheels, etc.) with boiler (on a separate set of wheels!) plus tender showed innovation rather than genius! The eventual result was the Board of Governor's appointment of Gooch over Brunel's head! But good old IKB was a truly great man and the two got along very well. If my memory is correct, their combined ages at this time was less than 55 years! Truly they had great men in those days.

●*To be continued.*

CLUB CHAT
With Stan Bray

UK News

An interesting idea from **Harrow & Wembley SME** involves the introduction of a first aid box for locomotives. Members have been asked to donate any spare items likely to be of use in the event of a breakdown of a model. We know the things that cause trouble include broken pins and bolts, lost nuts and springs, gauge glasses, gasket material and sealing compounds. These and other emergency supplies will be kept in a locked box available on public running days and anyone using anything from it will be expected to replace like with like. A review of the numbers of passengers carried over the last eight years makes interesting reading. The 1995 receipts indicate a total of 10,456 fare paying passengers. This has been followed by a steady decline; only 5561 fare paying passengers were carried in 2001, just over half those carried in 1995. The 2002 figures are expected to reveal a further fall in receipts. It is interesting to speculate why this might be. Like most clubs, the facilities are now far better than in 1995 and no doubt the operation is much more professional than it used to be. Maybe this is at the root of the decline; in the early 1990s, the attitude towards passenger hauling was relatively carefree and anyone who fell from a train picked themselves up, dusted themselves down, and probably had a laugh and a free ride. There was much more laughter around stations and steaming bays than we hear nowadays, and it could just be that the necessary tightening of controls means that there is less pleasure in operating for the public resulting in a more serious approach to the customers. This of course is pure speculation, but it would be interesting to learn how club activities compare with years gone by.

Saffron Walden DSME was one of the many clubs which suffered damage in the October storms. The last public running day of the season was scheduled for 27 October, but on arrival, members found that Lord Braybrook had been forced to close Audley End because of the dangerous situation created by numerous fallen trees and other damage. The last society newsletter we received indicated that members had been unable to assess the extent of the damage, but they do know that it includes the station kiosk which had been blown over together with the heavy concrete block with which it had been anchored down. Plans for work to be carried out during the winter are likely to be amended when the extent of the damage is discovered.

Thanks mainly to members' generosity, fund raising for the **Romney Marsh MES** clubhouse extension is making good progress and a considerable sum of money has been raised. Much of the work is being done by members who attend on Wednesdays, most of whom are retired and by whose efforts a lot of the work has been completed. Planning permission has been sought to cover the entire roof of the building, including the extension, with corrugated bitumastic, work which they hope can be completed before the onset of winter. Congestion in the parking area is to be relieved by introducing a marked off section designated for loading and unloading models, thus facilitating these operations.

The recent **St Albans DMES** annual exhibition was very successful and featured a brand new boating pool, one of the stars of which was a submarine that transmitted underwater pictures back to a monitor for all to see. The annual club competition was judged during the show with the following results: *Clifton Trophy* and *Vice President's Trophy* to S. Churchill for his Super Sentinel steam wagon; *Pauline Husband Trophy* and *Sail Trophy* to R. Verden for his Americas Cup yacht *Endeavour*; *Junior Craftsman Trophy* to S. Batchelor for his rolling ball engine; *Merchant Marine Trophy* to F. Fearn for his *Delta* research submarine; *Miniature Railway Trophy* to A. Harmer for his gauge 1 tram engine; *Senior Craftsman's Trophy* to M. Beak for his ignition coil winding machine; *Steam Trophy* to A. Ashberry for his side rod engine.

An all-steel shipping container has been obtained by **Chesterfield DMES** for conversion to a carriage shed. It has been fitted out with power and lighting and a spur is being laid from the main line so that vehicles can be run straight into it. Although not perhaps the most attractive of structures, these containers do make reasonably secure storage with the advantage that they require little maintenance and no erection. The society open weekend last September was very successful and made a welcome addition to club funds. A particularly pleasing aspect of the event was that the ticket office was manned throughout by junior members; a fine job they made of it, too. Paul Richards won the annual society locomotive efficiency trials.

Ascot LS successfully negotiated an entire running season, carrying out all their usual activities in addition to hosting the 7¼in. gauge rally, despite being under threat of having to relocate their track at any time. The move appears to be imminent and the terms of the new lease were due to be debated by the members at their November AGM. There is a suggestion that contractors will start work at the club site in December, so it rather looks as if the club will have moved by the beginning of spring. Thoughts are therefore turning from maintaining the present track to building the new one, planning for the signalling system being at an advanced stage. Point work will be electrically controlled using car windscreen wiper motors, and one turnout at the old site has already been adapted to try out the system which still permits manual point operation.

"Varied, particularly well-stocked and lively" is how the exhibition organised at the Quay Arts centre by **Isle of Wight MES** is described. Judging from the attendance figures and comments overheard, it seems the public thought it excellent too. The society usually finds it difficult to gather together enough models to fill the stands, but on this occasion the problem was to find sufficient room for everything to be displayed, although in the end it was. Instead of the usual portable boating pond, the models were operated this year on the river while two full-size steam launches gave rides to eager visitors. A stand displaying a large radio-controlled model called *Commengetorix* to be used in the *Robot Wars* television programme attracted particular attention, especially from younger visitors. The ground floor of the Quay Arts Centre was flooded less than 24 hours after the show closed due to a period of exceptional rain; members must be thanking their lucky stars that it did not happen a day or so earlier!

Following the theft of their ride-on mower, **Tyneside SMEE** is in desperate need of a replacement. Members have been faced with the time consuming and tiring task of dealing with a very large area of grass with their own mowers intended for domestic use. The replacement will not be kept at the club headquarters in case it is stolen, but will be stored elsewhere with better security. The autumn rally once more attracted many visitors from societies in the north of the UK. Apart from a downpour at lunchtime on Saturday, just as everyone was settling down to what is now the traditional fish and chip lunch, on the whole the weather remained fine throughout. The new track seems to be making excellent progress, although maybe not as rapidly as some would wish. Nevertheless the aim is for completion in time for the 2003 Spring rally.

A visit to **Erewash Valley MES** by the 009 Society which specialises in 4mm scale trains on 9mm narrow gauge track (the same as N-gauge) was enjoyed by both parties and provided an opportunity for each to obtain an insight into the other's aspect of modelling. On another occasion, the local community police officer gave an interesting talk with some pointers on extra security for the society premises and home workshops. Work on the new ground level track is making good progress, but like most societies it seems that a limited number of members are actually doing the work.

A total of 13 locomotives, representing six of the seven member societies participated when **Carlisle DSME** hosted the 2002 **Stephenson Memorial MLA** trials. There are three categories, and Ken Ellwood of West Cumbria won the 3½in. gauge competition with a model of *Evening Star*, Keith Panley of Sunderland won the 5in. gauge competition with a model of an A5 streamlined pacific *Seagull*, and Alan Bones of Tyneside won the 7¼in. gauge competition with *Holmeside*. Many favourable comments on the efficient way the meeting had been organised by the host society included particular appreciation of the excellent range of refreshments. The day finished with the trophies being presented by Bill Oliver, President of the Stephenson Memorial Miniature Locomotive Association. The event is to be hosted by **South Durham SME** in 2003.

A complete reshuffle of the **Leeds SME** committee at the AGM saw Colin Abrey taking over as Secretary; he can be contacted by e-mail at **colin.abrey@ntlworld.com** or by 'phone on 0113-264-9630. The post has traditionally included organising exhibition stands, open days and the like, but as time has passed this has involved an overwhelming work load. The organisation of these events now falls upon Tony Wall, leaving Colin free to concentrate on secretarial matters. With three new riding cars under construction it has been suggested that the club may wish to create more interest for passengers by painting them in the Pullman car colours of umber and cream and to give each a name. It has been further suggested that the names of notable past members may be appropriate, thus honouring their memory as well.

Fylde SME has received a donation of coloured fabric which will be used to brighten up and improve their stands at future exhibitions. Members experienced something well out of the ordinary when the Secretary, who was driving a train at the time, had his attention drawn by two children gesticulating urgently on a dyke near the track. On stopping the train to investigate, he discovered a man in the water and mud who, despite his efforts to hold on to some grass growing on the bank, was slowly sinking. He had apparently been trying to retrieve a ball for the children and slipped down the steep bank. It took four club members acting together to get him out. Advice to members in future is not to be tempted to do a good deed for children by trying to retrieve balls that have gone into the water!

We were pleased to learn that **Bristol SMEE** has been granted charitable status. Several clubs have previously applied for this but, as far as we know, this is the first time it has been granted to a model engineering society. Like many other societies, they have always organised charity events which this year included visits by a Children's Society and by a group of Beaver Scouts. Many of the latter took away small pieces of coal as souvenirs, never having seen such a substance before. How the world has changed! By being granted charitable status the club must comply with certain conditions, the first of which to take effect concerns their publications. In the past, and on a regular basis, they have issued *The Cog*, a small booklet providing general club information and a variety of interesting articles. There is now a need to produce a technical work that is educational, and this will retain the title. A newsletter is also published for the benefit of members. Normal club activities have not been neglected and several projects are under way which they hope will be ready in time for them to host IMLEC 2003. Unfortunately, having been scheduled for one of those special autumn days when it rained, and rained and rained, the popular family day turned out to be a non-event. A few hardy souls did turn out in the morning, but by lunchtime it became obvious that it would be impossible to go ahead and, to the disappointment of all, the event was cancelled.

After several years working to restore locomotive 740 from the Maltheran Light Railway, members of **Leighton Buzzard NGRS** were at last able to see it working in the summer. The engine was saved from the scrapyard by the late Mike Satow, a member of **SMEE** and presented by him to the Rail World Museum at Peterborough. For a number of years it stood outside the museum suffering inevitable deterioration and a certain amount of vandalism. The museum decided it would be more in keeping with Mike Satow's wishes to have the locomotive running, and it was passed to the Leighton Buzzard group. The inaugural run was attended by the Rev'd Richard Paten, curator of Rail World Museum. Some cosmetic work on the engine remains to be completed, this will be done during the winter and includes fitting an air pump for braking purposes. The first official run for the locomotive is proposed for Easter 2003 and readers interested in narrow gauge railways are advised that this is an event not to be missed. The engine is handsomely proportioned for a narrow gauge locomotive and is to be finished in the original attractive blue of the Maltheran Railway. A future project for the railway is to incorporate radio control on the trains. This does not mean that they will be driverless, but that operational control will pass from single line tokens to two-way radio, a system that has been successfully adopted on many preserved railways.

World News

New Zealand

Possibly the highlight of the **Southland SME** year is their annual Great Little Train Show, and the 2002 show was considered to be not only the biggest but also the best so far staged. The public visited in large numbers and with support from members of **Gore MEC** and **Otago MES** there were so many exhibits that it was necessary to use ▶

an extra hall. Visitors were charged a small fee to try their hand at operating radio controlled boats. Saturday evening was the time for those engaged in running the show to relax and enjoy themselves; 60 people sat down to the meal provided. The show also attracted a number of potential new members, at least two of whom have made application to join.

Canada

The new raised track of **Ottawa Valley LS and ME** follows a different route to that of the previous one, resulting in a cutting that was used by the original is no longer required. In the interests of both safety and appearance, a decision was made to fill it in. Material for such work is not easy to obtain without involving considerable expense, so it was decided to use 66 old concrete piers that had supported the old track. This was all very well, but they were useless for the purpose in their existing condition. It was therefore all hands to the pumps; or rather the sledge hammers, to break the piers into manageable lumps so they could be used. The work was completed but no doubt a few aching arms and backs resulted from the effort involved. This rubble only goes a small way towards filling in the cutting, and so the next plan is to widen the road to the 7¹/4in. gauge steaming bays and use the material taken from that for the same purpose. All this labour does not appear to have stopped work on the new track, for when we last heard 233 new posts had been made and erected ready for track laying.

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

26/27 **Leighton Buzzard NG Rly.** *Mince Pie Specials.* Enquiries: 01525-373888.
28 **Basingstoke DMES.** *Christmas Run.* Contact Ian Shanks: 01420-561741.
28 **Worthing DSME.** *Christmas Steam-Up.* Contact Chris Devenish: 01903-268158.
28/29 **Chesterfield MES.** *Steaming at Papplewick.* Contact Mike Rhodes: 01623-648676.
29 **Great Western Soc.** (Didcot Railway Centre). *Steamday.* Contact Jeanette Howse: 01235-817200.
29 **MELSA.** *Sunday in the Park.* Contact Graham Chadbone: 07-4121-4341.
29 **Plymouth MSLS.** *Mince Pie Specials at Plym Valley Railway.* Contact John Brooker: 01752-671722.
29-31 **Nexus Specialist Exhibitions.** ***72nd Model Engineer Exhibition*** at Sandown Park Exhibition Centre, Surrey. Admission: Adult £6.50, Senior Citizen £5.50, Child £2.50. Discounts for advance bookings. Sun/Mon 10.00-17.00, Tue 10.00-15.00. Information: 01353-654422.
31 **Plymouth MSLS.** *Mince Pie Specials at Plym Valley Railway.* Contact John Brooker: 01752-671722.

JANUARY

1 **Brighton & Hove SMLE.** *New Year's Day Steam-Up.* Contact Mick Funnell: 01323-892042.
1 **Cardiff MES.** *New Year's Day Steam-Up.* Contact Trevor Jenkins: 029-2075-5568.
1 **Chesterfield MES.** *Arctic Running.* Contact Mike Rhodes: 01623-648676.
1 **Erewash Valley MES.** *New Year's Day Steaming.* Contact Jim Matthews: 01332-705259.
1 **Frimley & Ascot LC.** *New Year's Day Run.* Contact Bob Dowman: 01252-835042.
1 **Great Western Soc.** (Didcot Railway Centre). *New Year Steamday.* Contact Jeanette Howse: 01235-817200.
1 **Leicester SME.** *New Year's Day Steam-Up.* Contact Raymond Wallis: 0116-285-8824.
1 **Leyland SME.** *Chairman's Run.* Contact Alan Wilson: 01942-715072.
1 **Melton Mowbray DMES.** *New Year's Day Steam-Up.* Contact Phil Tansley: 0116-2673646.
1 **N. W. Leicester SME.** *New Year's Day Running.* Contact John Elliott: 01455-847040.
1 **Oxford (City of) SME.** *New Year's Day Steam-Up.* Contact Chris Kelland: 01235-770836.
1 **Portsmouth MES.** *Frostbite Run.* Contact Bob Aldred: 023-92-523366.
1 **Rochdale SMEE.** *New Year's Day Steam-Up.* Contact Mike Foster: 01706-360849.
1 **Romney Marsh MES.** *Track Meeting.* Contact John Wimble: 01797-362295.
1 **Stockholes Farm MR.** *Running.* Contact Ivan Smith: 01427-872723.
1 **Surrey SME.** *Running.* Contact John Cook: 020-8397-3932.
1 **Tyneside SMEE.** *New Year's Day Running.* Contact Malcolm Halliday: 0191-262-4141.
2 **Cardiff MES.** *Matthew Carroll: Manx Electric Railway.* Contact Trevor Jenkins: 029-2075-5568.
2 **Leyland SME.** *AGM.* Contact Alan Wilson: 01942-715072.
2 **Sutton MEC.** *Bits & Pieces.* Contact Mike Dean: 0208-657-5401.
3 **Vale of Aylesbury MES.** *Mike Cavendish: Photography.* Contact Clive Ellam: 01296-623433.
3 **Maidstone MES.** *Review of 2002.* Contact Martin Parham: 01622-630298.
3 **North London SME.** *Archive Film Show.* Contact Tony Dunbar: 01992-465625.
3 **North Norfolk MEC.** *Model Shipwright from Wroxham Barns: Talk.* Contact Gordon Ford: 01263-512350.
3 **Portsmouth MES.** *Meeting.* Contact Bob Aldred: 023-92-523366.
3 **Rochdale SMEE.** *Meeting.* Contact Mike Foster: 01706-360849.
4 **Isle of Wight MES.** *Track & Pond.* Contact Ken Stratton: 01983-760762.
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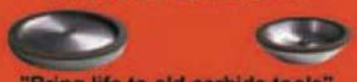

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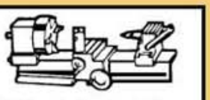

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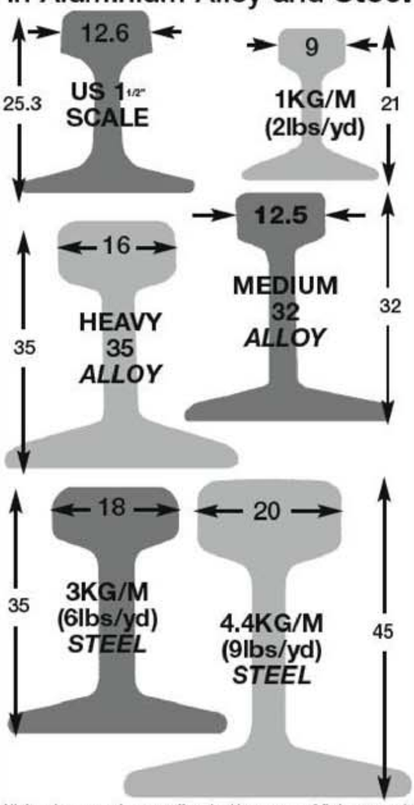

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