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COVER PICTURE

Mr. V. Hotchkiss driving his $3\frac{1}{2}$ in. gauge 4-4-0 "Virginia" on the Bracknell track. Colour photograph by Lorna Minton.

NEXT ISSUE

A model Aveling & Porter vertical-boilered steam roller.

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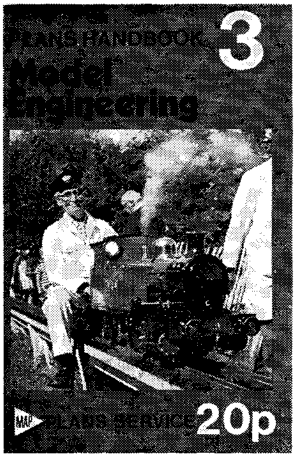

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Continued from p. 519

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Saturday & Sunday, May 31 & June 1, 1975

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SEVENTH INTERNATIONAL MODEL LOCOMOTIVE

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FOR STEAM LOCOMOTIVES OF $3\frac{1}{2}''$ AND 5'' GAUGE

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ENTRIES ARE NOW INVITED FROM SOCIETIES OR FROM INDIVIDUALS WHO ARE NOT CLUB MEMBERS

N.B. Competitors (except those from overseas) may only enter locomotives built by themselves.

Club entries should be made by Chairmen or Secretaries, and should be sent to the Editor of 'Model Engineer'. There will be no entry fee. Closing date for entries—June 25

Early application is advised

Technical information for competitors will be provided by the Society.

ADMISSION for SPECTATORS will be by TICKET ONLY, obtainable from Model Engineer. ADMITTANCE 20p per person. Children with parents admitted free.

Please make cheques, P.O.'s, payable to "Evans Locomotive Fund".

SMOKE RINGS

A Commentary by the Editor

S & D Anniversary

As part of the activities to celebrate the 150th Anniversary of the opening of the Stockton & Darlington Railway, the Duke of Edinburgh is to open the new National Railway Museum at York, on September 27th. After the ceremony, he will travel to Stockton to attend a pageant and banquet.

Exhibition at Derby

There will be a Joint Model Engineering Exhibition in the Queen's Hall, London Road, Derby from 6-11 October. This is being organised by the Derby Society of Model and Experimental Engineers and the Derby Locomotive Works Society of Model Engineers. Entries of models will be welcome and full details can be obtained from the Entry Secretary, Mr. A. J. Gent, 31 Cromford Road, Ripley, Derbyshire.

Anniversary Steam Party

This year is the 21st Anniversary of the National Traction Engine Club and a celebration "Steam Run" is being planned from Nettlebed to Appleford, followed by a "Steam Party", on 12-13 July. It is expected that between 30 and 40 traction engines will take part in the 16-mile run, arriving at Appleford by late afternoon 12 July. The Club are to publish a special issue of their magazine "Steaming" to mark the occasion.

B.B.C. Model series

Scheduled for transmission on B.B.C. 2, from 6.40 to 7.05 p.m. twice weekly through May and June, MODEL WORLD will be the first serious approach to modelling activities presented on television.

The programme sequence is: Tuesday, 13 May: "Something for everyone"—a general introduction. Thursday, 15 May: "Free flight model aircraft". 20 May: "Controlled flight model aircraft". 22 May: "Model yachts". 27 May: "Model power boats". 29 May: "Military Modelling". 3 June: "Military Modelling (2)". 5 June: "Model Railways". 10 June: "Model Railways (2)". 12 June: "Model Railways (3)", including live steam locomotives.

Additionally, a special B.B.C. Publications book of the series has been produced, entitled "Model World", available from booksellers and model shops price £1.60.

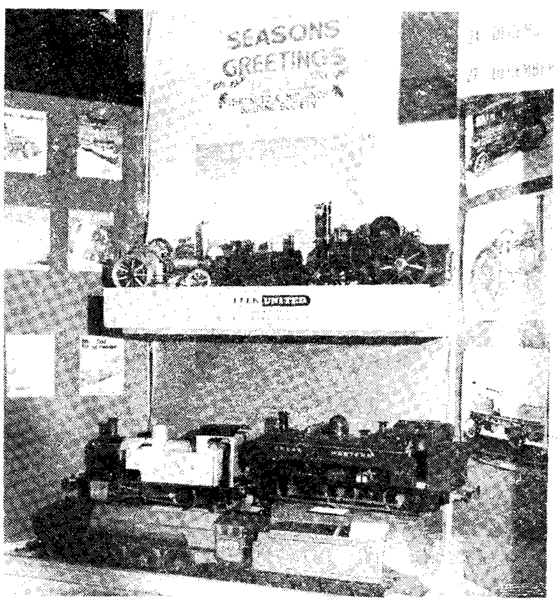
Society for Mid-Wales

I hear that a Model Engineering Society has been formed for the Aberystwyth district of mid-Wales. Known as the Aberystwyth Model Engineering Club, the Chairman is Mr. E. J. Andrews of Ogmore House, Penparcau, Aberystwyth, and the Secretary is Mr. Allan Wheatley of Tan-y-Gaer, Llangwryfon, Aberystwyth. Meetings are held monthly on the first Tuesday of each month at 7.30 p.m. at the Sports Centre, North Parade.

The late J. H. Balleny

The Birmingham S.M.E. have lost a much-respected member in Jim Balleny, well known for his *Tich* locomotive (featured in the M.A.P. book of that name) and for his Championship Cup winner *The Earl*. Jim will be long remembered for his many years' service as Librarian: his standards were high, while his interests covered electronics, photography and horology as well as model engineering.

Part of the Exhibition organised by the South Cheshire M.E.S. at Crewe. Photograph courtesy "Crewe Chronicle".



The "Model Engineer" Steam Roller

An Aveling & Porter 2 in. scale Compound

Part XIII — ***Built and described by John Haining*** — *From page 374*

KNOWN SOMETIMES as the bunker, but by a number of makers as the tender — Aveling & Porter preferred the use of the latter term — the hind quarter of a roller like that of a traction or ploughing engine was designed to fulfil several functions. It consisted generally of two side plates, a back plate, sometimes in one piece with the bottom plate and a floor plate; the lower part of the rearward section formed a water tank and the upper part, comprising a coal space, was divided off from the front portion or manstand by what Aveling referred to as a "parting plate". It was usual to provide a cut out opening in either one or both side plates to allow access to the manstand, and the top edges of the side and back plates were usually finished off with half round beading.

The side plates, bolted to each hornplate, sometimes had packing pieces between the outside of the hornplate and inside of the tender plates to increase the width of the tender slightly.

In the very early days of the first self-moving road engines, the tender was a rather flimsy looking addition to the rear end, consisting usually of little more than a rectangular water tank, attached to the boiler backhead by cleats, upon which the driver stood. Sometimes a couple of stay bars running from halfway up the backhead to the rear of the flat tank top afforded some slight extra support. Coal was carried at the back end. Such a lightly constructed appendage was obviously unsuitable for any heavy drawbar pull, and eventually the water tank and limited coal space developed in size and strength to something more in keeping with the demands made upon the engine, and makers started to develop their own characteristic tender shapes.

Generally speaking, tenders remained fairly plain until past the turn of the century, usually with functional flat back plates and simply formed plate and angle joints—in fact the handsome curved and radiused plates of the Fowler ploughing engine tender, for example, didn't appear until shortly before the First World War.

The tender, in addition to providing space for coal and water, supported the rear of any canopy or cab, fitted over the engine, and in addition was the anchorage upon which any brake gear was mounted, but the biggest load likely to be imposed upon its construction was in the haulage of loads behind the engine. It was usual to make the drawbar pin-plate a substantial bracket—sometimes a forging wrapping around the back of the tender to distribute the load over a large area of plate, and some engine manufacturers extended the drawbar pin-plate each side as far as the hornplate, to relieve the tender bolts of some of the sheer stresses imposed by traction! When hauling a heavy load, the drawbar pin-plate and in turn the tender plates and joints, were subjected to alternating stresses as the load tended to pull the engine back on inclines or push it forward on down gradients and when two engines were double heading a heavy load, as occurred frequently with the big road locomotives owned by heavy haulage firms, heavy handed driving by an inexperienced man could result in the drawbar between the engines being pushed right through the tank of the engine in front—luckily the drivers of the big engines were among the most highly skilled men on the road and such occurrences were rare.

Rollers, in the course of their work, usually had a comparatively easy time of it, where loads were concerned; the normal one for a roller usually being little more than a living van and water cart with sometimes the addition of a coal truck. However, the invention of the roller-mounted Scarifier, a device designed to tear up old road surfaces, imposed a new load on the tender plates and bolts, particularly on one side of the machine.

In 1921 Aveling & Porter were invited to take up the manufacture of a new "Patent Resilient Type Scarifier" developed by a large road rolling concern, Messrs. Price of Altrincham, in Cheshire. I hope to be dealing with the development and construction in 2 in. scale, of both this roller-mounted type and the Continental two wheeled towing type of Scarifier in a later article, so will not weary readers with details at this stage. The addition of a necessarily very heavily constructed piece of equipment, subject to considerable stress under working conditions, to the right hand side

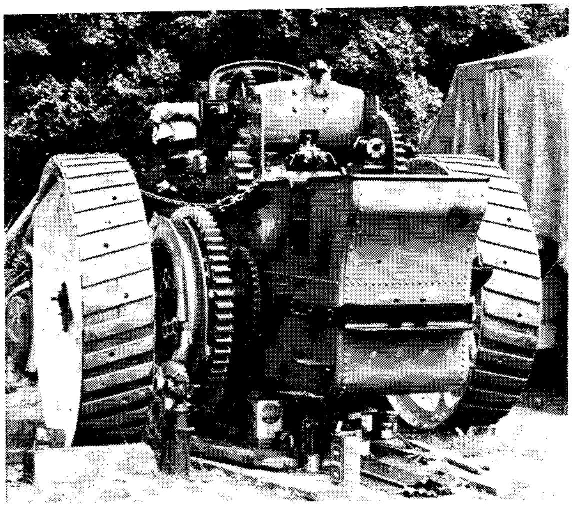
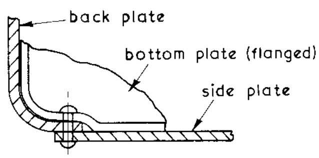
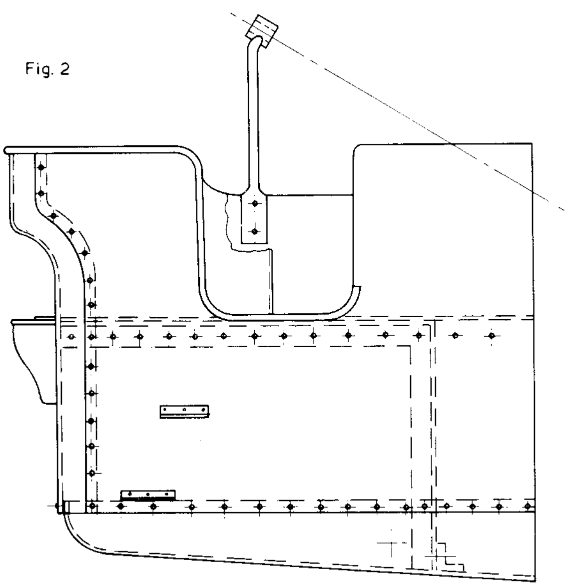


Fig. 1: Rear view of a Ransomes 4 n.h.p. traction engine.



DETAIL OF PLATE JOINT

Fig. 2



FOWLERS' METHOD OF TENDER CONSTRUCTION

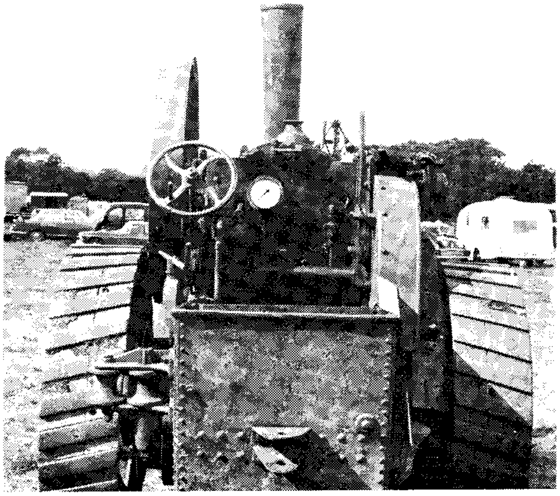
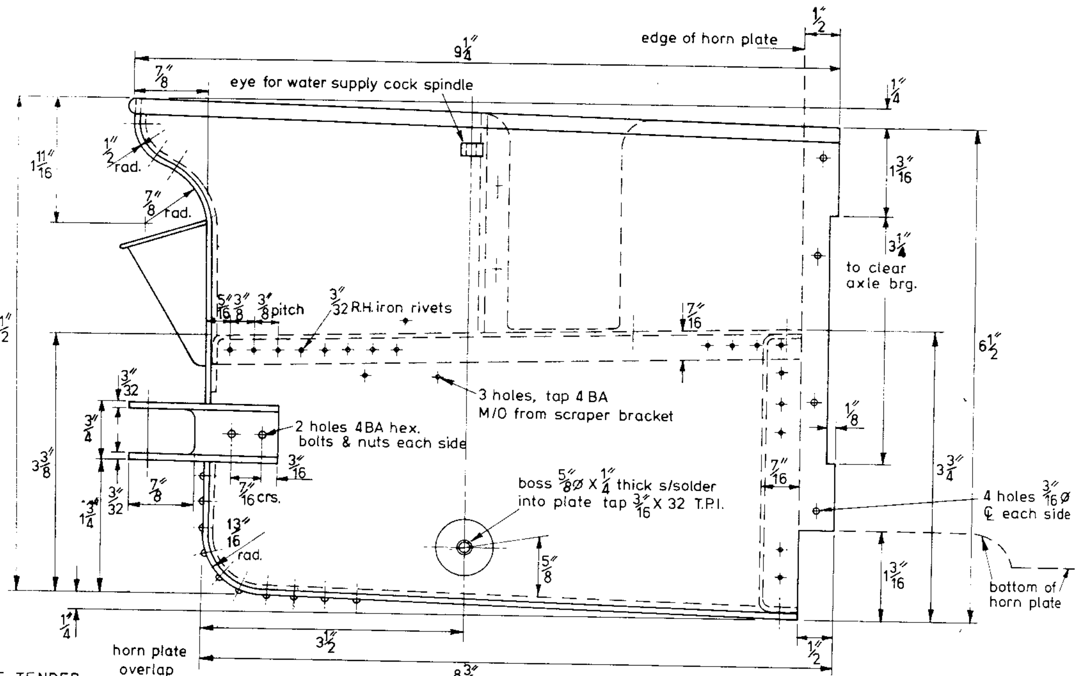


Fig. 3: Tender of a Clayton & Shuttleworth traction engine.

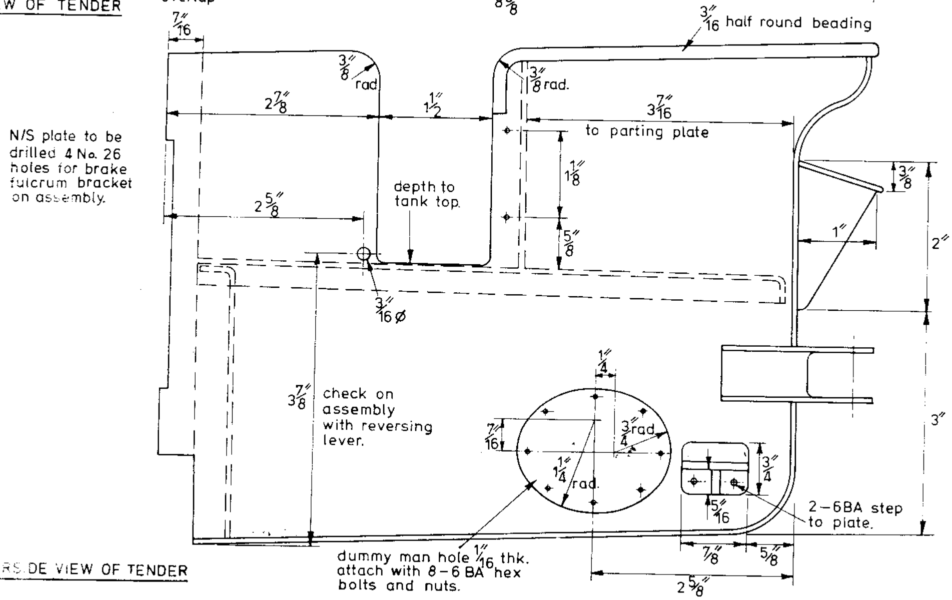
tender plate, imposed, as I have said, quite an added loading, and to take some of this off the actual tender plates and bolts, scarifiers were attached on the outer side by two arms, to a collar fitting over the outer end of the rear axle, outside the offside hind roll.

Aveling & Porter, in common with most other manufacturers, fitted a water pocket with hinged flap lid, at the back of the tender just above the pin-plate, for replenishing the water tank. A water lifter was offered as an extra, together with a length of armoured hose of sufficient length to reach down to roadside streams and other sources of clean water supply. As the scarifier, when fitted, occupied nearly all the space between the edge of the hind roll and the end of the tender on the offside, Aveling & Porter cut the *nearside* tender plate away to give the driver access to the manstand, and all fittings such as brakes, fulcrum bracket, tank manhole cover, pump suction cock, pet cock, and drivers' step, were mounted on the nearside tender side-plate—at least on the earlier rollers. A scraper blade on an arm, adjusted to almost touch the back surface of each rear roll, intended for the removal of picked-up road material etc., from each roll face, was attached to each tender side plate—incidentally, a second scraper was fitted at the front of both rear rolls as well, on arms mounted on the steering perch bracket to remove material when the roller was working backwards. Fitting the scarifier necessitated removal of the back offside scraper.

Tender construction was based on three main methods, the original and simplest form consisting



OFFSIDE VIEW OF TENDER

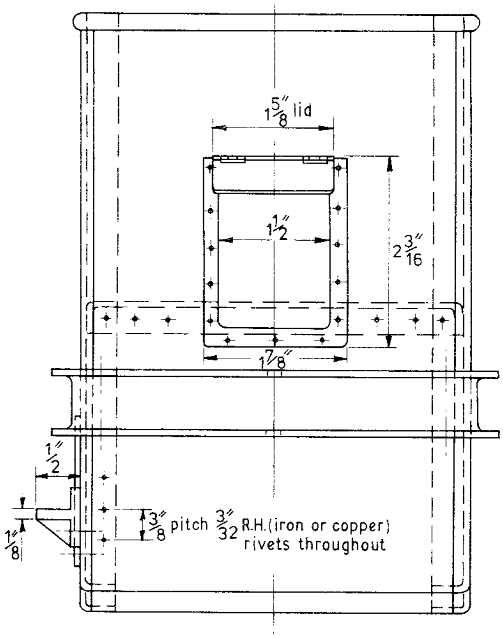


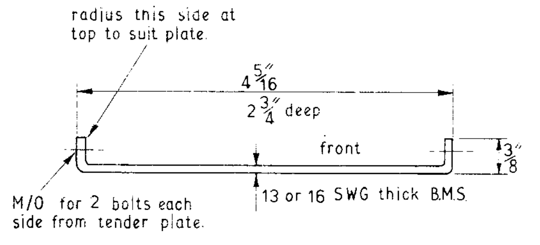
NEARSIDE VIEW OF TENDER

of flat side plates, riveted to a plain back and bottom plate by angle sections. Another method was to flange the side plates, avoiding any unnecessary radii and keeping all joint runs as straight as possible, riveting the plain back and bottom plate to the side plate flanges. A typical early tender is that shown in Fig. 1, a rear view of the Ransomes Sims and Head single cylinder 4 n.h.p. traction engine No. 5137, built in the early 1870's and now rebuilt and restored by its present owners after lying derelict for thirty-five years.

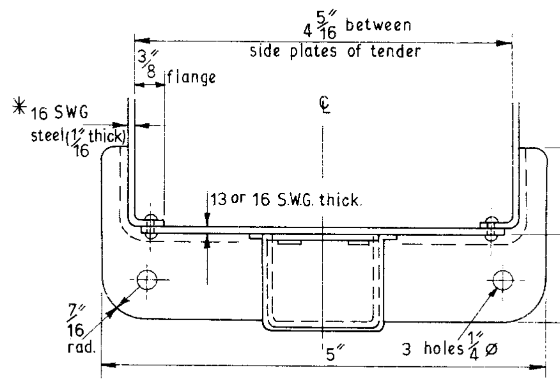
The shapely tenders of Fowler's later engines were constructed on a different principle, the side plates being flat, and riveted to a flanged and double-radiused back plate, with the bottom plate also flanged for first class plate and rivet work. This method is shown in Fig. 2.

The third main method of construction is illustrated in Fig. 3 which shows the tender of

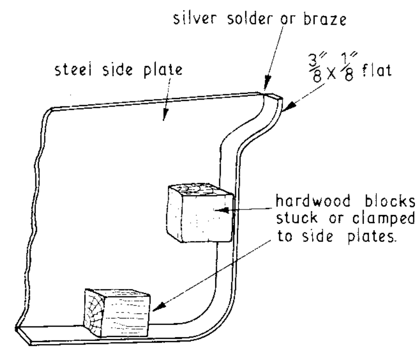




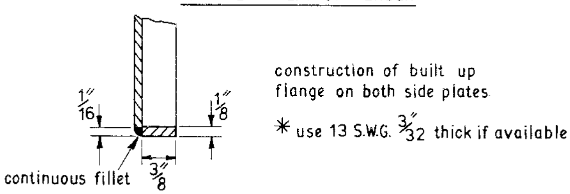
COAL BUNKER PARTING PLATE



PART PLAN REAR OF TENDER



Method of locating flat to form flange of tender sideplate.

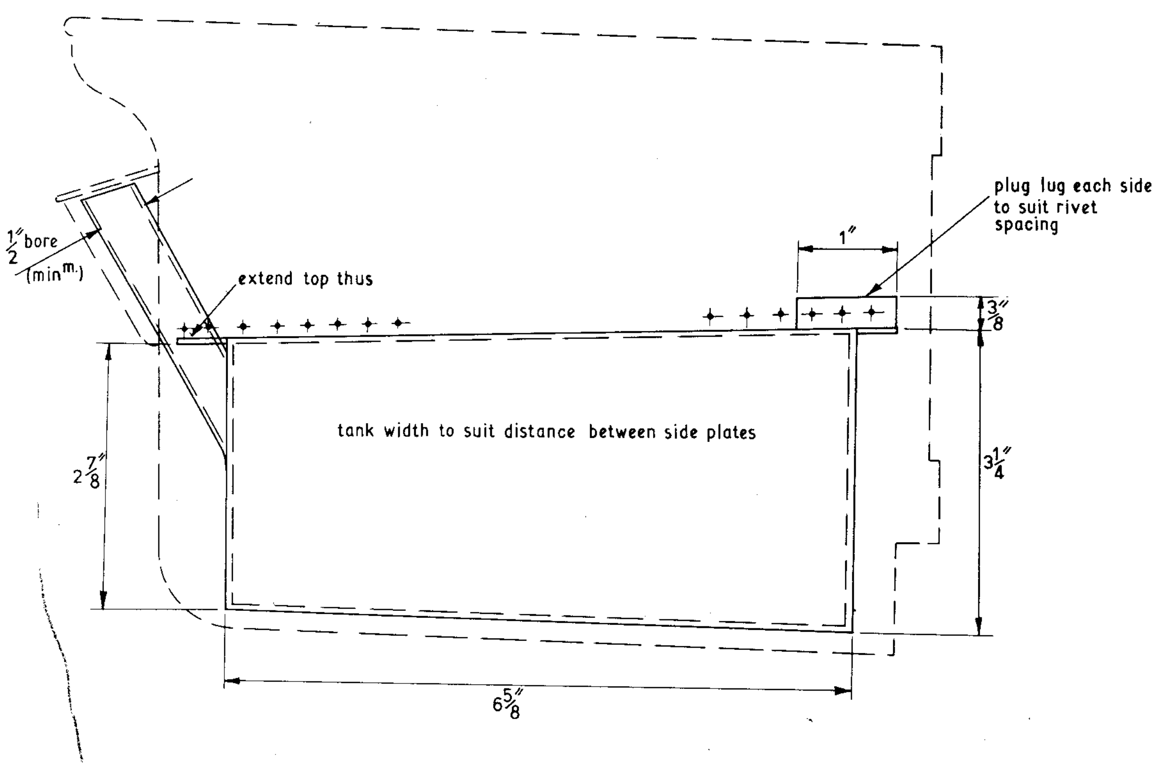


a Clayton and Shuttleworth traction engine undergoing overhaul by its owner, at Hartlebury. This clearly shows the flanged side plates, pressed in one piece, with cut-out for access to the manstand, beaded plate edges, and drawbar pin-plate extending along each side up to the rear axle. The back plate is riveted to the side plate flanges, and the line of floor plate and water tank top is indicated by the neat rivet lines extending along sides and back.

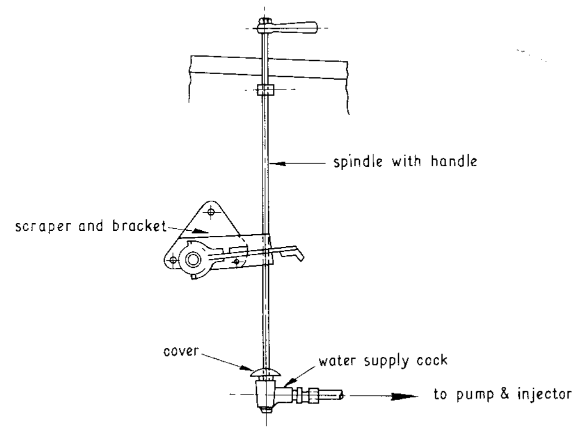
I have selected this photograph to illustrate the third method of construction as this is the one employed by Aveling & Porter, as well as by Clayton and many other latter day engine manufacturers.

Now to the actual construction of our Aveling & Porter tender in 2 in. scale. Construction of the Fowler tender, in the same scale, was simplified by having flat side plates, which were steel 16 s.w.g. thick.

The flanged backplate and bottom plate being 16SWG copper the task of flanging was comparatively easy, using hardwood formers and keeping the copper sheet well annealed. Unfortunately, with the Aveling tender the situation is reversed, as the side plates themselves have to be flanged, and the back/bottom plate is plain, merely bent to follow the outline of the sideplates.



DETAIL OF SEPARATE WATER TANK sheet brass. silver soldered throughout



WATER SUPPLY COCK CONTROL SPINDLE
on offside tender sideplate

We thus have a choice of either using copper as the material for the side plates, making for easy flanging, with a steel back/bottom plate, or using steel throughout and building up the side plate flanges to avoid the more difficult task of flanging steel sheet.

I am myself employing the latter method, cutting out the side plates to a cardboard template, then drilling all holes, and silver-soldering a length of bright mild steel bar inside to form the flange. The flat bar should be set to fractionally overlap the edge of the plate, so that the edge, after cleaning up with a file, will present a rounded appearance, to simulate a pressed flange plate. It is easier to mark off and drill all rivet holes in the bars *after* bending to shape and before silver-soldering in position on the plates.

If you decide to make the side plates of copper, (16 s.w.g.) leave about 3/16 in. allowance around the developed shape. Make a hardwood former, and beat the copper to shape on it, working in easy stages from the inside of the radii to the outside. In this way kinking can be avoided at the corners. Should the copper work harden during forming, anneal by heating to a dull red and quenching in cold water—don't be afraid of over annealing, either. For forming, use a 2 lb. ball-pein hammer, tapping round curves with the ball and smoothing surfaces finally with the flat end. Trim off the excess material from the flange edges.

Use a sealing agent on all mating faces before assembly, as the tank section must be water tight. Bostik sealer or equivalent is quite satisfactory for this.

To be continued

MAKING SMALL LIVE STEAM INJECTORS

Part III

by D. E. Lawrence

From page 432

IT IS BEST to do the drilling with the work held in the vertical-slide and square with the lathe axis, using the lathe mike collars to get the holes in the right places. Lucky owners of vertical millers will have no bother. Actually, I drilled both side members together and both top and bottom members together and I marked all the outside faces so that everything would be in line when assembled. I made the retaining or locating screws out of stock $\frac{1}{4}$ in. BSW hex. set screws and turned the heads to the shapes shown. If you do the same, put a screwdriver slot with a hacksaw in the end of each one; then make a suitable bush tapped the same as the screws you use and leave this in the lathe chuck. Put a locknut on a screw, put the screw in the tapped bush, tighten the locknut against the bush and turn the head of the screw to the required shape. To remove, slacken the locknut and unscrew the screw with your fingers. Do the rest without shifting the bush. Before using the jig, lightly smear the threads with MoS_2 grease or steam cylinder oil; after use, clean up, oil and put away for future use.

In order to avoid distortion of the body whilst silver soldering, assembly of the parts should conform to a particular order and method. Assemble the two sides of the jig on to the bottom member, best put them in the bench vice to keep them square. Put the top member on loosely; the holes in this are a little oversize to allow some adjustment; remove the overflow cover retaining screw and push a 5/52 in. dia. rod through the hole, through the overflow holes in a body (have it round the right way) and into the socket of the locating screw in the bottom member. You will probably find it necessary to take a thou or two off the rod for it to slide freely through all the holes. Perhaps I can add here that I used this little rod to ensure that the body had been turned properly through 180 deg. in the cross drilling jig. Enter the side locating screws into the bore to hold the body in position, finger tight will do, and tighten the top member screws. *Sparsely smear* the mating faces of the bosses with suitable flux and place in position, each one being *gently held* only.

At this stage I found it convenient to put the jig on to my makeshift brazing hearth. Then the 5/32 in. rod should be removed, the 2 BA screw partially inserted, the overflow cover sparingly fluxed along its edges and placed in position and the retaining screw eased down to hold it *gently* in place. Locate the jig on the hearth in such a way that you can slacken the side member locating screws so that they only *gently* hold the body, do this without disturbing anything. My makeshift hearth for this job was four bricks, two laid flat and apart with a Bunsen burner placed between

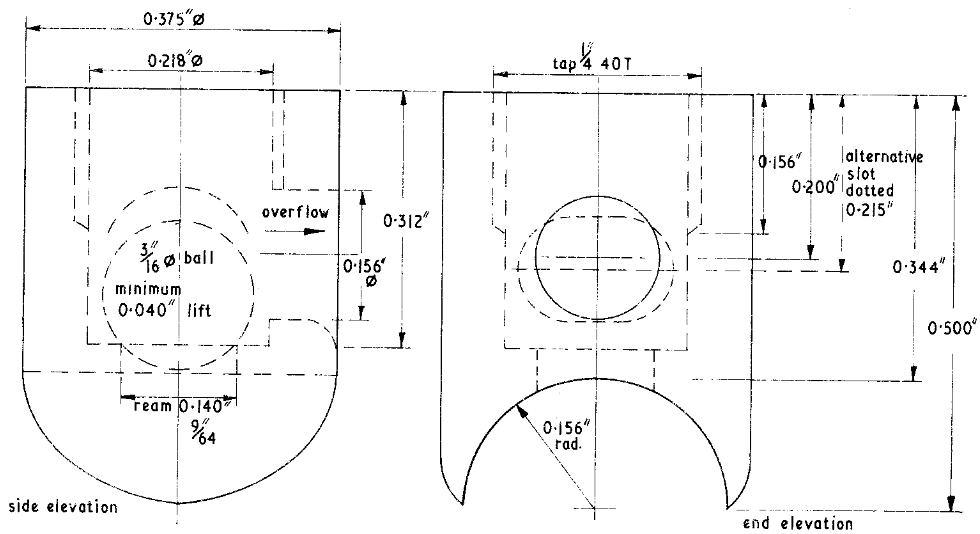


Fig. 8. BALL VALVE FOR LAURIE'S STANDARD No.1 INJECTOR brass

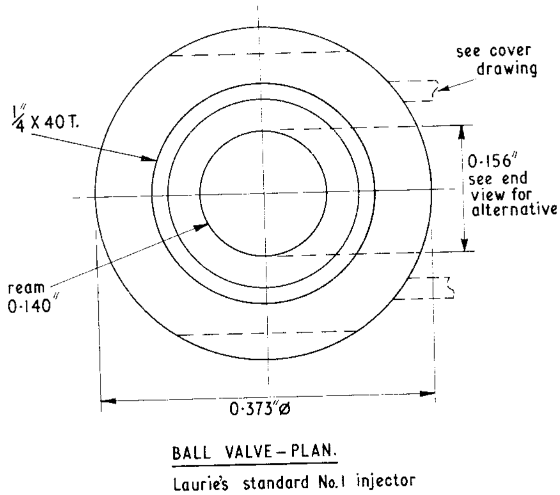
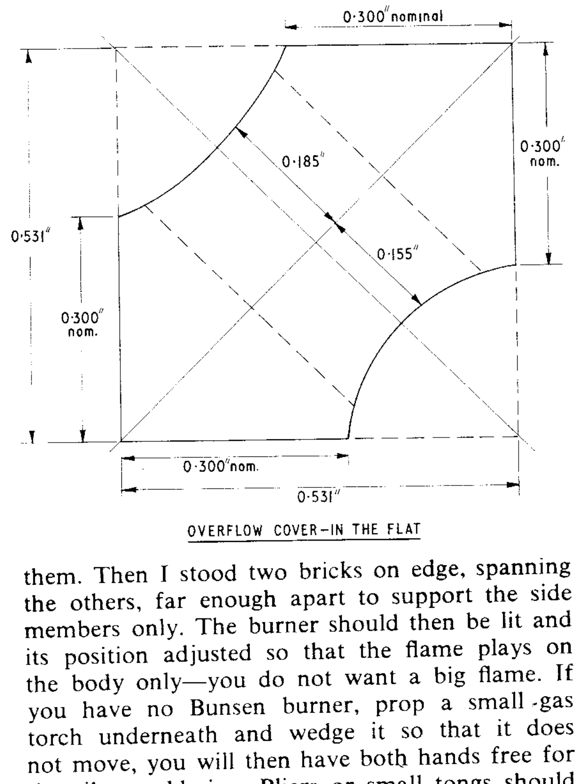


Fig. 8A. Below: Fig. 8C.



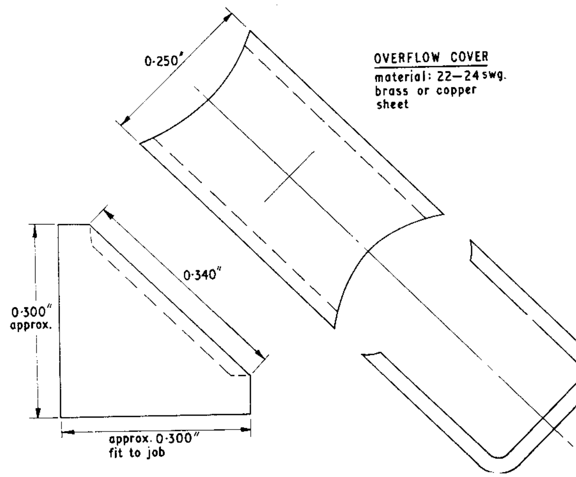
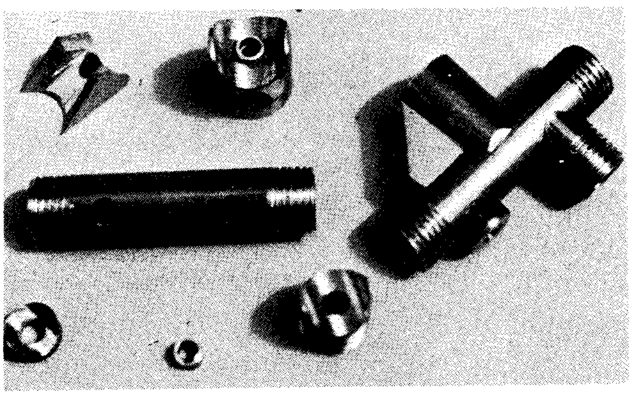


Fig. 8B.
Below: Fig. 8D.

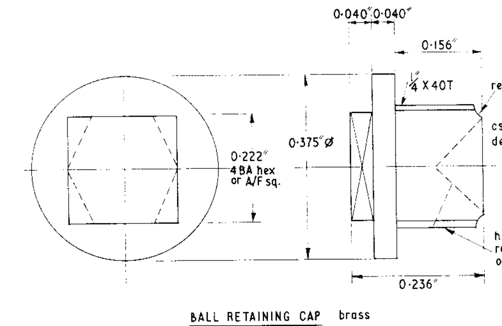


them. Then I stood two bricks on edge, spanning the others, far enough apart to support the side members only. The burner should then be lit and its position adjusted so that the flame plays on the body only—you do not want a big flame. If you have no Bunsen burner, prop a small-gas torch underneath and wedge it so that it does not move, you will then have both hands free for the silver soldering. Pliers or small tongs should be placed handy.

When the job is a dull red, apply Easyflo 1/32 in. dia. wire SPARINGLY to each joint. Have a close look at the joints and *gently* turn the job over; another close look and give a little touch of the Easyflo wire where necessary — the overflow cover is the most likely place for this. Let it cool off and drop the lot into cold water. After the usual pickle and clean up, put a 9/64 in. reamer in the ball seat and chuck the body and run a 7/32 in. reamer through to size the bore. Do this from the steam end and, if you bring the reamer back to the mouth of the bore, lightly press down on it and the entry will be very slightly broached; unorthodox, but it works just enough for what we want.

Reamers for the Cones

The reamers need to be accurate and exactly to the tapers specified. If they are not, then some parts of the cones will not be of the correct dimensions and the orifices could be in the wrong places. Actually, it does not take long to set over a top-slide on the lathe to turn the necessary tapers. Bill Carter uses a little sine-bar gadget; I



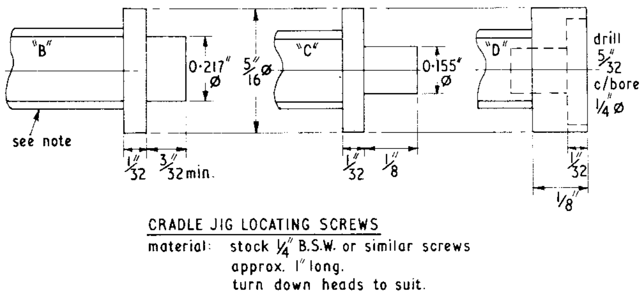
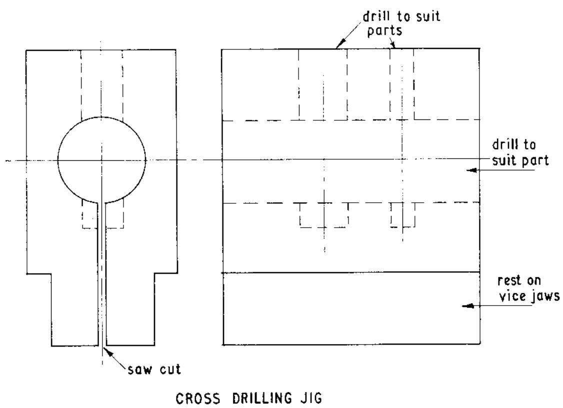


Fig. 11.

Fig. 9. Below: Fig. 10.



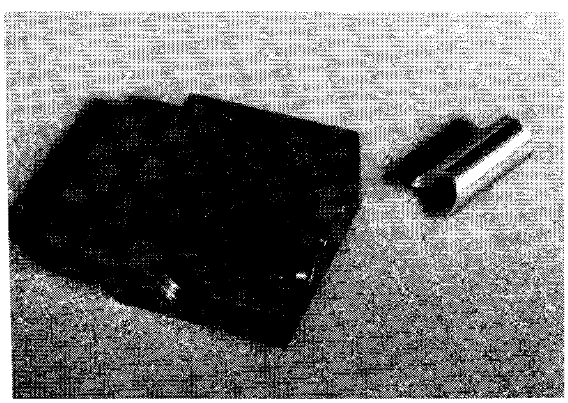


Fig. 10A: Simple drilling jig with part-machined boss.

don't have one of those, I used the halving of errors method. I have used various diameters from 5/32 in. to 7/32 in. including 5.5 mm silver steel (drill rod for our American friends) for the reamers, but 5/32 in. diameter is the minimum needed. The taper portion of a reamer needs *only to be as long as required* for the job; you will make better reamers like that. The table on the right shows the degrees and tapers in inches per inch, (taken from trig tables) and the uses of the reamers:—

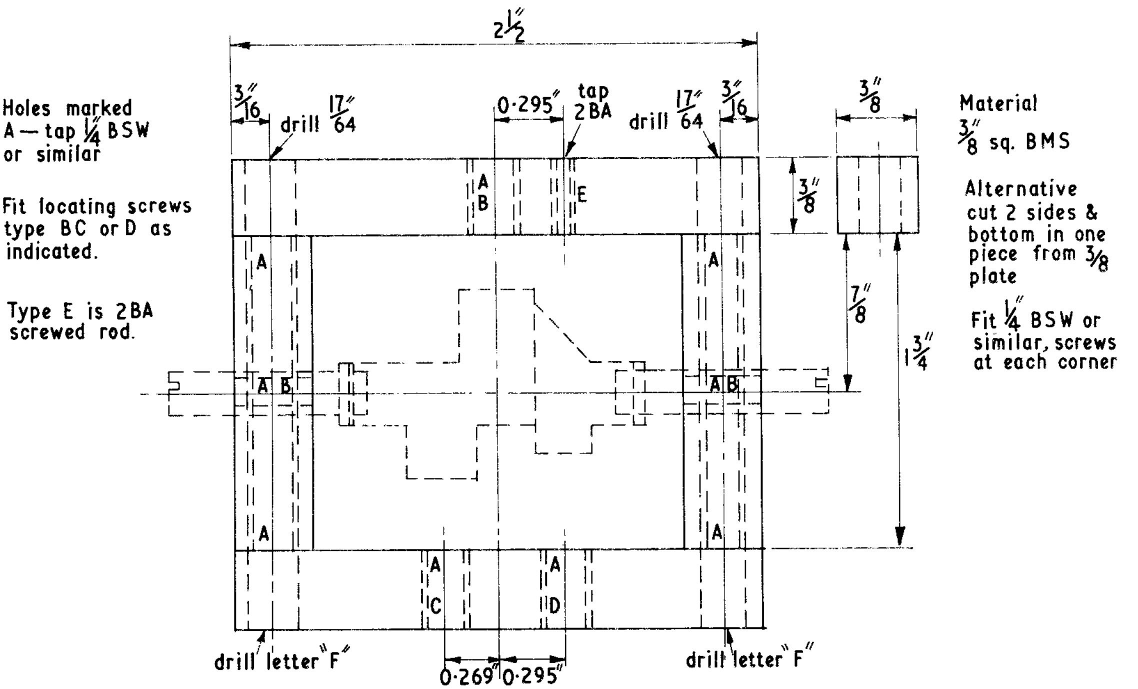
Those marked with an asterick are the only ones used in the Standard injector. The others are given for others who wish to experiment.

Hardening and tempering of reamers etc., has already been dealt with exhaustively in these pages and does not really need any repetition by me. You most *definitely need* paper and pencil or chalk to make a note of your figures as you proceed.

To save time and expensive material, you should make a dummy run for each reamer like this: put an odd bit of stock b.m.s. or brass in the lathe chuck, the same bit will do for several reamers as you turn it down, set over the top-slide index by half the number of degrees taper (the length along the side of the taper is a few thou longer than the axial length, see drawing). The work should be fairly close to the lathe chuck to avoid it "springing". Measure with micrometer each parallel's diameter and deduct one from the other; if the result matches pro rata the above table, then somebody has been very lucky indeed. Likely it will show a discrepancy and there are quick ways to correct and it pays to know how much you adjust the top-slide What I have done in the past is this:—

Example — Taper too *narrow* an angle, maximum diameter as turned on the dummy 0.293 in., minimum is 0.2 in., difference is 0.093 in., but my pro rata table shows that I want a difference of 0.113 in., so the thick end is 0.02 in. too small. To correct, run the tool into contact with the LARGER diameter, *gently* loosen the top-slide clamping screws, advance the *cross*-slide feed by one quarter of the error, i.e. $\frac{1}{4}$ of 0.02 in. =0.005 in. and the top-slide will swing. Carefully lock up and try again; do the same until right.

Example—Taper too *large* an angle; measuring the difference shows the maximum as 0.02 in. too much; run the tool into contact with the LARGER diameter, note the collar reading, withdraw tool (take up any slack!) 0.005 in., i.e. $\frac{1}{4}$ of the difference, *gently* slacken the top-slide clamp-



CRADLE JIG FOR S/SOLDERING PARTS TOGETHER

Fig. 11.

ing screws, swing top-slide until tool is in contact with the larger diameter, lock up and try again. Three or four shots are usually enough to get the angle right. Of course, you cannot always divide the difference exactly by four into whole thousandths of an inch, so one does a little "guesstimating" on the feed screw micrometer collar. You can get very close with this method, so close that it is not worth bothering with the odd half thou. In any case, the degree of taper of a cone is only relatively important, but other things hinge on this, so it is as well to get things right.

When turning silver steel, it is my habit to use a suitable cutting oil or compound and take a good cut. The tool should be *sharp* and *well honed*. Put a nice finish on the paper with a fine slip stone using a little light oil or paraffin with the lathe running fast — don't rock the stone. In Fig. 12 you will see each reamer starts with a short parallel portion which should be of accurate length. This is for what industry calls quality control and for the benefit of those people who will be filing the reamers down to half section. What one needs is a reamer with the cutting edge exactly along the axis; if it deviates from this, the reamer will not cut "straight" and may not cut at all. Thus it is essential when making reamers and cones that the lathe tool be set exactly at centre height. Incidentally, the full size injectors do not have all "straight" taper cones, the delivery cone is usually curved along its length in relation to its axis; more about this later; sometimes the combining cone is curved or multi-tapered.

For filing the reamer down to half section, the saddle is racked clear of the work and a suitable bar is clamped in the tool post and packed up to height and extended far enough to support the pip only. Both parallels are measured at intervals during filing; use a dead smooth file when near the half diameter to get within half a thou of finished size. Stone carefully by hand on a fine oil stone to get the best possible finish on the reamer — the little used edge of the stone used for wood cutting tools is what I used. Injector cones like to be smoooooooth!!

Bill Carter's reamers are put in a holder on the cross-slide of his lathe and, with an end mill in the chuck, he reduces them to half section taking light cuts.

Whilst the top-slide is set over at the particular taper for the combining cone, make a small taper mandrel out of $\frac{1}{8}$ in. dia. brass or steel rod, turned down to a near point; leave about $\frac{1}{2}$ in. or so of full diameter and part off. Its use will be explained later. Note that only one reamer is made for the combining cone because the two halves of this cone are not parted until after they have been reamed in one piece.

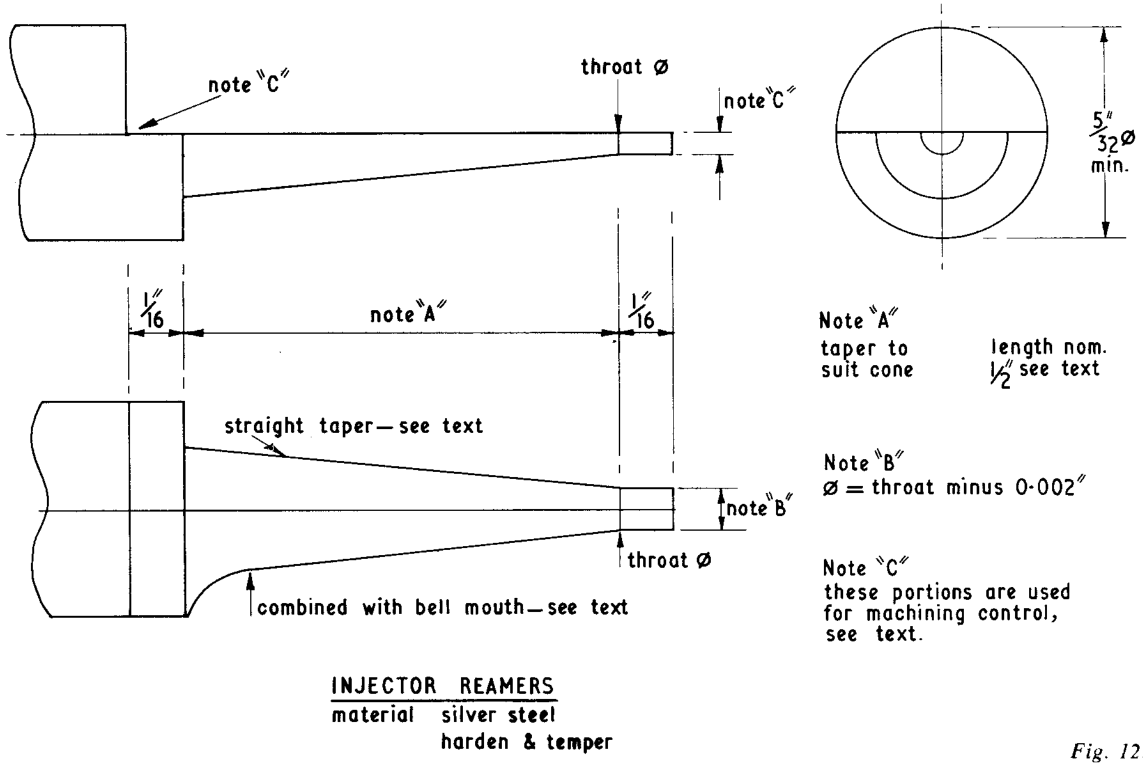


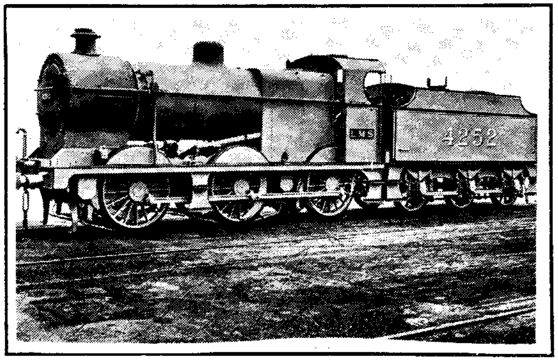
Fig. 12.

Reamer Degrees incl.	**Inclusive taper per inch**	**Length not more than**	**Generally used for**
6	0.105 ins.	0.6 ins.	Delivery Cone, Steam cone exit.
7	0.122 ins.	0.5 ins.	Delivery Cone, Steam cone exit.
8	0.140 ins.	0.5 ins.	Delivery Cone, Combining Cone
9*	0.157 ins.	0.5 ins.	Combining Cone, Steam Cone.
10	0.175 ins.	0.5 ins.	Delivery Cone.
11	0.193 ins.	0.5 ins.	Delivery Cone, Steam Cone entry.
12	0.210 ins.	0.5 ins.	Delivery Cone, Steam Cone entry.
13*	0.230 ins.	0.5 ins.	Delivery Cone, Steam Cone entry.
14	0.246 ins.	0.5 ins.	Delivery Cone, Steam Cone entry.
15*	0.263 ins.	0.5 ins.	Delivery Cone, Steam Cone entry.
16	0.280 ins.	0.5 ins.	Delivery Cone, Steam Cone entry.

Radiused in ins.	
0.15*	Bellmouth for Steam entry, Delivery exit.
0.10*	Bellmouth for Combining entry.
0.062*	Bellmouth for Delivery Cone entry.

The bell mouth reamers are a bit different; the radius to each one should commence at a *tangent* to the taper—no dog's hind legs! LBSC's method of shaping them with a small round file over-simplified the whole business. The sketch shows what is involved, Fig. 13. If this cannot be done on a tool and cutter grinder, then the time honoured method of taking a slice of suitable diameter silver steel and brazing on to a mild steel shank can be used. As an alternative, one can get four radii, two each on opposite corners each end of a bit of square silver steel and these can be filed round using hardened steel buttons as guides. Don't forget to hone them well after heat treatment.

To be continued



"DERBY 4F"

A simple locomotive for 3½in. gauge

by Don Young

Part VIII *From page 404*

THE JOINT to the adjacent cover is on the centre line, so with a square from the centre line on the top of the block, mark the cover, saw off and file almost to the line, leaving just a little for fitting when the other cover is at this stage. Remove one cover and mark on the horizontal centre line, which is very easy as it is the centre of the two flats just produced. From this, mark on the vertical centre line, which can be estimated simply by eye; it is an amazingly perceptive inspection device! Use these centre lines to mark off the seven No. 34 fixing holes that can be tackled at this time; drill these and countersink for 6BA brass or stainless steel screws. Offer both covers up to the block, spot through the No. 34 holes, drill the block No. 44 to 7/32 in. depth and tap 6BA, fasten with a couple of screws. On the horizontal centre line between the covers, centre pop and drill No. 34 just into the block for the eighth screw, drill and tap the block and finish by countersinking the covers to suit the screw.

Remove the covers and blow into the two front steam ports, like playing a mouth organ, to note the resistance to your "puff". Hold the cover in place and repeat; there will be a marked increase in resistance, caused by the restriction around the cover area. Ease the cover spigot, locally as shown, to allow freer access for the steam and also give attention to the flat filed at the end of the steam passages; this may project into the bore by as much as 3/32 in., but no more. When you have finished this job, fitting the cover should cause no additional restriction to your "lung pressure".

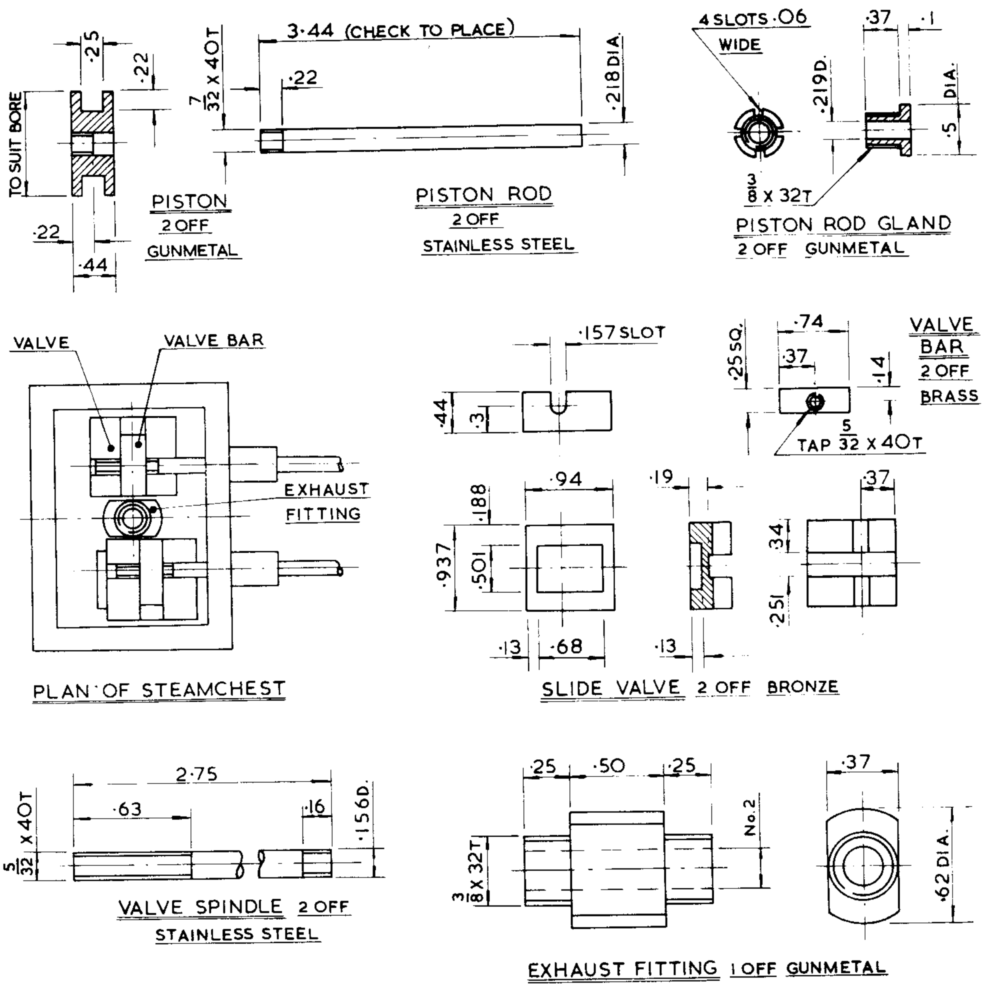
We can move on to the back covers, which can be dealt with quite quickly as many of the operations are the same as for the front pair. This time we do not need the chucking piece, so cut it off before chucking by the periphery. Face across the stuffing boss, to give the required 5/16 in. stand off from the cover, centre and drill through at No. 4. Follow up with a 11/32 in. drill to ¼ in. depth, "D" bit to 5/16 in. depth and tap ⅜ in. x 32T before running a 7/32 in. reamer through the remains of the No. 4 hole.

Grip a length of ½ in. dia. bar in the 3-jaw, either brass or steel, with about ⅜ in. projecting. Face the end and turn down for 7/32 in. length to ⅜ in. dia., leaving a nice square shoulder. Screw 32T, holding your die in a tailstock die-holder, another useful tool from our regular suppliers. Screw the embryo cover to this turning aid and it then becomes our chucking piece, ensuring that the spigot we shall be turning to fit the cylinder bore is perfectly concentric with the piston rod hole; very important this.

Carry on and finish this pair of covers as previously, making sure that the spigot is a really tight fit in the bore, and just cleaning up the back face in way of the fixing screws. The only point to watch when fitting is to get the slide bar facing, on top of the stuffing boss, as level as you can by eye; we will machine these faces later on.

The piston blank is another gunmetal casting, complete with chucking piece; tidy up the chucking piece first as for the front covers and then reverse in the chuck. Carefully face the end, centre, and bring the tailstock into use before turning down for the whole length to 1 5/32 in. dia. We must now rough out the first groove, so grind an old parting-off tool, with about an ⅛ in. blade, as square as possible at the cutting edge. With the lathe running at a fairly low speed, form the groove 3/16 in. wide x 3/16 in. deep. Start parting off at 15/32 in. length, but only reduce to ⅝ in. dia. for the moment. Remove the tailstock centre, replace with the drill chuck and drill No. 10 for a full ½ in. depth. Follow up with a 7/32 in. "D" bit to 7/32 in. depth and tap the remainder of the hole at 7/32 in. x 40T. Part off completely, run the tap right through, and then bring the second piston up to this stage.

For the first piston rod, chuck a 10 in. length of 7/32 in. stainless steel rod in the 3-jaw and turn a 90 deg. point; if the tool chatters, as very



often happens, rough out with a file and only complete with the tool, turning the lathe by hand. Reverse in the chuck and check with a d.t.i. that the rod is running perfectly true, with approx. 9/16 in. of rod protruding from the jaws. If there is more than .001 in. eccentricity, revert to the 4-jaw chuck and set to run true to within said .001 in. limit. When all is well, face the end and then screw 40T, using the tailstock die-holder. Screw an embryo piston onto the rod and face to the overall thickness of 7/16 in., this will have the effect of screwing the piston hard into place.

Start turning down the piston, a few thou at a time, until it is a sliding fit, with no shake, in the larger of the two cylinder bores. There is bound to be a slight difference between the bore sizes and by choosing the larger, if you do make a mistake the piston can be retrieved for the smaller bore. Finish by completing the packing groove to the drawing sizes, removing any burrs caused on the working surface with a fine file.

Beginners may be a bit worried about the effect of the different bore sizes on performance; it will not be noticeable, in fact you will be emulating full size practice after a refit. Taking as example one of the brilliant Gresley A4 "Pacifics" on which I was lucky enough to work, the L.H. cylinder was a replacement and bored out to the "starting size" of 18 in., the R.H. side had barrelled and was bored out to 18¾ in. dia., whilst the third cylinder between the frames was fitted with a cast iron liner to bring the diameter down to 17 in., to try and combat overtravel on the middle valve causing excessive load on the middle big end.

For the piston rod glands we need a piece of ½ in. dia. drawn gunmetal bar. Chuck in the 3-jaw, face, centre and drill No. 4 to 9/16 in. depth, following up with a 7/32 in. reamer. Reduce to ⅜ in. dia. for ⅜ in. length and screw 32T before parting off at a full 15/32 in. overall. The little adjusting slots can be produced by milling, with a slitting saw or Woodruffe key cutter, but by far the simplest method is to file them by hand; it does not matter one iota if the slots are not 90 deg. apart, though it looks much better if they are.

Screw the glands into the back covers and slide the pistons, rod first, into their correct bores. On the side of the block closest to the lengthened piston rod, mark out for the frame fixing screws, centre pop and drill No. 44 before tapping 6BA ONLY the centre hole in the upper row, no more.

Fit the block between the frames and secure with the sole ¼ in. BA steel countersunk screw. Push the piston along the bore until its point strikes the frame stay behind the driving axle. Adjust until the point is 7/16 in. up from the bottom edge of the stay, the cylinders are correctly positioned and a check will be those other hole centres that you marked on the block. Clamp the frames together, to trap the block and spot through all the fixing holes, from both frames. With the block still in place, drill both top rows of holes at No. 44 for 7/32 in. into the block and tap 6BA; remove the block.

The bottom row of holes is not far from the cylinder bores through the wall, so drill them No. 44 to no more than 9/64 in. point depth, using a collar on the drill to prevent it cutting too deep, as we did when drilling the ports; tap 6BA.

Saw the first piston rod off at 3½ in. overall, we shall have to shorten it again later; the cylinders are almost complete save for the items in the steam-chest, which are rather important, putting it mildly. To start the ball rolling the valve spindles and their glands can be quickly dealt with, no need for description for these simple parts; on to the slide valves. These again are gunmetal castings and require very little machining. Chuck in the 4-jaw and face across the working surface until the cast-in cavity is a full ⅛ in. deep. Reverse in the chuck and reduce the overall height to 7/16 in. Reduce the width of the valve to a bare 15/16 in., keeping the cavity central and using a piece of brass or aluminium packing between the relevant chuck jaw and the working face of the valve.

We must now revert to the machine vice and vertical-slide set-up, with the working face of the valve facing the chuck. With a large diameter end mill, between ½ and ¾ in. dia., and using the side teeth, mill the valve to the correct overall length of .937 in., again keeping the cavity central and check the finished valve length with your micrometer. Now, with the 1/16 in. end mill, clean up the cavity until you obtain that .188 in. dimension shown at each end; this dimension must be equal and the .188 in. shown may be reduced to .180 in. to achieve this if necessary. Turn the valve over and with a 3/16 in. end mill tackle the ¼ in. slot to accept the valve bar, which is a selected piece of ¼ in. square brass bar at this stage. This slot need not be absolutely in the centre of the valve, but it must be square across, so the ports are opened square and clean by the slide valve.

To finish the valve bars, cut to length and grip in the machine vice, on the vertical-slide. Centre and drill through at the position shown at No. 30 and tap 5/32 in. x 40T. Fit in the valve slot and try the valve spindle in place, you will probably have to depend the "U" slot a fraction so that the valve bar "bottoms" before the spindle does in its slot. Achieve this with a file, keeping the slot to a close fit for the 5/32 in. spindle, then the valve will not wander sideways and strike the exhaust fitting, the next piece we must tackle.

Chuck a length of ⅝ in. diameter gunmetal bar in the 3-jaw, face the end, centre and drill No. 2 for 1⅛ in. depth. Turn down for ¼ in. length to ⅜ in. dia. before screwing 32T and parting off at 1 in. overall. Reverse in the chuck and screw this end also, leaving a piece of original bar the same as the depth of the steam chest, within .005 in. plus or minus; this you can check with a micrometer.

Screw the fitting hard into the block and mark on the position of the two flats; file these on initially to suit a ¼ in. BSF spanner and use this item to tighten in again and check for final reduction to ⅜ in. across the flats; fit with this size spanner. You can now assemble the valves and check that they do clear the exhaust fitting, but before final assembly we must attend to the working face.

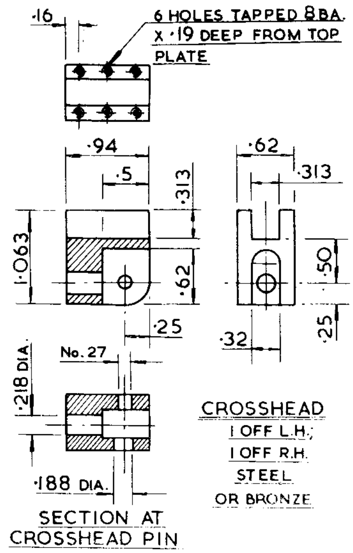
My experience has been that when milling the slot at the back of the valve for the valve bar, this distorts the working face slightly. To correct this, first rub along a large, flat, smooth file. To complete the renovation, lay a piece of crocus paper, or fine grade "wet and dry" on your surface plate and rub to a mirror finish. Assemble once more, put the steam chest cover on and we can cap this with the exhaust flange. For the moment this is simply an ⅛ in. thick disc of ¾ in. dia. brass or gunmetal bar, tapped centrally at ⅜ in. x 32T. The cylinders are virtually completed and can be laid aside for quite a while, whilst we move on to other items. Incidentally, in earlier years, yours truly used to think that if the cylinders and boiler were completed successfully, and these were the first two items tackled, the rest of the construction would present little problem. Beginners can now feel they have successfully negotiated the first part of the course.

The motion

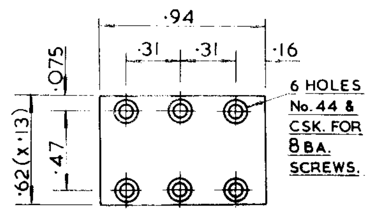
We have now completed the major part of the chassis and the drawing of the complete frames, which if published earlier might have frightened a few beginners. Although there are still a lot of pieces to be made, most of them are quite straightforward and we shall be making much more rapid progress ; let us commence right away with the crossheads.

Although the crossheads can be machined from 1 in. x $\frac{5}{8}$ in. b.m.s. bar, because the same material is used for the slide bars, it would be better if a nice chunk of bronze could be acquired. Whichever material is used, first machine up two blocks, by chucking in the 4-jaw, each 1 1/16 in. x 15/16 in. x $\frac{5}{8}$ in., Scribe on the centres of the crosshead pin and piston rod holes, also the slot to suit the slide bar. Re-chuck in the 4-jaw with the crosshead pin hole centre running true, centre and drill through at No. 27, following up with a 3/16in. 'D' bit to $\frac{1}{4}$ in. depth. Remember this hole hands the crossheads, so chuck the second block the other way round, so to speak, so that both 3/16 in. holes are on the inside. Next use the machine vice and vertical-slide set-up, turning the top of the block towards the headstock ; grip a $\frac{1}{4}$ in. end mill in the three-jaw and mill the slot for the slide bar, to suit the latter material, a 3$\frac{1}{2}$ in. length of 5/16 in. square mild steel bar. Make the slot a nice close fit over the slide bar and to check for the correct depth, hold a dummy top plate firmly in place and check that this does not trap the slide bar, nor provide a clearance of more than 1$\frac{1}{2}$ thou., the thickness of your thinnest feeler gauge blade. If there is excessive clearance, mill a little from the two top faces to arrive at the correct clearance.

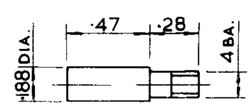
On the back face of the crosshead, 15/32 in. up from the bottom face on the vertical centre line, centre pop deeply. Chuck in the four-jaw with this pop mark running true and drill 5/16 in. dia. to a bare $\frac{1}{2}$ in. point depth ; 'D' bit to the full $\frac{1}{2}$ in. depth. Another way to do this is to grip the body in the machine vice, chuck the drill in the three-jaw and feed the job onto the drill, followed by the 'D' bit ; this is the way yours truly would tackle this part, but the advice to beginners is to follow the first instruction. Then you can go back to the machine vice and mill out the 5/16 in. wide slot to accept the connecting rod small end, with a $\frac{1}{4}$ in. end mill, carefully breaking into the 5/16 in. hole. In fact it is a good plan to feed the end mill centrally into the 5/16 in. hole, $\frac{1}{8}$ in. or so at a time and then traverse the job so that the end mill works its way to the bottom face of the crosshead, then you just widen the slot to size.



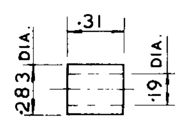
CROSSHEAD
1 OFF L.H.; 1 OFF R.H.
STEEL OR BRONZE



TOP PLATE 2 OFF STEEL OR BRONZE



CROSSHEAD PIN 2 OFF SILVER STEEL



SMALL END BUSH 2 OFF GUNMETAL OR PHOSPHOR BRONZE

That operation finishes the crosshead pin holes, except for removing any burrs, so we can turn attention to the piston rod hole. Back to the four-jaw chuck and set up so that the piston rod centre pop is running true. Use a short length of 5/16 in. square bar in the slide bar slot, to prevent the chuck jaw damaging the slot inadvertantly. Centre and drill through initially at No. 4. The object of the exercise is to get the piston rod a very tight push fit in the crosshead, something that was not very easy to achieve in days past, for my experience of 7/32 in. stainless steel rod is that it is invariably slightly undersize.

To be continued

AN EXPERIMENTAL FLASH STEAM LOCOMOTIVE

Part II

From page 450

is proposed by Harold A. Illingworth

A VERY HOT BLAST under the fire and a red-hot steampipe to the engine, implying boiler and engine able to stand up to and make use of these temperatures is, as I see it, the way a flash steam entry might win IMLEC.

Though some would find a powerful flash generator a much less daunting building proposition than an equivalent copper loco. boiler, this has not shown itself hitherto in response to such articles as those by the late Edgar Westbury but which unfortunately stopped short before generators had been considered at all. The Author told me he had been depending for this on the collaboration of certain experienced flash exponents, but which was in fact not forthcoming in time. In this respect I feel even the new "Flash" book is rather vague; the actual method of forming the coils or grids is hardly mentioned, yet it is only too easy to spoil tubing in finding out. Anyone who has been in a shop specialising in tube manipulation will have noticed the ingenious appliances and gadgets, often made in the shop, but it is not a subject recently dealt with at any length in "M.E.".

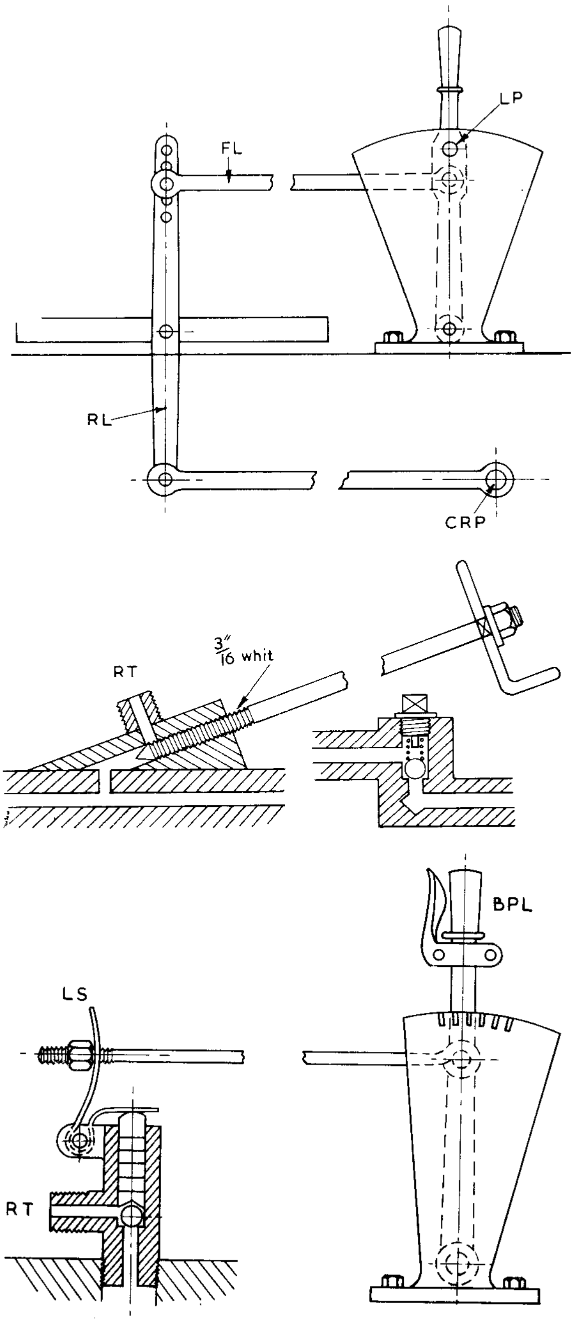
Not being particularly nimble fingered myself, I have found it pays to make simple wooden jigs and formers for any repetitive formation rather than try to bend it up 'freehand' by me. The time spent on the preparations will probably be more than on the bending itself but over the whole job no more time will be needed while the result is certain to be nicer to look at.

Nor can the matter of joining the lengths of tube be evaded. Where there is no powerful blowlamp to play directly onto the tubing, and the windings consist of straight lengths between short bends I think silver soldered sleeves quite adequate if each is protected, perhaps by an asbestos jacket as used on electrical work, and wired on to prevent slipping. But in such an untried venture as a powerful flash loco. the builder would probably want to incorporate some means of separating the generating elements, for which I would suggest the unions used by Pearson and the earlier European steamcar builders. Although the joint shown by Benson & Rayman on p.152 is used successfully in quite large sizes, and R. & L. sockets were used in all the "White" cars, I think the plain union with flanged tube ends combines steam tightness, ease of manipulation, and robustness better than other systems. But they would almost certainly have to be machined from hex. steel rod by the builder himself.

Still the question of length and dia. of tube has not been answered. Guessing at this distance in time, the P-C "15" might have had somewhere about 180 ft. - 200 ft. of boiler grids — perhaps ⅜ in. OD and 5/16 in. ID. Whether the bore varied between inlet and outlet I do not know, never having had occasion to replace a grid. So although the Flash Steam book seems to imply that for model racing hydroplanes the biggest lamp on the smallest boiler brings the best results, I cannot myself believe that the same recipe will necessarily bring home the IMLEC Trophy. I think that both capacity and mass of metal are of value for traction work, besides extended heating surface to secure reasonably low smokebox temp., and that when a grate area has been decided on, then the firebox with the largest possible volume and H.S., followed by as deep a convection stack as possible without choking the draught, will between them not give an undesirably long circuit. Mr. Ewins in his Report gives a formula for grate area, but I cannot make it work: most builders will have their own ideas on the matter, perhaps based on data published in the IMLEC reports.

As to steam temp. at the output end I would say "As hot as the engine will stand," and bring the circuit round for maximum final temp., trusting the results to speak for themselves; which is why I would specify poppet valves for preference. But evidently the hydroplane men have learned how to run piston valves pretty hot too.

The form of Control may now be considered, because for a variable output plant — as opposed to a 'flat-out' racing plant—this is really the key to its practicability in use. Benson & Rayman refer (p.9-10) to the tendency to increasing superheat on uncontrolled plants; this is very noticeable on the road where, on the occasional level straight of several miles, a car will go on picking up speed without alteration of the controls until road con-



The three cab controls proposed by the author.

ditions compel a shut-down. The same authors also refer to the dire consequences of water failure with the burner still going full bore. I feel therefore that a flash model loco. should generally follow the European control system without "automatics" other than simple spring-loaded valves, and that it should also be essentially "fail-safe" as well. Although I have no experience of non-condensing flash jobs, this seems a case where the Competition restriction to solid fuels is very favourable to these desiderata because not only does the locomotive blastpipe have the characteristic of drawing a weight of combustion air fairly closely following the weight of steam passing, but if the blower fails when the engine is drifting or standing the heat output from the fire at once falls to a harmless amount.

The simplest way to keep the blower going would be to pressurise the water tank slightly, feeding the generator through the pump valves. This would depend on the tank capacity being sufficient for the IMLEC half-hour run, otherwise the system would become a little more complicated. Another way would be to use a steam driven donkey pump as in the later Serpollet and DABEG systems, though I would not choose it myself.

The type of feed-water pumps indicated are horizontally opposed as used by both White and the Stanleys. They are driven from a coupling rod and mounted on the running plate much as in the French ACFI system. The linkage is so arranged that the pumps can be worked at starting by a lever in the cab, and so cutting out a separate hand pump and its piping.

The amount of water passing to the generator is controlled, as in the Miesse and Pearson systems, by a spring-loaded bypass valve also worked from the cab. This bypass is between the pumps and the boiler check valve; immediately following the latter is the release valve returning the water in the generator to the water tank if an emergency stop is necessary. This release valve is also controlled from the cab. The pumps and their drive must be far more heavily made, but otherwise can follow good loco. practice. The by-pass valve, whatever form it takes, should be easily accessible because in operation it is kept 'on the dance' and so needs regular attention. At least that was my experience.

At the steam end of the generator there is another lightly spring-loaded valve which leads to the blower jet, and set to open when boiler pressure falls to the air pressure on the water tank — or the 'pressure tank' if a separate one is fitted. This blower steam might be arranged to pass through the engine steam-chest to keep it warm while standing.

The cab controls are therefore three levers and a steam pressure gauge, though a pump delivery pressure gauge as well would be interesting, to see the pressure drop which will vary with the generator through-put. A fourth lever would operate the Reverse, combined with the essential reduction gearing from the high-speed enclosed engine. For this I suggest two crown wheels and a driving pinion between them; either the crown wheels to slide along a squared shaft, or else the pinion to engage one or other crown wheel by inclining the driving shaft a degree or two to either side, the engine holding-down bolts having a trifle of play.

For this experimental IMLEC engine I visualise everything of a strictly functional nature—boiler casing, engine mounting, pumps, piping — and with a width, to Continental loading gauge on 5 in. gauge, of 10 in. over running boards, an all-over casing, like Bulleid's "Leader", to clip on and off in a second. Even the driver's cab at each end would not just be "full of emptiness" but would hinge or lift off for firing or other necessary attentions.

As to wheel arrangement, all loco. men seem to have their favourites, and I am "a child in these matters". In a general arrangement I roughed out there were two sets of 4-coupled 5 in. driving wheels with a bogie each end, making a 4-4-4-4 arrangement. The cross shaft carrying the crown wheels also carries two chain sprockets, each driving to one set of 4-coupled drivers, and giving some choice of ratio by varying the sprockets.

But I do not offer 'Wheel arrangement' as part of my present thesis, which is now complete. (—"and about time too" I seem to hear!).

"FURY" of the L.M.S.

Sir,—The letter from Mr. E. A. Langridge published in "M.E." No. 3503 was of great interest to me, containing as it did, items of information relating to the design of the *Royal Scot* of which I and many others must have been unaware. Furthermore, his statements seem to support my belief that the drawings of the Southern Railway's "Lord Nelson" Class in no way influenced the design of the L.M.S. engine.

Referring to the comments in the same letter relating to *Fury*, I endeavoured to ascertain when Stanier had the locomotive put in steam and the route it covered for any evaluation of the coal consumption; the results of my enquiries were totally inconclusive and no-one could produce any record of *Fury* working over any main line section of the L.M.S. in regular traffic or with a test train. To have arrived at such a positive decision such running would have to have been done but no records appeared to exist. In any case, exhaustive tests in service in Germany of the prototype Schmidt-boilered engine provided the answer and the figures would have been available to Stanier.

Fury's boiler was not returned to the builders, the North British Locomotive Company. It was built under a separate "D" order number but it was to the order of the L.M.S. I was told that its manufacture was partly paid for by the Superheater Company. The oval plate on the side of the firebox was worded. "The Superheater Co. Ltd., Bush House, Aldwych, London. Schmidt high pressure two pressure loco boiler".

In the caption to the photograph on p.136 of "M.E." No. 3506 I queried the identity of the three figures depicted. Mr. R. Greiffenhagen, of Cheltenham, has kindly provided me with almost certain evidence that the right and left hand personages are Col. H. A. Stenning, OBE, TD, MIME, Managing Director of the Superheater Co., and Mrs. Stenning. The source of the information is "The Locomotive" of 15th November, 1934, and "the curriculum vitae of Col. Stenning, which appeared on p.350 . . . on the eve of his retirement", together with a photograph. The identity of the central figure remains uncertain. Various portraits of Sir Henry Fowler show him wearing glasses (pince nez on occasions) and with a fairly large moustache. It is also doubtful if Fowler and Col. Stenning were ever at the NBL works at the same time, as the recorded dates of their visits were separated by a gap of four days.

One reader has found a weak spot in my records relating to *Fury*. On p.135 I said that "an authoritative German text book demonstrated conclusively that, whatever gains the Schmidt-Henschel system might have had, the high initial cost of such a locomotive could not be justified. In addition, the expected saving in coal consumption was not apparent." The querist asks for the name of the book referred to and this I cannot provide as the typed translation has disappeared from my files. A German member of the NBL staff showed me his copy of the book and gave me the translation referred to, details of which are quite clear in my mind. In fact, they were the only positive details which indicated why *Fury* was scrapped. Can any reader supply the name of the book which, to my knowledge, has never been translated from the original German?

Ludlow. John H. Court.

Hot Air Engine

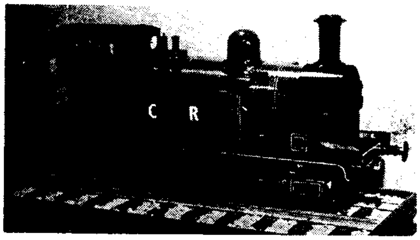
Sir,—Other M.E. readers may be interested to know that I have completed a really hot propane burner for my rhombic drive Stirling engine, and it now has made on the brake 29.5 watts at 1400 r.p.m. at atmospheric pressure, and 50.5 watts at 1350 r.p.m. at 15 p.s.i. above atmospheric.

Columbus, Ohio. M. Andrew Ross.

ERRATUM

In the letter on "Nuts & Bolts", April 4th, page 360, the formula for the stress in studs should be:

$$f = \frac{1}{a}\left[T + P\left(\frac{ae}{ae + AE}\right)\right]$$



MODEL LOCOMOTIVE CONSTRUCTION FOR BEGINNERS

by Martin Evans

Part VIII

From page 32

BEFORE I deal with the various methods of machining cylinders, perhaps a few words on valve functions would not come amiss.

The function of a valve, whether of the slide, piston or poppet type, is to control the inlet of steam to the cylinders and the outlet of it into the blast pipe after it has done its work.

There are four events which take place on each side of the piston during each revolution of the driving axle. These are:

1. Admission 2. Cut-off 3. Exhaust
4. Compression.

In normal running, admission takes place slightly before the piston reaches the end of its previous stroke. (Depending on the amount of "lead".) A small amount of the exhaust steam is trapped in the cylinder, by the closing of the valve, at the point of compression, and between this point and the point of admission is the period of compression. Admission of live steam now takes place and raises the pressure in the cylinder to 80 to 85 per cent of boiler pressure.

Steam now continues to enter the cylinder until the point of cut-off is reached, as determined by the position of the screw or lever reverser in the cab and therefore by the valve gear, after which the steam continues to do work by expanding. When the piston has nearly reached the end of its stroke, the valve closes to exhaust, and the point of compression occurs.

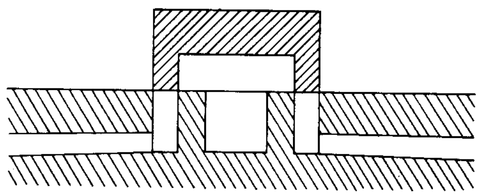
In the earliest steam locomotives, the slide valves in use had no "lap", i.e. the valve just spanned the ports, thus at almost any position the valve was either open to live steam or to exhaust, and as the steam had no chance to expand, it was used wastefully. In more modern locomotives, the valves were given lap, leading to smoother and more economical running as described in the cycle of events above.

The lap of a valve can be defined as the amount by which the valve overlaps the outside edge of the steam port when the valve is in its mid position.

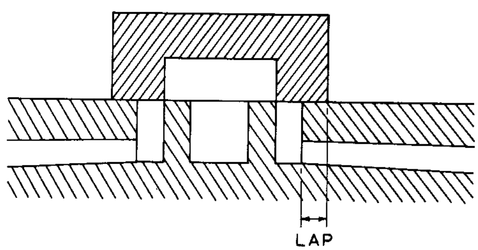
In a steam cylinder where the valve is not given "lead", when the piston is exactly on dead centre, the valve is just about to open to steam at that end. If the valve opens to steam before the piston reaches dead centre, it is said to have lead. Lead may therefore be defined as the amount by which the valve is open to live steam when the crank is at dead centre.

In full-size locomotives, a certain amount of lead is essential, except at starting, so that full pressure can build up against the piston as early as possible in the stroke. This applies even more

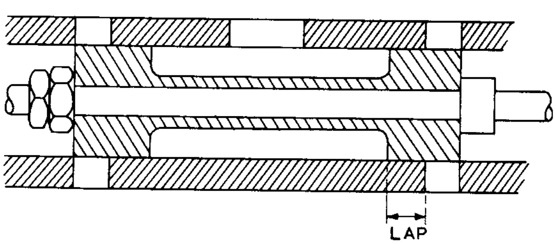
A. SLIDE VALVE WITHOUT LAP

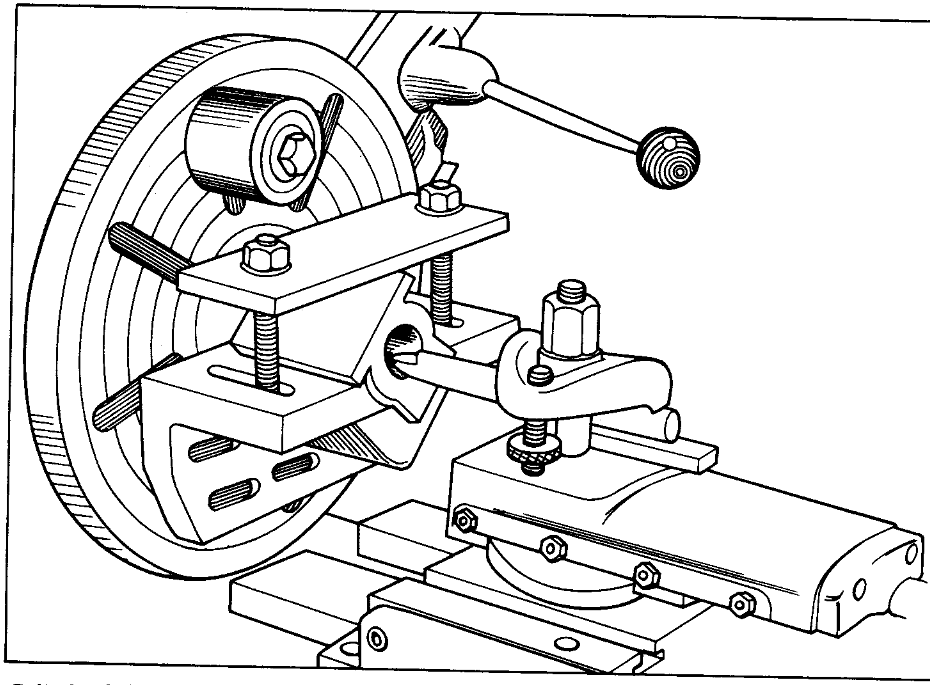


B. SLIDE VALVE WITH LAP

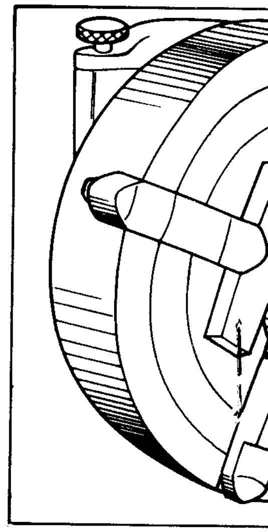


C. PISTON VALVE WITH LAP





Cylinder held in Vee angle plate for boring.



Cylinder he

to the model locomotive; the difficulty is to decide how much lead to allow as it depends on many factors, such as the type of valve gear, the proportions of steam and exhaust pipes, ports and passages, cross-sectional area of regulator port, main steam pipe, etc.

Generally speaking, the lap in model cylinders should be made equal to the port width, though this may not always be possible in early types of locomotive for purely mechanical reasons.

The lead, in the case of constant lead valve gears such as Walschaerts, Baker, etc., should be between $\frac{1}{8}$ and 1/12 of the lap. In the case of Stephenson Link valve gear, the lead is variable, but this will be examined in a later article.

To assist a free exhaust, valves are sometimes given "exhaust clearance". Exhaust clearance can be defined as the amount by which the inside edges of the valve overlap the inside edges of the steam ports, or in other words, the amount by which the valve is open to exhaust when in its mid position. On a normal locomotive with adequate steam pipes, ports and passages, no exhaust clearance should be necessary, but if it is given, it should only be a very small amount—not more than 1/15 of the lap. Where compound locomotives are concerned, the situation is different, and some exhaust clearance should be provided for the high pressure cylinder/s.

The question of the size of the steam passages between ports and bores was dealt with in my last article (3 January), so I will now pass on to valve travel.

Valve Travel

In a two-cylinder locomotive, the cut-off in full gear should not be made too early, otherwise starting will be difficult, especially if the valve gear is a constant lead one, as lead is of no assistance in starting. At least 75 per cent should be allowed for. A three-cylinder locomotive with its cranks at 120 deg. may have a full-gear cut-off of 70 per cent.

Anything up to 85 per cent cut-off is of advantage in starting.

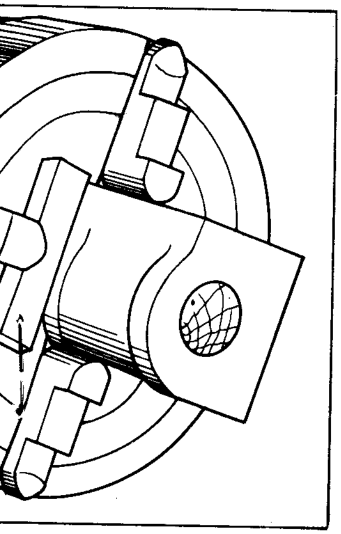
For a valve which opens the ports fully in full gear, the valve travel will be 2 (port width+lap) in full gear.

The cut-off in full gear can be calculated as follows:

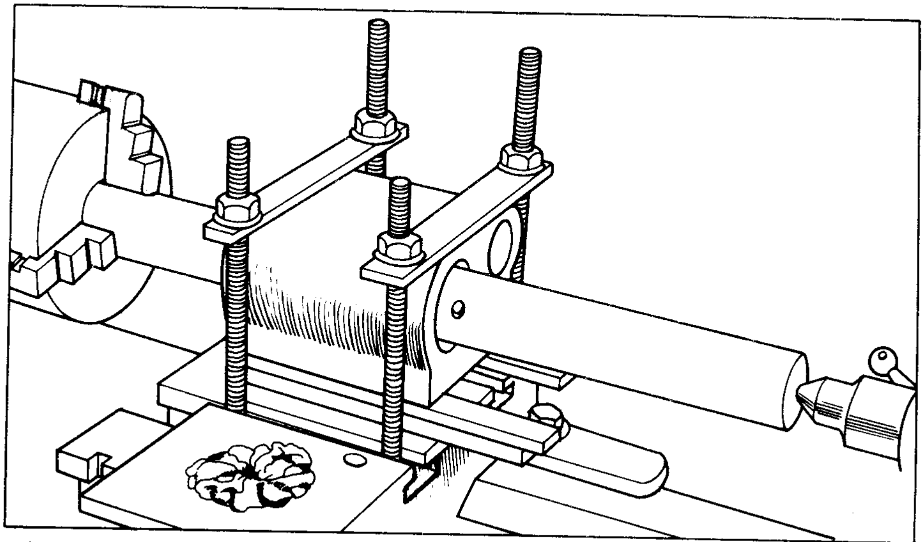
$$\text{Cut-off} = \frac{\text{Port}^2 + 2\,(\text{port x lap})}{(\text{Port} + \text{lap})^2} \text{ x } 100\%$$

To take an example, if the port width in a one-inch scale cylinder is 3/16 in. and the lap 5/32 in.,

$$\textit{Then}\ \text{Cut-off} = \frac{3/16^2 + 2\,(3/16 \text{ x } 5/32)}{(3/16 + 5/32)^2} \text{ x } 100\% = 80\% \text{ approx.}$$



r held in 4-jaw chuck.



A 5 in. gauge piston valve cylinder clamped to cross-slide for "between-centres" boring bar.

If both port width and lap are 3/16 in.,

$$\text{Cut-off} = \frac{3/16^2+2\,(3/16 \times 3/16)}{(3/16+3/16)^2} \times 100\% = 75\% \text{ approx.}$$

In the above formula, lead is neglected, but this would decrease the cut-off point.

Machining Cylinders

In machining model cylinders, it is logical to make a start on the block or body of the cylinder. If the lathe is large and heavy enough, the block may be clamped on an angle plate bolted to the faceplate or one of the special Vee angle plates, such as the Keats', may be employed. As this set-up will probably be considerably out of balance, some kind of balance weight will have to be bolted to the faceplate.

Beginners sometimes have difficulty in obtaining this balance, even though only an approximate balance is required. One method is to choose a short length of b.m.s. round, perhaps $1\frac{1}{2}$ in. dia. drill this through $\frac{3}{8}$ in. dia. and bolt this by one of the slots in the faceplate close to the cylinder. Try this first at low speed, then increase the mandrel speed up to its maximum, when any vibration due to the "out-of-balance" will be obvious. Now move the balance weight further out in its slot and try again. A position will soon be found where the vibration at top speed is at a minimum. On now reducing the mandrel speed to about half full speed, all vibration will disappear, when facing and boring the cylinder may proceed.

The cylinder, incidentally, should be set out far enough from the faceplate to enable the boring tool to pass right through without fouling it.

As stiff a boring tool as can be accommodated should be used, and when the finishing cuts are approached, the tool should be removed for re-sharpening. Having reached the final size, the boring tool should be put through at least a second time without shifting the cross-slide.

Reaming either a gunmetal or a cast-iron bore is not necessary and in any case, reamers of $\frac{1}{4}$ in. dia. and larger are very expensive and difficult to manage in small, light lathes. If a better finish than can be obtained from boring alone is required, the answer is to lap. A proper lap should be used, and only a few thou should be removed and great care taken to avoid "bell-mouthing". A very smooth bore that is not parallel is much worse than a truly parallel bore that is not quite smooth. A copper adjustable lap should be used and this should be mounted in the lathe and the cylinder block (up to 1 in. scale) held in a gloved hand.

After lapping, great care should be taken to remove all traces of the lapping compound used, by washing repeatedly in paraffin, this is even more important with gunmetal cylinders than with cast-iron.

For inside cylinders, the block may be lined up for the second bore by shifting the angle plate only; this also applies to boring a piston valve cylinder for the valve liner. An outside cylinder may now be removed for facing off the other end. One way of tackling this operation is to turn up a length of round brass rod to act as a mandrel, a tight push fit for the bore, the cylinder block being pushed on to this for facing the end. In case the bores of the two cylinders are not exactly the same diameter, care should be taken to turn the mandrel to suit the larger bore first, after which it can be skimmed down to suit the smaller.

When cylinders are too large or too heavy to be mounted on the faceplate or held in a chuck, they may be bored by bolting them on the lathe cross-slide. The cylinder block is packed up so that the centre of the bore is exactly at lathe centre height; a boring head or a between-centres boring bar is then used, and these should be as large and heavy as will pass through the unmachined bore. Care must also be taken that the clamping bars used to hold the block down do not distort it; to avoid trouble these bars can usually be arranged over the flanges, where the metal of the casting is considerably thicker than between them.

After completing the bores and facing the ends, the port face and the bolting face of the cylinder block may be machined. A large 4-jaw chuck can be used here, but great care will have to be taken to ensure that the block is held square, and pieces of a soft metal should be put between the chuck jaws and the cylinder, especially if it is of non-ferrous metal. Another method is to bolt the block on end to an angle plate attached to a vertical-slide, by means of a large bolt through the bore, the machining being carried out by end mills. The same set-up can then be used to cut the ports, if the cylinder is of the slide valve type.

Although the steam and exhaust ports of a slide valve cylinder can be "gang-milled", either in the lathe or on a milling machine, this method leaves the ports in a "$\frac{1}{4}$-moon" shape, which are too shallow at the ends, and causes difficulty when drilling the outer holes (or milling out the slots) forming the passages between ports and bores. With the end-milling set-up, either a regulation end-mill or a slot-drill can be used, in collet or 3-jaw chuck. (Slot-drills can be obtained as small as 1/16 in. dia. for the steam ports of Gauge "O" locomotives.)

Where the lathe in use has the cross-slide and vertical-slide with graduated dials or handwheels, the width and length of the ports can be quickly read off from these, though the ports should always be marked out beforehand as a precaution and as a check on one's figures. If the lathe lead screw has a graduated handwheel, by engaging the saddle, the depth of the ports being cut can also be determined with accuracy.

On large scale cylinders, the passages between the steam ports and the ends of the bores may be cast in, but if not, these will have to be drilled or milled and filed out, a process which should be done with care. Whether a "milled out" or a "drilled out" passage is required, always start by filing a good flat on the outside edge to give the drill or mill a good start at the right angle to break out low down in the steam port.

For the "drilled out" method, proceed as follows:

Mark out the shape of the required passage and centre pop deeply (at three to five points, according to size), at intervals equal to $1\frac{1}{2}$ times the diameter of the drill to be used. Drill right through. Now cut off some lengths of brass rod an easy fit in the holes, the full length of the passages; "tin" them with ordinary soft solder, insert in the holes until flush at each end and heat the cylinder gently until the solder just melts.

Next pop again *between* the original holes, drill again, heat up the cylinder until the solder melts again and shake out the "bits". With a flat coarse-cut needle file, the slot can now be finished to size.

Incidentally, the cylinder block should be carefully set up on the drilling machine table and lightly clamped at the required angle, which can be determined by "sighting" the drill against the side of the block before drilling. A depth stop should be used if available.

The difficulty of *milling* cylinder passageways is in obtaining an end mill which is long enough. Extra long end mills can however be obtained to special order, and in the diameter required for most scales of models should not be unduly expensive. Failing this, an ordinary end mill could be extended by brazing on an extension piece of a diameter a few thou smaller than the cutting end. Needless to say, milling passages must be done with great care, only very light cuts being taken.

The position of cylinder passages must be chosen with due regard to the position of the steam chest and cover fixing studs.

DRAWINGS FOR "FURY"

LO.942. Sheet 3. Coupling rods, inside motion, inside cylinder, simpling valve.

Sheet 4. Inside valve gear, inside crosshead and motion plate, outside cylinders and details.

Sheet 5. Inside connecting rod, inside valve gear details, outside motion plates, crossheads, slide bars, valve crossheads.

Sheet 6. Outside valve gear, connecting rods and link brackets.

Price 70p each inclusive of post and VAT.

TICH-TIMES-TWO

The story of a doubled-up "Tich" for $7\frac{1}{4}$ in. gauge

Part II

by W. J. Manley

From Page 458

THE LUBRICATOR is fitted to the offside running board and has a hinged lid to avoid it getting mislaid or lost. It is per LBSC except that I have used flat bronze springs instead of pawls and coil springs. They seem less likely to give trouble. The delivery is to a clack on the side of the smokebox and thence to the steam delivery between the hot header and the steam tee to the cylinders.

The steam delivery to the cylinders is also provided with removable plugs protruding through the running boards and will enable a shot of cylinder oil to be administered before running commences. On the opposite side of the smokebox to the oil delivery clack, a snifting valve is fitted and this is connected via an $\frac{1}{8}$ in. pipe to the wet header.

Most of the valve gear links were machined from $\frac{1}{2}$ in. square steel bar and had 3/16 in. silver steel pins. These pins have been secured in this case by 1/16 in. split pins and washers, the same as in the brake gear. On previous jobs I have reduced the ends of the pins and screwed 8 BA with steel nuts and washers which I must admit looks much better and nearer to prototype.

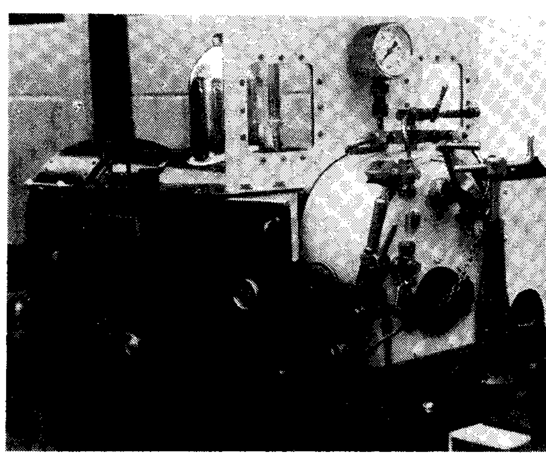
After making the pole reverse lever I was able to rig up some temporary pipe work to each cylinder in turn and, with my compressor, adjust each cylinder's operation to my satisfaction. Setting the valve gear was made easy by using a dial indicator to register the front and back centres of the piston stroke.

First the dial indicator was fastened to a bracket to register the front dead centre of the piston by removing the front cylinder cover. I then turned the wheels gently forward until 1 thou. less was indicated on the clock. With a red paint spot on the wheel flange a corresponding mark in pencil was made on the frame. I next turned the wheel gently in the opposite direction and again when 1 thou. less was registered made another corresponding pencil mark on the frames. Naturally between these two pencil marks was true dead centre and a paint spot was made on the frame. By applying the same procedure to the back dead centre and using yellow spots the indication was made from the crosshead. These marks were of untold value when ascertaining the correct length of eccentric rods and position of the return cranks. I hope to find a more permanent way of indicating these settings before she is eventually steamed up.

Each side of the engine was tested on air separately and during this process any tight spots were located and corrected to ensure that all would be well when both sides were working together. Being able to rotate the chassis on the erecting stand made these numerous checks and adjustments so much simpler and any paintwork remained unscathed in the process. With only the chassis slung in the erecting stand it will be a little unbalanced weightwise, but when the boiler, smokebox and side tanks are fitted it will be in almost perfect balance.

Now that I was satisfied with the performance of the chassis on air, I was able to make a start on the smokebox. The front and back of this was cut from $\frac{1}{4}$ in. brass plate and at this stage I differed from the drawings and made the smokebox straight sided similar to "Woolwich", a 2 ft. narrow gauge locomotive that runs at Bicton Gardens not far from where I live. She came from Woolwich Arsenal and now does yeoman service transporting passengers around the gardens instead of munitions at the Arsenal.

The wrapper of the smokebox was made from 16 s.w.g. sheet brass, previously having done service as a brass door step. Some holes were filled in with rivets and it was fastened to the ends with $\frac{1}{4}$ in. × $\frac{1}{4}$ in. × 1/16 in. brass angle, nicked every $\frac{1}{2}$ in. to make the curve and fastened with 1/16 in. RH brass rivets. The effect is quite



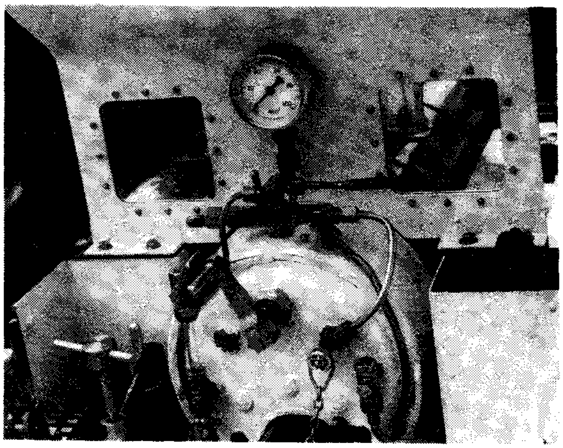
pleasing. The smokebox finishes about 1 in. below the front tube plate and has a flat bottom. This in itself enables the steam and exhaust pipes to be effectively sealed with running nuts and plumbers jointing. I noticed the square base of the chimney on Mr. Balleny's TICH and copied this on my version. The chimney is a steel tube and the cap once did service as a mandrel bush on an old lathe. I turned this a press fit for the chimney and the finished shape was obtained by hand turning with a graver and a round nose tool. The hand tools were rested on a bar secured in the tool post of the lathe.

Hand turning is most rewarding and a similar process was used for making the handrail knobs. These were formed from a $\frac{3}{8}$ in. gunmetal rod, one at a time by first reducing about $\frac{3}{8}$ in. at the end for a 4 BA thread, rough turning the ball with a parting tool in the slide rest and using a form tool for finishing. The form tool was ground from an old 10 in. flat file. One with a plain part at the end. I find it was not so old after all, as I am still using it normally.

To drill the cross hole in the ball, I end drilled for about $\frac{1}{2}$ in. deep a $\frac{3}{8}$ in. hole in a short length of $\frac{1}{2}$ in. square mild steel bar, and marked and drilled, half from each side, the cross hole 5/32 in. diam. The handrail knob blank when inserted was then drilled true and square. By leaving the blank in the jig the 4 BA thread was put on the shank with a die by hand, a peg in the hole prevented it from turning. The $\frac{3}{8}$ in. gunmetal knobs contrast nicely with the 5/32 in. stainless steel handrails.

The boiler came next and this was of $\frac{1}{8}$ in. copper. The shell was formed and the firebox made when it came in to my possession and is brazed and silversoldered throughout. The crown stays are of the girder pattern but the firebox stays are of $\frac{1}{4}$ in. copper rod screwed $\frac{1}{4}$ in. × 40 TPI and similar to that used by Henry Greenly in the past.

Each stay was screwed through a carefully drilled, reamed and tapped hole, square through the outer and inner firebox. The inside and outside of the firebox were carefully faced true with a special cutter similar to a hollow mill or counterbore. This cutter is $\frac{1}{2}$ in. dia. and about $\frac{3}{4}$ in. long with a 7/32 in. hole through the centre and a hole in the side, tapped 2 BA for a grub screw. The teeth are filed on each end before hardening. The 2 BA grub screw secures the cutter to a 7/32 in. silver steel rod with a flat on one side for the grub screw to seat on. The cutter is used, with cutting oil, to surface the inside and outside of the firebox before the thread is tapped. If the $\frac{1}{4}$ in. x 40 T.P.I. stay is screwed in with Boss White and locked both inside and outside with truly faced gunmetal nuts no leaks will occur.



I found that I could only complete about three or four stays in an evening but I have never had one leak. This is the second boiler I have stayed in this manner and the previous one has done many hours of steaming. If the threads remaining between the plates were turned off before inserting I would think it possible to remove any stay at any time. I feel so confident with this system that I will attempt the crown stays in the same manner on any future boiler. With a Belpaire firebox there would be no problems but with a round top boiler I would anticipate wedge washers would require to be silver soldered on first to the outside.

With the boiler completed and tested 200 lb. hydraulic, and working at 80 lb., I set the Salter pattern safety valve to this pressure. I had to use gunmetal for the safety valve top lever as I had no stainless steel but the pins and the rest of the parts are in stainless. I still have to rivet over the pins when I am sure that the spring will be satisfactory. I quite expect it will settle down in service and may require changing.

The dome I found quite interesting to make. The top half was the top half of a 3 in. door knob and a little thinner than the 16 s.w.g. 3 in. tube used for the lower portion. In fact the 3 in. tube was a bit of a problem and not of the very best material I would guess. I was afraid to anneal it and worked the flange on it in its original state.

A friend provided me with a piece of 3 in. bore aluminium tube, a full $\frac{1}{8}$ in. thick. This provided me with the outer former and was filed on the end to fit the boiler shell plus $\frac{1}{4}$ in. allowed for lagging. It was then radiused from the inside out by carefully filing. The brass tube was then pushed inside and filed to the same contour. A boxwood plug was now turned a snug fit inside the brass tube and pressed in just below the radiused end of the outer former. I now formed the radiused flange on the brass tube by beating it out towards the outer former with a $1\frac{1}{4}$ in. ash rounders stick, ex sports equipment. I carried on forming the radius until I felt that any further working may eventually split the tube.

I found that a hammer was necessary to drive the brass tube from the outer former and the boxwood interior was chucked to enable me to part off the brass tube to length, and from what was left over cut a $\frac{1}{4}$ in. ring to joint the two halves of the dome together.

For $\frac{1}{8}$ in. deep the top of the 3 in. brass tube was bored until it was similar in thickness to the top half of the door knob, a section of the $\frac{1}{4}$ in. brass ring was removed and the remainder used to join the two halves of the dome together and silver soldered. The joint is almost invisible and would easily polish out.

With the smokebox and boiler in place on the chassis, I was able to lag the boiler with a layer of $\frac{1}{8}$ in. asbestos millboard and two layers of thin felt to the thickness of $\frac{1}{4}$ in. This had to be sewn on to keep it in place whilst I was cutting and fitting the sheet copper cleading.

The cleading was salvaged from a copper hot water cylinder that had suffered some damage during a cold spell one winter. The cleading is held in place around the boiler with a $\frac{1}{4}$ in. copper strip as used in some heavy duty motors for windings. Bolts and nuts hold the ends together beneath the barrel. The cleading sheet was cut flush with the backhead, and the asbestos and felt a little shorter. The copper was then neatly beaten inwards to seal and hide the lagging.

The pressure gauge, water gauge and clacks are of Stuart Turner manufacture and were already on hand, but the remainder of the fittings were made up as per LBSC's instructions as required.

The emergency hand pump was made to sit on the floor in the cab, and just ahead of the pole reverse lever. On the opposite side of the cab, and in a similar position, a coal space is provided on the end of the side tank.

Hand pumps, when not used very often, sometimes fail with the suction ball stuck to the seating. A pump in the cab is more accessible I find.

The side tanks are made of heavy gauge brass and bronze sheet. To avoid cutting in to a large sheet, oddments were used and silver soldered together. In fact quite a few joints inside the tanks finished up in this manner, particularly the duct that was required to house the reach rod.

The tank filler lids are hinged, and under the offside one is the discharge from the by-pass valve. It is visible from the driving position when the lid is open. The by-pass valve is situated just below this and has an extension rod fitted to enable it to be operated from the cab.

The tank lids are heavy bronze sheet held down with countersunk screws to home made brass angle secured inside the top of the tanks. The brass angle was folded from sheet.

With the tank lids in place the spectacle plate came next. It was made from 18 s.w.g. galvanised sheet. The spectacle plate and the brass window frames were cut on my Driver Jig Saw and the holes for the windows were cut with the frames in place ensuring that both are the same size and shape. The windows are glazed with perspex and the frames are fitted with 10 BA brass screws and nuts.

The pressure gauge was rather a large one and for neatness was fitted between the two windows.

I liked the idea of half round brass beading for the edge of the spectacle plate and the top edge of the bunker. I milled this myself from round brass rod removing half of its diameter. It is fastened in place with 1/16 in. brass rivets. To curve the beading and keep it flat, at the top of the spectacle plate, I made up a simple jig. I cut out a disc of steel to suit the inside radius I required for the beading. This was a little thicker than the bead itself. It was clamped with a $\frac{3}{8}$ in. bolt between two other discs just a little larger. I held the jig upright in the vice and gently pulled the bead to the required shape. I would think a similar device could be used for angle.

I noticed that the bunker I had made was not as wide as the side tanks were, and to correct this error I cut the centre section completely out. I now riveted a new centre section in position with a double row of rivets each side and there was a decided improvement in the appearance of the bunker from the rear. I thought it rather plain before.

With the bunker in position it was rather too close to the backhead for easy firing, as I had anticipated, and I made it to hinge backwards at an angle of about 30°. I added two 3/16 in. square rods with rounded ends to the bottom of the bunker. The rods pass through holes in the footplating. Similar rods are fitted to the front edge of the bunker each side and pass through holes in the footplating by the doorway. The round ends of these rods are waisted and with the bunker sprung outwards, snap into position when the bunker is upright.

The bunker removes completely when required. At the rear of the bunker the works plate is fitted. It is made similar to the number plates on the cab side.

A piece of 1 in. heavy gauge brass tube was held in the chuck and the end radiused outwards and inwards to form a half round head. This was parted off, squeezed oval in the vice and rubbed on a smooth file to level the back and lightly tinned. It was placed on a piece of brass plate with a spot of Bakers Fluid heated until the solder ran. The number was punched on the plate inside the head and the outside filed off, held between two pieces of wood in the vice. The plates were tapped 10 BA from locating holes in their desired positions and fitted when the painting was completed. The name plates are from $\frac{1}{8}$ in. brass plate, recessed 1/16 in. deep with a $\frac{3}{8}$ in. end mill and secured with two 10 BA csk. screws in each. The punching was done after the plates had been annealed.

You will notice that the brake column is fitted on the driver's side of the cab. Believe me this was on the fireman's side to start with, but on going through the motions of firing I found that it got in the way of the shovel. Seeing that I was driver and fireman too I decided to move it to the other side. The rear buffer beam was therefore drilled the other side to accept it and the floor panel could be turned upside down. The brake shaft was now modified and the brake arm sawn off.

A new one was made, a slide fit, and a key-way was cut in it and the end split for a clamp bolt. Two key-ways were now cut in the reverse shaft and the brake arm can be fitted for right or left hand operation. If I ever get a fireman I will put the brake column back where it belongs.

I now had the ash pan and fire bars to fit, and with the chassis inverted, this was not very difficult. I had been reading in the 'M.E.' about using thinner fire bars to get more air to the fire, and as I had some $\frac{3}{8}$ in. × 1/16" spring steel I used this with $\frac{1}{8}$ in. spacers for my grate.

The ashpan

The ashpan was made from 18 s.w.g. sheet steel and was fixed in position. It has a vertical support fitted on the front to hold up the grate, and the rear of the grate rests on a semi rotating lever, and operating it drops the grate into the ash pan. The whistle is attached with a $\frac{3}{8}$ in. brass clip to the underside of the ashpan to keep it warm and, I hope, give me a clear note.

A mild steel circular door with a baffle covers the firehole and is held closed with a latch. To the latch is fastened a chain and the other end of the chain is secured to the blower valve. A pull on the chain lifts the latch and opens the door. The door can be shut with the shovel and with no burnt fingers.

I was now able to complete the painting, with the spectacle plate, side tanks, cleading, running boards etc. removed. Everything was cleaned with Carbon Tetrachloride and when painted, last thing at night, was hung upside down in the workshop to dry until next day, or perhaps later. A rub down was given between each coat of paint with very fine wet or dry paper, used wet, and two or more coats were used as necessary.

The main colour for the boiler, cabs, side tanks etc. is Humbrol No. 15 Blue. The early Valspar for the black and an early Valspar Icefall for the cab interior and the backhead. Icefall is a kind of ice blue and contrasts nicely with the No. 15 blue, the principal colour of the locomotive.

The final coat of paint was allowed a good week to harden and eventually a final assembly was made and the pipe work connected up to the whistle, injector, pump etc. Boards were then placed across the stand and packed up to make contact with the wheels, and the end portions of the erecting stand removed. The buffers and couplings were fitted and the $\frac{1}{4}$ in. packings removed from between the axle boxes and the axle box keeps.

Raising steam

With some help she was lifted from the stand on to about 20 ft. of multi-gauge track already prepared, on the workshop floor. A small 5 in. gauge passenger truck was coupled up and my B.E.N. compressor was coupled to a spare outlet on the steam turret by means of a long flexible air line.

I took my position on the passenger truck and with the compressor switched on, and the Salter safety valve blowing off at 80 lbs. and with the pole reverser right forward, I apprehensively opened the regulator. I must have been a little ham fisted as I shot forward along the track at a surprising rate.

After the excitement had died down I was able to have a few more docile runs up and down the short test track and will have to console myself with that until I can have my steam trials. These I hope will be next summer.

I have enjoyed the four years that I have taken to complete TICH TIMES TWO and I am most grateful to my friend Mr. C. H. A. Walker, who is responsible for the many photographs that were taken throughout the building and without whose help and co-operation this illustrated article would not have been possible.

TICH TIMES TWO is named 'LADY MAX' and her number is 874. She weighs 140 lbs., 28 lb. of which is the copper boiler. She stands 31 in. long, $19\frac{1}{2}$ in. high and $13\frac{1}{8}$ in. wide.

Model Traction Engines at Cambridge

by

C. J. Dawes

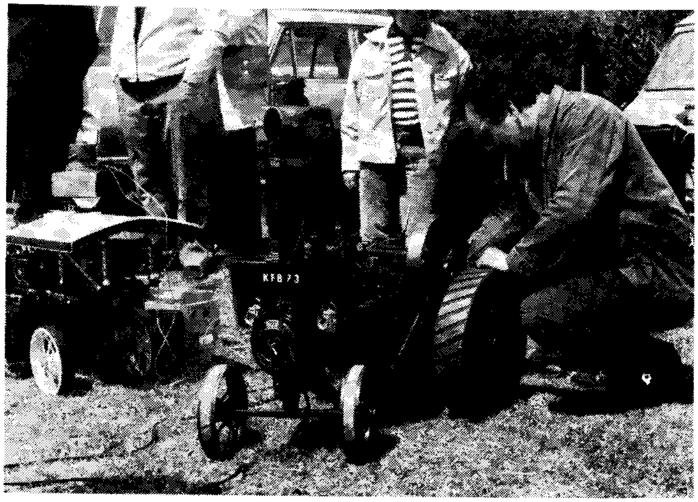


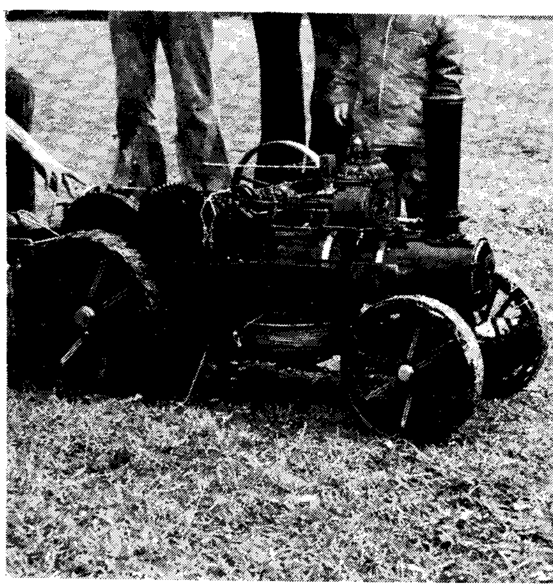
Fig. 1: A 3 in. scale Burrell built by K. F. Biggs of Bedford M.E.S.

READING W. J. HUGHES'S ACCOUNT of the model traction engine rally at Illshaw Heath, in the 20th December 1974 issue of *Model Engineer*, reminded me that soon I would have to start thinking about organising the next model traction engine rally at Cambridge. Our 1975 meeting will be the fourth model traction engine rally and on thinking about it my mind wandered back over the previous three.

Back in 1971 after reading about the Guildford MES traction engine rallies in *Model Engineer*, several enthusiastic members of the Cambridge Society suggested that the society should hold an invitation model traction engine rally. We wrote to the Guildford Society for advice on the ins-and-outs, which we acknowledge to this day, and arranged our first rally in the Summer of 1972, and have held one every Summer since. An account of our first rally appeared in the 2nd February, 1973, *Model Engineer*. On looking back it was soon apparent that the success of our rallies was very much as a result of the publicity given by the *Model Engineer* and the support of other local Societies, especially our friends of the Bedford Model Engineering Society whose support is apparent from the photographs we have accumulated over the years.

To share with other readers the pleasure of seeing some of the model traction engines that have appeared at the Cambridge rallies, I have picked out the following selection of photographs. The first, Fig. 3, shows a really beautiful 2 in. scale Burrell showman's engine, *Thetford Town*, built by Mr Wooding of the Bedford MES. The detail and finish on this engine are superb as can be seen in the closeup of the footplate entry, Fig. 4, which at a first glance could be mistaken for the original. The excellent motion work of this engine is not lost beneath the canopy since Mr. Wooding has a very neat cutout in the canopy to give access to the motion and driving controls. Two regular visitors to the Cambridge rally are Mr. Leslie Smith and his son from Wickford, Essex. Normally they bring a very fine Wallis and Steevens agricultural engine, which has been shown several times in *Model Engineer*. However, they surprised us all in 1974 by bringing a newly completed $4\frac{1}{2}$ in. scale Foden steam tractor, which they are shown driving in Fig. 5. Leslie

Below. Fig. 2: One of a pair of 2 in. scale Fowler ploughing engines built by Mr. Shipman.



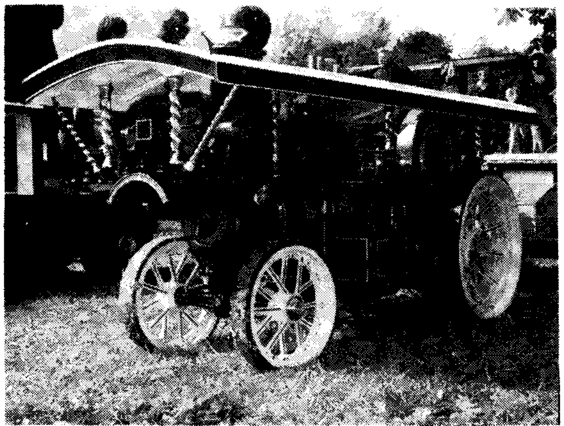


Fig. 3. 2 in. scale Burrell showman's engine "Thetford Town" by Mr. Wooding of the Bedford M.E.S.

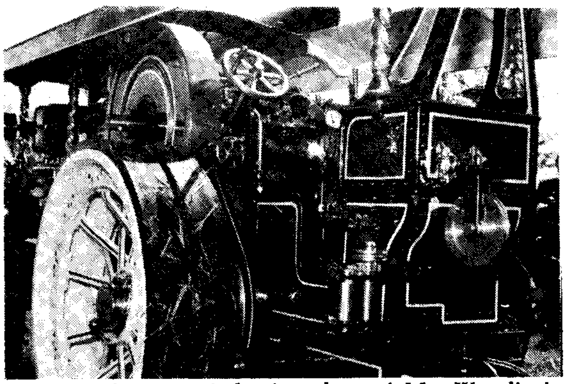


Fig. 4: Close-up of the footplate of Mr. Wooding's "Thetford Town".

Below: Fig. 5. Mr. L. Smith driving his 4½ in. scale Foden tractor.

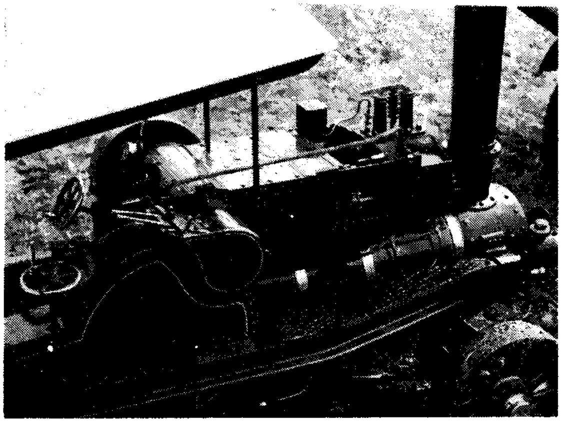


Fig. 6. 3 in. scale Wallis & Steevens steam wagon by Mr. D. Shipman.

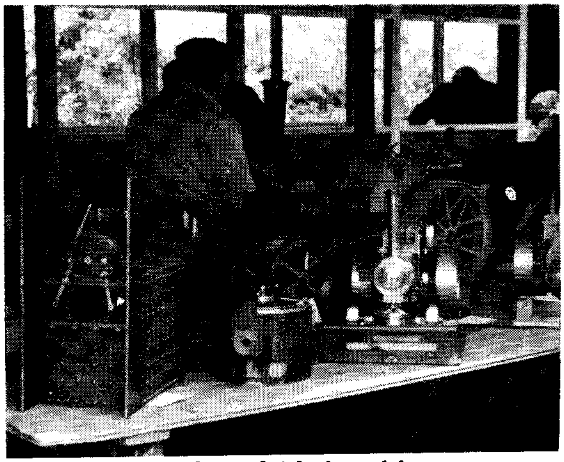


Fig. 7: Some of the unfinished models.

built their Foden in under two years. Perhaps the smile on his face in the picture indicates the performance, those who have seen this tractor in steam will agree that it is capable of a fine turn of speed.

Another fine steam vehicle which is a pleasure to see both static and in action is the steam wagon, Fig. 6 of Doug Shipman from North London. The detail and finish of this 3 in. scale Wallis and Steevens wagon are in the writer's opinion excellent. The picture chosen not only shows the detailed motion covers and fine paintwork, but also one of the wooden road wheels which is fabricated true to the original prototype. This is not the only fine model that Doug Shipman has brought to Cambridge, indeed, he also has a very nice pair of 2 in. scale Fowler ploughing engines, one of which, *Princess Alice* is shown in Fig. 2.

Many readers will have recently read about Ken Bigg's Ransomes bailer in Postbag, 17th January, 1975. We have not seen Ken's bailer at Cambridge yet, but we have seen his very fine 3 in. scale Burrell, Fig. 1, which drives the bailer. The picture shows Ken raising steam at our 1974 Rally.

Apart from showing traction engines in steam we encourage our visitors to display any engine that they may have under construction. The range and sizes of these exhibits are usually extremely varied as can be gauged from Fig. 7. In the foreground, left, is a 4½ in. scale Burrell boiler, hornplates and smokebox built by Mr. Padmore from Wirral, Cheshire. On the right of Mr. Padmore's smokebox is the almost complete 1½ in. scale Allchin, being built by Wally Nye of the Cambridge Society. Oddly enough, although there have always been several 1½ in. scale Allchins to be seen under construction, we have never seen an Allchin under steam, perhaps this will change in 1975.

All readers of *Model Engineer* who have found these pictures and notes interesting and who may wish to assist or exhibit at our 1975 model traction engine rally, on Sunday, 6th July, 1975, are invited to send a S.A.E. to: C. J. Dawes, Hon. Secretary, Cambridge & District Model Engineering Society, 9 Queensway, Sawston, Cambs., CB2 4DJ

Some random thoughts on "FURY"

by George H. Thomas

IT IS OFTEN INTERESTING and instructive to study the various designs of models and pieces of workshop equipment which are published in *Model Engineer* even if one has no intention to build the item in question. There are usually many solutions to a given design problem and, for me, the interest lies in seeing how the designer has overcome the inevitable difficulties. Quite recently I was looking at the cylinders for *Fury* and, especially, the method adopted for adjusting the piston-valves by adding or removing shims.

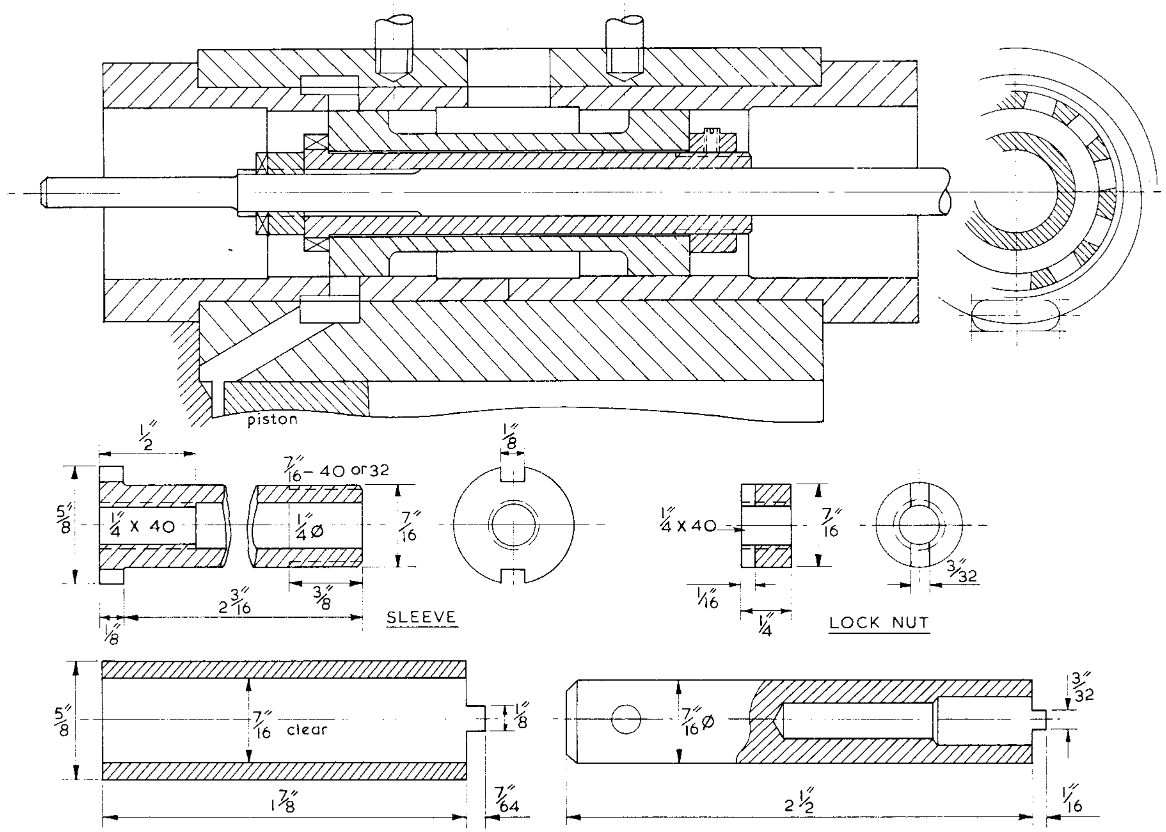
In view of the fact that Martin Evans stated in his introductory remarks to this series that a certain amount of experimentation, and possibly modification, might be found necessary in this design which was, in any case, intended for the more advanced worker, I hoped that a few comments and suggestions might be acceptable and would not be regarded as an unwarranted intrusion into matters about which I do not profess to know a great deal. Having, so to speak, thrown in my hat, it would be interesting to hear the views of other and more experienced locomotive builders.

Looking first at the means provided for adjusting the valve position by shims, my own reactions were, in roughly reversed order of importance, the following: —

1. It would probably be very difficult, if not impossible, for the home worker to obtain stainless-steel shimstock in the range of thicknesses specified though I can see no reason why brass shim would not serve the same purpose. I mention this matter because so many workers are becoming increasingly frustrated due to the non-availability of materials in small quantities, especially if the requirement is for something a little out of the usual run. This was already becoming evident five or ten years ago when, on ordering, say, one oil-seal (value 5s.) for a prototype job, it would be delivered together with an invoice for "minimum charge" £5 — and the minimum charge did not stop there! This is not the place to go into the economic reasons behind this state of affairs but its effects are being felt, I am sure, by most of our readership.

2. Shims, when drawn, are simple-looking objects but they can be very time-consuming to make — especially when there are three each of eight thicknesses. A few of the thicker ones could be parted off from bar but the thin washers present a problem. My own approach would be to punch the ¼ in. dia. hole — but then I have a punch and die set. For those without such luxuries (in my case a product of my own workshop) a start could be made by clamping a stack of shimstock between two stout plates and drilling through the lot. Maybe some cunning reader knows of a better way! After cutting out roughly they would be mounted and firmly clamped on to a special mandrel for turning the O/D, and gently does it! After all this follows a tedious but very necessary de-burring op. on the O/D's and I/D's.

3. When carrying out the valve-setting operation, every change of shims looks like a fiddling performance some 3 in. down inside the valve-liner. May I suggest that the shims be made larger in diameter than the collar which is pinned to the spindle? Say 15/32 in. or ½ in. so that they



could be gripped by a stout pair of tweezers and, if the thickest is placed on first, the whole lot dragged off together.

When I was building a $3\frac{1}{2}$ in. gauge locomotive in 1937 the published arrangement was such that it was virtually impossible to set the valves correctly, so I devised an alternative method which allowed of the valve being set in any desired position and, importantly, permitted it to float within the liner thus avoiding side pressures between the valve and liner which could result in rapid wear. We have often read of piston valves which proved to be unsatisfactory because, although steam-tight when first made, they soon wore and leaked badly. Could these cases be due to friction brought about by lack of concentricity between valve and liner?

I have scaled up by arrangement and applied it to the piston valves of *Fury* as shown in the accompanying drawing which will be largely self-explanatory. The valve is carried on a sleeve, with appropriate radial clearance between the two, and located endwise by a threaded collar which is locked by a grub-screw. This collar is adjusted so that all end-play is taken up but, at the same time, leaving the valve free to accommodate itself within the liner. The sleeve can be moved along the spindle by a threaded portion at one end and finally locked in its correct position by a circular nut having notches to engage a key. The key consists of two parts working one within the other, the outer moves the valve and the inner one locks it. An advantage of this method is that the valve sleeve can be held positively whilst its locking nut is tightened firmly against it, imposing no strains on the valve crosshead or any part of the valve gear. A few dimensions are indicated as a guide but as this loco is intended for more advanced workers I would imagine that they would sort these matters out for themselves.

When making the drawing I checked over the port and passage areas to make sure that the suggested arrangement did not impede the steam flow. For the information of those interested, the areas, in square inches, are as follows:

Main steam entry, 7/16 in. dia. ...	.150
Annulus between liner and central part of valve	.295
Port area (11 ports 5/32 in. dia. = .0192 sq. ins. each)	.211
Milled passages to cylinder ends ...	.0680
Annular grooves around liner	.0188

With regard to the last figure, it was assumed that the groove is 5/16 in. wide x .06 in. deep although none of the detail or G.A. drawings of either inside or outside cylinders show this groove but only what could be assumed to be a milled recess of some sort at the bottom. This is obviously a draughtsman's error, but I feel some concern about the small size of the intended passage and the weakening of the C.I. sleeve which is intended to be press fit in the cylinder casting. Whilst the area of this passage can be regarded as doubled to .0376 because the steam will flow around both sides of the groove, it is still very small and, I feel, cannot be increased by cutting the groove deeper having in mind the row of 5/32 in. holes leaving lands only 3/32 in. (exactly) at this section. One approach would be to *decrease* the depth of groove to 1/32 in. and turn eccentric annular grooves in the bore of the main casting. By boring these recesses offset downwards increased area is provided as more ports break in.

If the recess were made 1/16 in. deep at the top, this, together with the 1/32 in. in the liner would give an area of .0294 — the equivalent of about one and a half 5/32 in. holes. In order to provide at the bottom an area equal to that of the milled passages (which are the smallest of those being considered), and bearing in mind the split flow, a total depth of about 1/8 in. would suffice, of which 1/32 in. is in the liner. I think that it could, with advantage, be made deeper than this as the comparison is being made with the worst of existing conditions. It would be quite practicable, also, to increase the width of the groove in the cylinder block, thus adding to the available area without increasing radial dimensions.

If the grooves in the bore of the main cylinder casting are considered to be a reasonable proposition then it would be desirable to increase the thickness of the metal around the liner, especially at the top. A thickening at this point would be helpful also in providing more hold for the 2 BA screws or studs where, as drawn, it appears to be hardly adequate, especially for blind-tapped holes which would give not much more than 1/8 in. hold on a 2 BA stud.

I am not unmindful of the fact that there is possibly no room to provide for more metal — this is the usual designer's dilemma; putting a quart into a pint pot. Having spent a lot of my life at this game I find that it is usually resolved by decreasing the size of the quart and increasing the volume of the pint pot! As a contribution to the second part of that solution I would be tempted to reduce the diameter of the valve to, say, 3/4 in. (Lese-majeste!) At this size the liner could carry nine ports 5/32 in. dia. (at a slightly greater spacing than those shown) which would give a total port area of .170 sq. ins. that is, two and a half times that of the cylinder passages. The reduction in diameter would still leave valve-to-cylinder proportions in line with average full-size practice and it would provide some much needed room to enlarge the steam ways at certain points.

All of the foregoing should be regarded, not as recommendations, but as the recording of one reader's thoughts arising from a perusal of some drawings.

George Thomas' suggestion for the valve liners of 'Fury' (or for that matter, for any 5 in. gauge locomotive with piston valves) seems an excellent one, although the large diameter of the proposed sleeve would reduce the steam chest volume considerably. For that reason a reduction of the diameter of the valve to 3/4 in. would be a retrograde step. As regards the shims proposed in the original design, these could of course be made from brass, there would be no need for stainless steel here.

As to the 2 BA screws which hold down the steam pipe flange, the tapped holes for these could be run into the liners, to give a more secure hold. — Ed.

CASTLES, KINGS AND SCOTS

Sir,—I appreciate Mr. Gibson's compliment on the 2-6-4t motion, but we don't know where the "break-through" he mentions occurred; has he forgotten little Horwich and the "Crab"? Later on, other things came my way—the first Swindon type narrow firebox boiler and the Coronation — you can read of that in "LMS Duchesses" edited by Doherty, published by M.A.P. — to mention two.

I cannot see how praise of the G.W.R. makes their engines any more suitable to L.N.W. conditions. Neither is it helped by falsifying "facts" about the Scots. To make an expensively shaped boiler doesn't help, it is what is inside that matters. The same with the axlebox — it's the keep and contents that matter. The enthusiast seems to suffer from an inferiority complex and is ready to break out at any minute, but if he were an engineer and would compare the as-built *Princess Royal* and *Lord Rutherford* with the "Duchess" and "5736" of Ivatt's day, he will note the disappearance of Swindon detail, indicating its unsuitability. Finally, a true tale: one day, my regional M.E. called me in and said, 'Langridge! Get a copy of that wedge and welded block we put on the *Princess Royal's* cylinders. So-and-so (the W.R. regional M.E.) says he can't keep the cylinders tight on the "Castles" and "Kings".

Hastings, Sussex. E. A. Langridge.

Correcting Wear in Lathe Saddles

by T. E. Clement

HAVING READ about the methods of correcting wear in the lathe saddles by Mr. Radford and Mr. R. A. Ganderton, and having had similar trouble on my 17-year-old M.L.7 four years ago, I was thinking along similar lines of work to cure the wear, but not having access to other machinery I could not attempt such drastic remedies.

After consultation with the chairman of my club, who was at one time a millwright and machine tool erector, he put me on to a logical remedy which would not require any machinery and would also guarantee the following points:

(a) the minimum amount of material is removed from the lathe.

(b) the cross-slide is kept square to the mandrel.

(c) the machined face is flat and square as it should be.

The method of correction is as follows:

The apron is removed from the saddle and placed to one side. The saddle is then stripped down and cleaned and the centre of the guide-face is relieved with a flat scraper by approximately 0.005 in. for 0.5 in. as shown in Sketch Fig. 1.

(No-one should feel afraid of tackling the job of scraping, as I had not done any before apart from a trial on a piece of cast iron with reference to past articles in the M.E. before starting on the lathe.)

The saddle is then re-assembled complete with cross-slide but without the apron. The cross-slide is wound out almost to the end of its travel with the cross-slide screw engaged by one turn.

With a Test Dial Indicator (T.D.I.) or cranked bar in the chuck, measurements are taken on the edge of the cross-slide with the saddle clamped; the point of measurement is marked on the cross-slide, which is then wound in until, with the T.D.I. rotated in the chuck $\frac{1}{2}$ turn, the points of measurement on the cross-slide and T.D.I. coincide.

The difference in reading is then noted by direct readings from the T.D.I. (or by feeler-gauges if a cranked bar is used). See Fig. 2.

This test gives information as to the way in which the guide-face on the saddle has worn.

The saddle is then removed from the lathe complete with the cross-slide.

The guide-face is then scraped to bring the cross-slide back square, i.e. T.D.I. reading or feeler-gauge measurement is the same at both ends of the cross-slide travel.

The above test and work with a scraper is continued until the T.D.I. reading is the same at both ends of the cross-slide travel and the guide-face of the saddle is flat and bedded to the bed of the lathe with marking-blue. When this point has been reached the guide-face is relieved again in the centre to a total amount of 0.005 in. by 0.5 in. long. This helps to prevent the saddle pivoting about the centre of the guide-face. One of the main causes of the saddle guide strip wear-

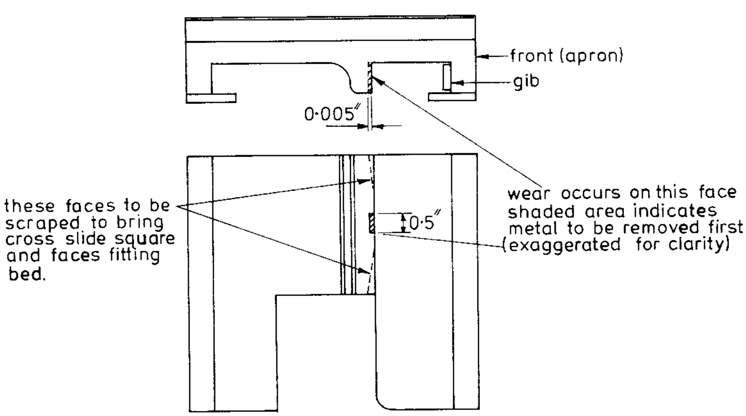


Fig. 1. VIEW ON UNDERSIDE OF SADDLE

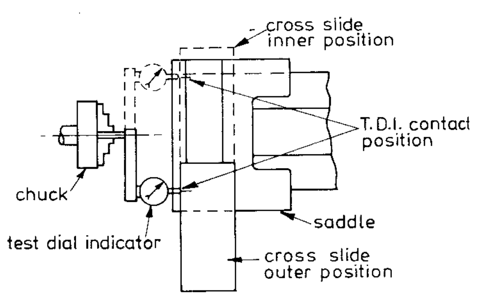


Fig. 2. CROSS SLIDE ACCURACY TEST METHOD

ing is the adjusting screw for the gib at the tailstock end of the saddle. I understand that Messrs Myford recommend that this screw should be only just bearing on the gib strip and not exerting any force on it as there is no guide-face to resist its effect if over-adjusted. I use fingers only when setting this screw.

This work is very tedious due to the number of times the saddle has to be fitted to and dismantled from the lathe. It took me about 12 hours to correct my lathe as the saddle was dismantled about 30 times before the wear was corrected.

Since then I have built four two-stroke engines ranging from 10 cc. to 30 cc. for racing hydroplanes and all the sealing joint faces are straight from the lathe metal-to-metal joints without any gaskets or jointing being used or needed.

One great advantage of this method is that it can be done at least a dozen times in the life of the lathe before resorting to either Mr. Ganderton's or Mr. Radford's solutions.

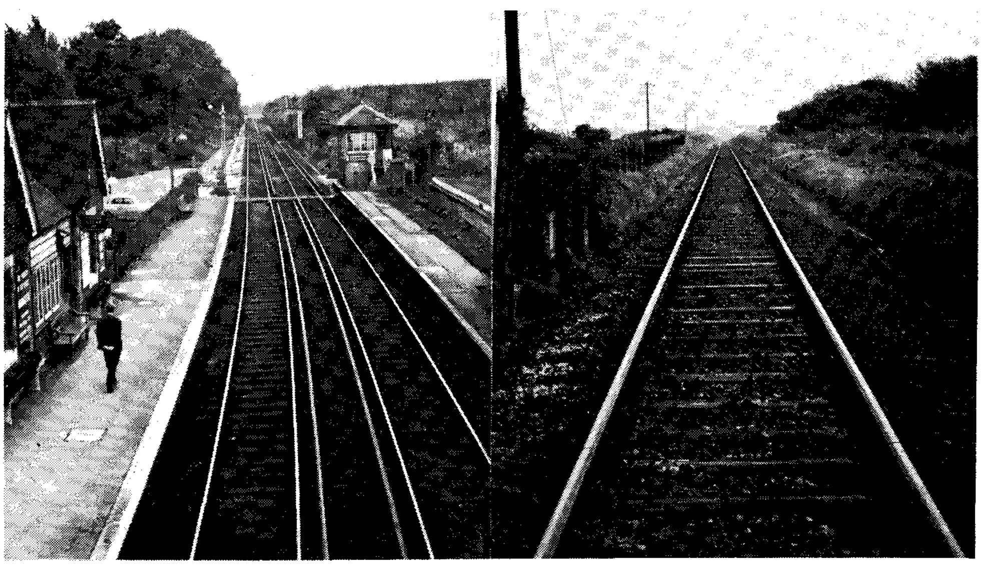
TRACK ALIGNMENT

by D. E. Lawrence

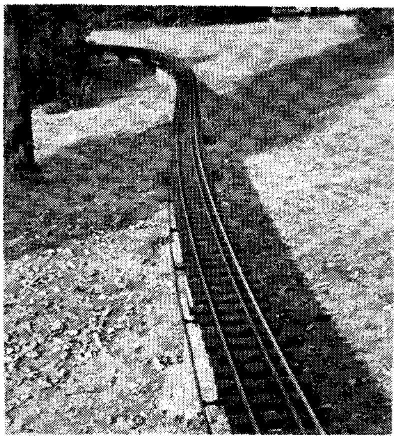
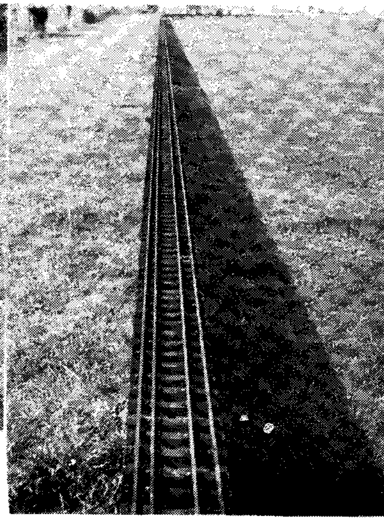
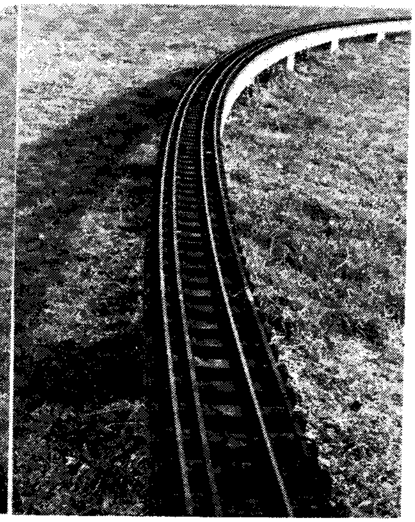
THE LETTER from Ted Martin, M.E. 21 March, 1975, manages to combine the debates which have been going on about Wheel Profiles, Rail (tracks) and, by inference, Safety Measures. Although these three matters have some relationship to each other, the Editor thought it might be useful to extract one item and give it separate emphasis; so here is a short dissertation on my philosophy about track alignment.

In a recent letter I made the point that rail (track) and wheels are *complementary* and they have an *intimate working relationship*. In fact the wheel is guided by the radius (between tread and flange) and not by the flange—that is, for as long as the wheel remains in contact with the rail! It has always completely baffled me that, whilst model engineers will build their locomotives to fine limits of three or four places of decimals, many of the tracks on which they run are often built (by the very same people!) to the nearest half yard or some such inappropriate limits. I have openly said this many times in the past, but I must ruefully acknowledge that my views on the subject are tolerated in the main rather than heeded. I remain baffled! It would seem that we need standard track, well laid, in addition to standard wheel profiles. To do an indifferent job costs time, money and sweat; it may cost only a little more (perhaps even less) to do it well. The accompanying photographs show what is done and what can be achieved.

It would need a fair sized book to cover the subject of track construction and how to obtain a high quality track. In a very short article such as this, it is only possible to outline some basic requirements. There are many ways of putting tracks at or above ground level (i.e. raised). The various types of construction seen in club tracks show the highly individual thought and variety of

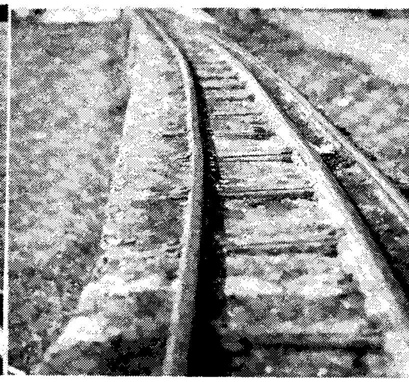
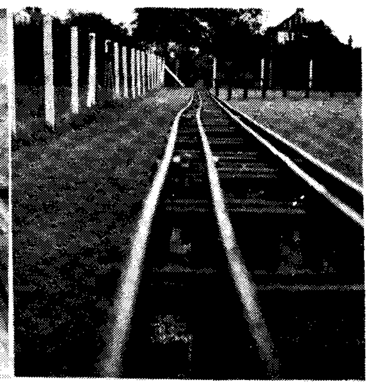


Two views of some of British Rail's track.

Three views of two very fine model tracks.

Below: Three views of three not so fine model tracks. To avoid too many red faces, perhaps they should remain anonymous!

effort which has gone into building them. Scarcely two are the same. With very few exceptions, all show some lack of appreciation of some fundamental requirements. A good well aligned track needs firm and true foundations; an accurate "deck" on which the rail is laid; accurately laid rails without humps, hollows and kinks; sound fastenings; regular maintenance.

There are different methods used to obtain the necessary truth: optical; a *good* spirit level; surveying instruments; tensioned steel wire for straights and, with a different technique, for curves; visual halving of errors using sighting sticks—plus a good eye!; halving of chord errors on curves; long gauges or jigs for curves. I could write here, etc. etc., as no doubt track builders use many other means, orthodox and unorthodox, as well. One most necessary ingredient in track building is CARE. Another useful thing is the rejection of the attitude "that'll do" and the adoption of "let's have it right". My apologies if this sounds like a bit of finger-wagging, but the photographs do show some remarkable variations of quality!

INDEXES

Indexes for 1974 are now available. Price 20p. post free. 1971 and 1973 are also available.

BACK NUMBERS

We have a limited number of back numbers of "Model Engineer" 1967-1973.

Enquiries to the Editor please.

A Fine 2-6-4 Tank Locomotive

built by Cyril Hammond

THE PROTOTYPE weighed 86 tons 13 cwts. and was the largest of the standard B.R. Tank Engines. Built at Brighton and was included in the B.R. Exhibition held at the Willesden (London) Depot. The writer visited this exhibition and was privileged to go on the footplate of the prototype when new and was so impressed decided to make a small edition to 1 in. (to be strictly accurate 1 1/16 in.) scale, 5 in. gauge.

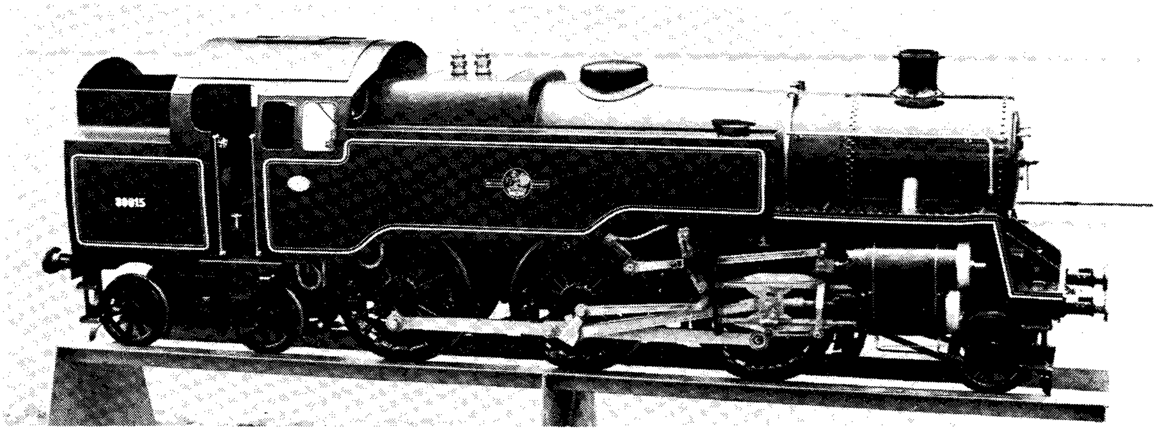
The model finishes at an overall length of 50 in ; overall width of 9¾ in ; overall height of 13¼ in. and is straightforward with no deviations. There are two outside cylinders fitted (incidentally they are cast iron piston valve type) and fitted with pistons 1.65 in. However, I would suggest to anybody making a copy of this loco keeping to the standard 1½ in. or 1⅝ in. dia. bore, as the piston rings would be easier to obtain. I fitted Wellworthy piston rings which took nine or 12 months to obtain, whereas the standard type I could have got quickly. Stainless steel piston valves fitted running in phosphor-bronze liners. The valve gear is straightforward Walschaerts. The front and rear bogies are each independently sprung with side control springs.

Possibly the most interesting job was the machining of the oval buffers which occupied a space of three months spare time and were made from a piece of scrap steel shafting and the sockets were made from straight forward B.M.S. square, but they are fitted with chequer plate foot steps and twin opposed keyways as prototype. The boiler is straightforward made from ⅛ in. thick copper plate, standard multi-tubular type with superheaters and the regulator being horizontal slide type fitted in the dome. I have also fitted twin water gauges and the usual accessories. Tested to approximately 220 p.s.i. normal working pressure approximately 100 p.s.i. The boiler feed is from twin axle pumps situated between the frames driving and driven by the centre axle and in addition two injectors are fitted one either side beneath the cab foot steps. One high pressure, one low pressure.

Forced feed lubrication is fitted to the cylinders and piston valves from a rotary (not piston type) oil pump. This was made to the original design of the late Mr. J. Austen-Walton, with whom I used to be extremely friendly. For driving purposes the cab roof is completely removable. Working steam brakes are fitted.

Time spent by the writer in construction was approximately six years, but assuming scale drawings were available I feel it would be possible to construct the loco quite easily in half of this time. In addition a Mr. Clark did the painting, for which I take no credit and in as much as Mr. Clark seems to be extremely busy he was in possession of the loco for an additional 12 months.

A number of small details are required to complete the job, which the writer hopes to get done as soon as possible.



A MODEL STEAM CRUISER

by H. V. Gough

THE AIM IN DESIGNING this boat was to build a strong reliable working model, simple to operate, and with sufficient detail to make it interesting to look at either on or off the water.

The finish above waterline is based on a design prepared by Mr. John B. Langford of Glasgow, entitled Steam Cruiser "Barbara", about 1948, modified to suit the hull and power unit available.

Length overall	48 in.
Beam	9½ in.
Depth, main deck to keel ...	6 in.
Depth, foredeck to keel ...	7¼ in.
Draught to U/S propeller ...	4½ in.
Keel to top of mast	15½ in.
Keel to top of funnel ...	11¾ in.

Weight with fuel and water approx. 25 lbs.

The hull was cut from selected softwood, the bottom plank being 4 in. nominal thickness, the middle plank 2½ in., and the raised foredeck 2 in. The planks were planed and screwed together, and sawn to shape on a band saw at the Timber Yard. The hull was then hand shaped, and taken apart to enable the bottom plank to be hollowed out, leaving a minimum thickness of timber of ¾ in., using gouges and chisels etc. The middle and top sections were cut out with a pad saw.

The three sections were now glued and screwed together and the outside of the hull finished to the required contours, papered off, and given a coat of white lead priming paint. The foredeck has quite a noticeable sheer.

The decks are ¼ in. mahogany, and the sides of the saloon, and wheelhouse are cut from tinplate secured to a light timber frame with panel pins.

The boiler is made from 3 in. diameter copper tube 8 in. long, with ends 3/32 in. thick turned to a push fit in the barrel.

The ends are strengthened with a hard brass rod, 3/16 in. diameter, through the centre, and screwed and nutted both inside and outside the boiler. The ends are soft soldered into the barrel, and peened over slightly.

A water test was made with a hand pump up to 60 p.s.i. and without any sign of leakage, and as the boiler supplies ample steam at 10 p.s.i. to keep the engine running nicely, I was quite satisfied.

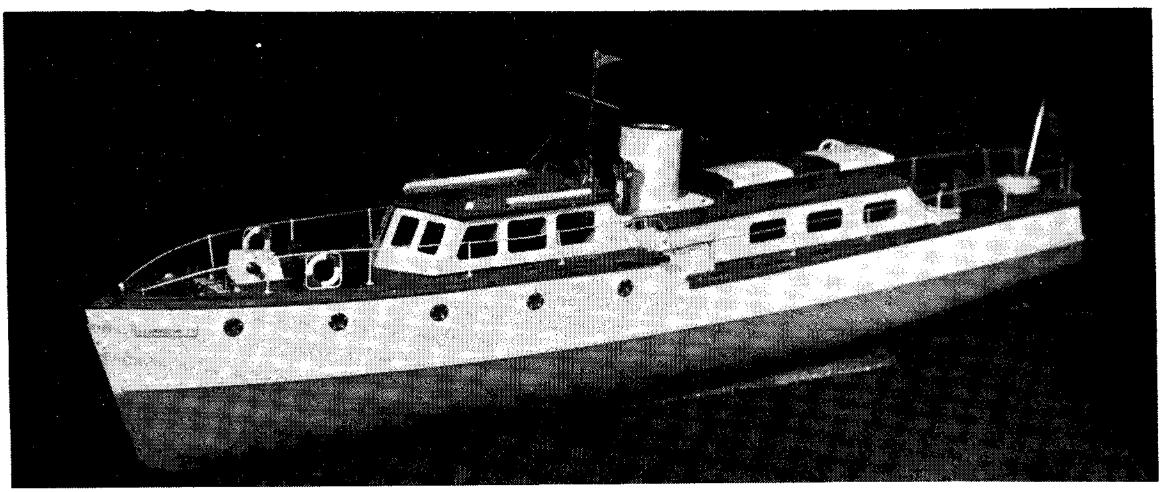
The boiler casing, including the firebox, is made from tinplate about 1/64 in. thick, and the upper part lined with sheet asbestos. The ends of the casing are bent at ninety degrees, and secured to the side with 3/16 in. screws at 1¼ in. centres.

The engine is a twin cylinder, single acting, totally enclosed, by Stuart Turner, with a cast iron body and brass pistons, ¾ in. bore and stroke.

The engine has a horizontal piston valve, connected by an open frame to a crankpin, attached to a vertical shaft at one end of the engine, and this is driven off the main crankshaft by a bevel gear.

This bevel drive is composed of two wheels, one on the vertical shaft, and one on the main crankshaft.

To be continued.



JEYNES' CORNER

E. H. Jeynes on Phase Conversion

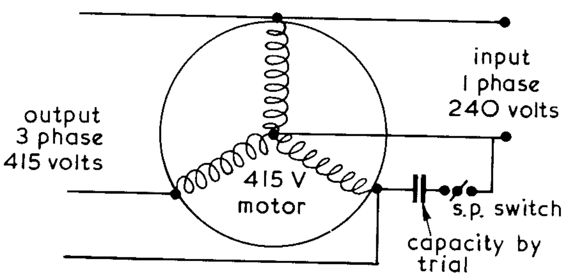
I was very interested in Mr. F. Butler's article on running three phase motors on single phase supply, which to a point, forestalls an article of my own on the same subject; as a follow-up to my previous articles of 5 June, 1970, and 1 November, 1974. I quite agree with Mr. Butler's remarks that there is a dearth of literature on this particular subject.

Yes, the principle is old, but has generally only been used on large installations where only a single phase supply has been available, but where a three phase supply has been projected. A large Pilot motor generally of the synchronous type was installed, together with capacitor banks for the purpose of improving the power factor. Some of the early supply companies would give a rebate where this system was in use, as it also improved their own power factor, if their load was largely inductive.

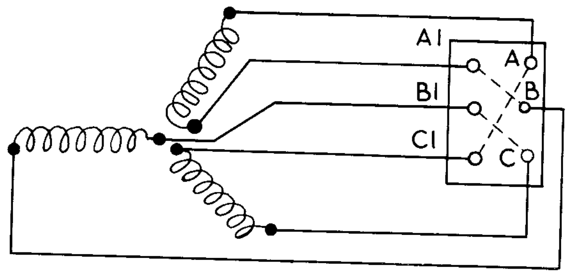
I think some experimenting would bear good fruit if undertaken before an auto, or double wound transformer is purchased. It will be evident to the investigator, that the star connected stator has two windings in series between the 415 volt terminals, therefore there are three potential 240 volt windings already there. If the motor is opened up and the star point disconnected and three new leads connected to the now open ends, and brought out to a new terminal board having six terminals instead of the three original ones, the lettering A, B, and C, being retained for the three original ends, and three new ends being connected to the other three new terminals and marked AI, BI, and CI this gives three windings suitable for operation on 240 volts, and can be used either for starpoint feed, or delta connection by the use of appropriate strapping of the terminals. If the connections are well made, and insulation good, the motor can be used if required on 415 volts again by simply altering the straps if connected in delta, if starpoint fed terminals AI BI CI are strapped. It will be seen that the alteration has simply brought the start point outside the carcase instead of inside.

To use the star point feed, one side of the 240 volt supply is connected to terminal A, and the three terminals AI, BI, and CI are strapped together and the other leg of the supply connected to them; between the terminal B and the strapped terminals AI BI CI is connected the capacitor say 60 Mfd in series with a single pole switch, which is opened when the motor attains full speed; it may be found that a small capacitor placed permanently between B and star point will improve the running of the motor. When the motor has attained full speed three phase 415 volts should be obtained at terminals A, B, C.

three from one



star point fed with 240 volts input



Alteration to windings of star connected motor to enable delta connection experiments.

The bringing of the star point connections outside the motor was for the purpose of experimenting with delta connections, in which case three phase current at 240 volts could be expected. This would only require the alteration of the strapping of the terminals. A larger capacitor might also be required than the star connected motor.

Mr. Butler mentions American three phase motors having a required voltage of 110-115; all the American motors I have handled were 220 volts. There is a misprint on page 278 where two pole motors are mentioned: the speed being given as 300, this should be 3,000 r.p.m. To revert to the American motors, it must be recognised that their iron circuit is designed for 60 cycles, (hz), and even if no heating from iron hysteresis arises, the speed on our 50hz will have no relation to the speed on nameplate.

If possible any motor intended for the experiments should have a double cage rotor; these motors start easier, only taking about four times running current, compared with the six or eight times of the standard motor.

Club Diary Continued from page 512

May 28 Harrow & Wembley S.M.E. Traction/General Meeting. B.R. Sports Ground Pavilion, Headstone Lane, Harrow. 7.45 p.m.

May 28 Sutton Coldfield Railway Society. Modellers' Problem Night. Wylde Green Library, Emscote Drive, Little Green Lanes, off Birmingham Road, Sutton Coldfield. 7.30 for 8.15 p.m.

May 28, 31 Nottingham S.M.E.E. Model Engineering Exhibition.

May 30 Torbay M.E.S. First track night. Foxhole Community Hall, Bellfield Road, Paignton. 8 p.m.

May 31 Southern Federation of M.E.S. 2½ in. Gauge Rally — Romford M.E.C. Ardleigh Green Road, Gidea Park, Romford.

May 31 Romford M.E.C. 2½ in Gauge Rally. 42 Ardleigh Green Road, Hornchurch, Essex. Light refreshments will be available and car parking facilities.

May 31 S.M.E.E. Clearance Sale of Useful Oddments. Marshall House, 28 Wanless Road, SE24. 2.45 p.m.

May 31, June 1 National Traction Engine Club. Tynedale Steam Rally. Corbridge, Nr. Hexham, Northumberland. W. G. R. Weeks, 11 Mitchell Avenue, Jesmond, Newcastle-upon-Tyne.

June 1 Guildford M.E.S. Running Day for members and friends. H.Q., Stoke Park.

June 1 Harrow & Wembley S.M.E. Pond Meeting. West Harrow Recreation Ground, Harrow. 10.30 a.m.

June 1 Cambridge & District M.E.S. Invitation Loco Rally. Fulbrooke Road, Cambridge. 10.30 a.m.

CLUB NEWS

News from Auckland

At an unofficial meeting on 7 January, Lou Wyman ran his *Caribou* and Keith Bankart drove his big New Zealand Kb until midnight, his engine's headlight being most effective.

At a "bits and pieces" meeting, Lou showed his finished "Mikado" boiler, Dave Watt brought a Wf boiler for inspection, with some trouble with the crown stays. Phil Isaac showed a useful jig for clamping bandsaw ends together for welding. He also had a nice device for extending the drive from a lathe headstock spindle. Rex Hill produced the machined cross-slides for a Dore-Westbury vertical milling machine, together with a cast aluminium base. Rex had made his own patterns, and the castings were poured in Auckland. Murray Lane showed the camshaft for a *Kittiwake* engine, together with a jig for machining the cams. Secretary: Peter Baker, P.O. Box 1352, Auckland, New Zealand.

Birmingham S.M.E.

At the A.G.M. of this society on 19 March, A. F. Farmer was elected President, A. Reason Vice-President, C. Kay Secretary, C. J. F. Tickle Treasurer, P. Lakin Social Secretary, P. Wardle Librarian, D. Spence Public Relations Officer, and D. C. Piddington Editor. Mr. Kay's address is 7 Rowbrook Close, Mayors Green, Shirley, B90 1EJ.

The Cup Competition was held at Illshaw Heath on 23 March. The Picknell Cup for finished models was awarded to P.V. Pugh for a 1 in. scale traction engine, the Lehmann Cup for unfinished models also to Mr. Pugh for a 3½ in. gauge *County Carlow*, while the Junior Cup went to D. Robinson for an experimental swashplate engine.

Birmingham S.M.E. are running a rail trip to the Romney Hythe & Dymchurch Railway on Sunday, 18 May. The train, comprising two diesel multiple units, will call at Solihull, Leamington and Banbury before proceeding to Sandling and Folkestone via Reading.

The Society will be staging the West Midland Federation Cup Competition at Illshaw Heath on 8 June from 10 a.m. to 7 p.m.

East Sussex Model Engineers

There has been a change of Secretary for the East Sussex M.E. The new Secretary is Mr. R. W. Taylor, 24 Mitten Road, Bexhill-on-Sea, East Sussex. Tel: Bexhill 216486.

Activity at Ramsgate

Members of the Ramsgate & District M.E.C. have around 10 locomotives under construction. These include a *Springbok*, a *Nigel Gresley* a *Rob Roy* and a Tich. The Society also have an *Ajax* as a Club locomotive, while the track facilities include a 600 ft. line for 3½ in. and 5 in. gauges.

On Saturday 14 June, the Society will be at home to the Romney Marsh M.E.S. at the track at Ellington Park, Ramsgate. The Clubhouse is at 90 Southwood Road, Ramsgate, and is open on Friday evenings 7.30 to 9.30 p.m. New members will be welcome.

Secretary: Mr. F. Crispe. May we have your address please Mr. Crispe?

Westland M.E.S.

At the A.G.M. of the Westland Model Engineering Society held on 6 March, the following officers were elected: Chairman T. Egginton, Secretary A. Prosser, Treasurer H. Lumb. It was decided to apply for membership of the Southern Federation of Model Engineering Societies. Plans are also in hand for another exhibition, to be held on Saturday, 29 November at St. John's Schoolrooms, Yeovil. The Secretary's address is: 3 Woodstock Road, Yeovil, Somerset.

CLUB DIARY

Dates should be sent five weeks before the event. Please state venue and time.

May 21 Brighouse & Halifax S.M.E.E. Public Open Day. Ravensprings Park, Brighouse.

May 18 Huddersfield S.M.E. Liverpool-Walton, Hall Park, Northern speed eliminations M.P.B.A. members only.

May 19 Stafford & District M.E.S. Bits and Pieces Night. New Inn, Stafford. 7.30 p.m.

May 19 City of Leeds S.M.E.E. Templenewsam — Informal meeting.

May 20 Chesterfield & District M.E.S. General meeting. Canteen, Bryan Donkin Co., Derby Road, Chesterfield. 7.30 p.m.

May 21 Sutton Coldfield Railway Society. L.N.E.R. Pacifics Part II (Dave Palmer and Peter Thomas). Wylde Green Library, Emscote Drive, Little Green Lanes, off Birmingham Road, Sutton Coldfield. 7.30 for 8.15 p.m.

May 21 Guildford M.E.S. Final of Bits and Pieces Competition. H.Q., Stoke Park. 7.45 p.m.

May 21 Southampton & District S.M.E. General meeting.

May 21 Bristol S.M.E.E. Derek Williams — Quorn Grinder. Unitarian Hall, Lewins Mead, Bristol. 7.30 p.m.

May 21 Cannock Chase M.E.S. Track Building — programme continues. Rear of Cannock Swimming Baths, Cannock Park.

May 22 Leyland, Preston & District S.M.E. Meeting. Roebuck Hotel, Leyland Cross, Leyland, Lancs. 8 p.m.

May 23 Colchester S.M.E.E. A talk by Mr. Spinds — "A car of the future". Club House, Old Allotments, Lexden. 7.30 p.m.

May 24 Paddle Steamer Preservation Society. Annual Models Rally. Blackheath Princess of Wales Pond, Blackheath. 2-6 p.m.

May 24, 25, 26 Crofton Beam Engines. 1812 Boulton & Wyatt and 1845 Harveys of Hall beam engines in steam. Crofton Pumping Station on the Kennet & Avon Canal. Enquiries: Crofton Beam Engines, 273 East Grafton, Burbage, Wilts.

May 24, 25, 26 National Traction Engine Club. Pirton Steam Rally, Pirton, Nr. Hitchin, Herts. Mrs. B. Mayes, 23 Nunnery Lane, Luton, Beds.

May 24, 25, 26 Los Angeles Live Steamers. Brotherhood of Live Steamers Meet. Scales are ¾ in., 1 in. and 1½ in. Several thousand feet of track to operate upon. Griffin Park, Los Angeles, U.S.A.

25 May Huddersfield S.M.E. Sunderland M.E.S. — Roker Park. Start, steering and speed of Humberside M.C. Eastpark, Hull. 1 p.m.

May 25 Harlington Locomotive Society Open Day. High Street, Harlington, Middlesex. 2-6 p.m.

May 25, 26 National Traction Engine Club. Beaulieu Steam Festival. Beaulieu, New Forest, Hants. B. Johnson, 18 Orchard Gardens, Woodgate, Chichester.

May 25, 26 National Traction Engine Club. Festival of Steam, Yelverton, Nr. Plymouth. F. G. Burt, 17 Toronto Road, Exeter, Devon.

May 25, 26 National Traction Engine Club. Welford Steam Engine Rally. Husbands Bosworth Airfield, R.E. West, 4 Adam & Eve Street, Market Harborough, Leics.

May 25, 26 National Traction Engine Club. West Wycombe Steam Rally. West Wycombe, Bucks. J. Ross-Barnard, Cherrytrees, Candlemas Lane, Beaconsfield, Bucks.

May 26 Guildford M.E.S. Track event at Surrey County Show.

May 26 Northampton S.M.E. The society's track will be available from 10 a.m. for members of other societies and their friends. (Boiler certificates please.) The track is situated in Delapre Park, on the London Road, Northampton. Refreshments available.

May 26 Bracknell Railway Society. Public Running Day. Jock's Lane, Bracknell, 3 p.m.

Further Diary dates on preceding page.

POSTBAG

The Editor welcomes letters for these columns. He will give a Book Voucher for £1.50 for the letter which, in his opinion, is the most interesting published in each issue. Pictures, especially of models, are also welcomed. Letters may be condensed or edited.

"Sir Sam Fay"

SIR,—I thought your readers might be interested in the enclosed photograph of an engine I have just completed. It is of the Great Central "Sir Sam Fay" No. 423.

I scaled it up from Mr. Skinley's 7 mm. drawings and used all existing castings from other $3\frac{1}{2}$ in. gauge locomotives that were in stock at our friends in Birmingham.

The cylinders and "Joy" valve gears were from L.B.S.C.'s forgotten locomotive—the "Miss Ten to Eight" of 1938 vintage, which I found just fitted into the frames, but had to incline the cylinders at about 10 deg. to allow for the swing of the bogie.

The Belpaire firebox and boiler flange plates were from "Firefly" but I would recommend anyone else making one of these to use a standard roundtop firebox with a false cover over—it's much easier.

It is a nice big locomotive 4 ft. long and very easy to build. I started it on 1 June of last year and finished on 16 February.

Northampton J. P. Forsyth

Manning Wardle Locomotive

SIR,—May I say how much I enjoy "Model Engineer" with its wide range of topics and information.

I enclose a photograph of "1021" a 5 in. gauge miniature of "1021" which served as depot shunter at N.S.W.G.R. "Cardiff" for a few years. Built by Manning Wardle in 1916 it is quite small.

Length over buffers	$22\frac{1}{4}$ in.
Weight in steam	50 lb.
Boiler pressure	80 p.s.i.
Grate area	$6\frac{1}{4}$ sq. in.

Boiler 4 in. dia. with 205 sq. in. heating surface saturated steam

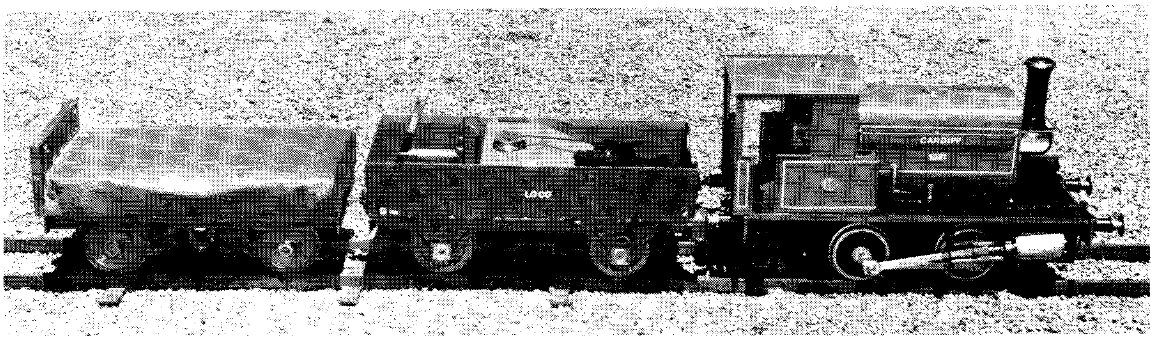
Wheel dia. 3 1/8 in.

Completed January 1974—18 months construction time

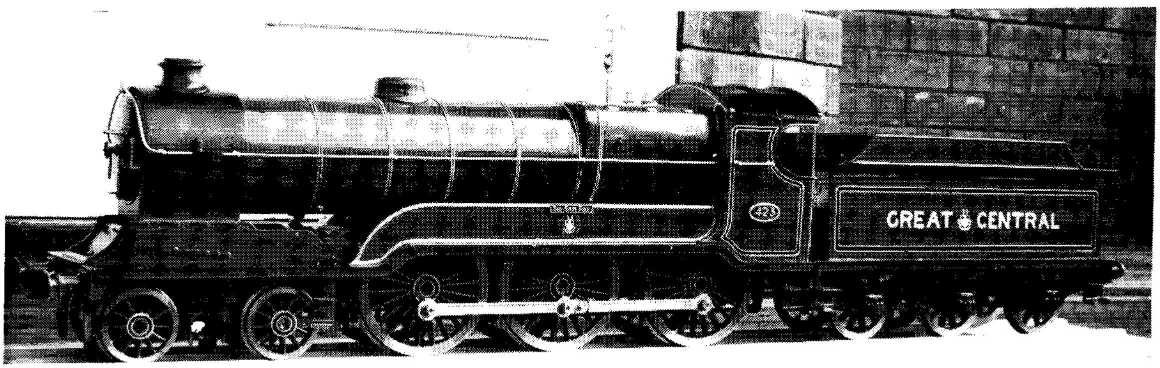
It has proved a most successful model. On two occasions it has hauled 800 lb. over a not-quite level road; working hard it can be most spectacular.

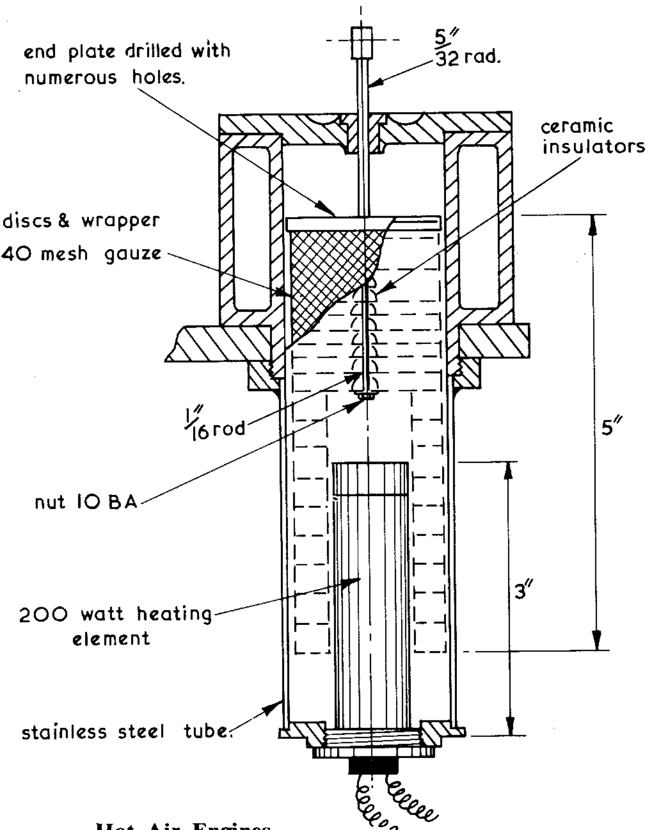
The following driving truck is complete with brakes which have proved essential on continuous tracks.

Berowra, N.S.W. Bob Quinn



5 in. gauge Manning Wardle Locomotive with tender and driving truck by Mr. Quinn. Below: "Sir Sam Fav" by Mr. Forsyth.





Hot Air Engines

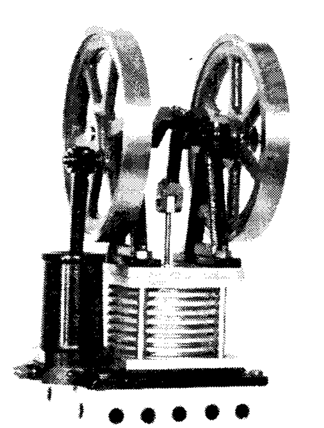
SIR,—I was very interested to read the letter about hot air engines from your correspondent Mr. D. H. C. Fulton and I hope that he intends to use a gauze regenerator such as I described in my article. I have now four engines running very well with these regenerators and I no longer make them with the machined end plate and rings shown in the diagram. These were used to enable me to dismantle the regenerator for modification. All that I do now is to make the thing entirely of gauze with the discs mounted on the central rod and separated with insulators as before. The wrapper is then bound temporarily with fine wire and the end discs and wrapper fixed with a few spots of silver solder. This makes it rigid enough. The gauze discs can be formed quite easily with a template cut from aluminium or brass sheet. I punch an $\frac{1}{8}$ in. dia. hole in suitable square pieces of gauze, bolt each one to the template and then nibble round the template with shears held in the vice. I am looking forward to hearing the experience of anyone replacing an orthodox displacer with one of these regenerators. The drive mechanism should be as light as possible.

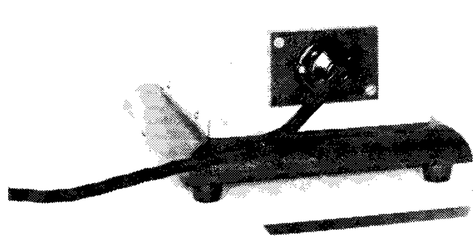
Although I have never seen a model Stirling engine working at an elevated pressure, there can be no profound difficulty. Dr. Stirling himself in 1816 was well aware of the need for pressure and introduced it successfully at the time by means of a force pump driven by the engine. With a high speed model the pump need only be very small and I am working on a double-acting engine at the moment, with pressure in mind, but I too would welcome practical information. As I understand it, pressure can be applied to the crankcase of a simple engine and from thence fed to the power cylinder at the lowest point reached by the piston, through a fine pipe or hole.

Stirling engines, I am coming to realise, are queer beasts quite unrelated to I.C. engines. They are more like a cross between a steam engine and a turbine. Perhaps the following points may be helpful to Mr. Fulton in designing his engine:

1. The Philips rhombic drive, which was described in some detail by Mr. R. Seir in M.E. 3464 (4 May, 1973), although fascinating mechanically, has not, in my opinion, any practical merit for a working model engine, even if it could be given some pressure. The object of this complicated mechanism is to avoid the problems involved in pressurising the crankcase and to ensure that there is no lateral thrust on the piston and displacer rods. Also perfect balance can be achieved. If one is going to use helium at 110 atmospheres as Philips do in their 100 h.p. engine, one cannot tolerate any leakage whatever, but with a model, minimising friction by using the simplest possible mechanism is much more important than perfect sealing.
2. One must remember that the piston is being blown through the cylinder by a few p.s.i. only and it should be as free as a turbine rotor. I make my pistons of duralumin and the cylinder out of stainless steel tube, which only needs lapping to produce a mirror finish, and with a working clearance of at least .001 in.. I have also abandoned any idea of using a piston rod with attached piston as opposed to a connecting rod because with the latter the piston is floating freely in the cylinder.
3. Another small but important point that has

Below: A Heinrici hot air engine by Mr. Urwick.





emerged is that the transfer passage between the heat exchanger and power cylinder must be large enough. Since the volume of air swept by the piston passes through this passage twice each revolution, its average speed at, say, 1,200 r.p.m. can be anything up to 4,000 to 5,000 ft./min. and is in fact a controlling factor in the output. Increasing the diameter of the transfer pipe in one of my engines from 3/16 in. to ¼ in. put another 200 r.p.m. on the no-load speed.

4. No doubt quite a number of your readers must have built the Heinrici 1/20 h.p. engine designed by Mr. Westbury. Mine was a pretty poor performer with a no-load speed of about 400 r.p.m. and no torque worth speaking about. However it was interesting because I had a 200 watt soldering iron element as my heat source, standing upright in the bottom of the displacer cylinder. The copper displacer was provided with a suitable pocket to receive it. After fitting a gauze regenerator, to the arrangement shown in the attached drawing, the no-load speed has gone up to 1,000 r.p.m. and it makes quite an inspiring demonstration model.

It would be interesting if someone with one of these engines would fit such a regenerator, ignoring the special pocket I have used. The performance with flame heating could well be better than mine with its heat input of only 200 watts.

5. The great merit of Mr. Slack's arrangement of the engine was that, in making my experiments, I could alter any one component without affecting the others and so get a clue as to whether I was benefiting or otherwise. The proportions of my best engine to date are as follows:

Power piston swept volume (¾ in. stroke)	0.745
Regenerator volume	2.969
Heated zone volume (1¼ in. stroke)	1.856
Total enclosed volume	5.570
Ratio of power piston swept volume to total	1:7.476

If the regenerator was a normal displacer this ratio would have been 1:2.49.

I shall look forward to hearing how Mr. Fulton gets on with his proposed engine and hope that these notes may be of some interest and value.

Malta — W. D. Urwick

Wiring and "Great Britain's" Engines

Sir,—Having reference to Mr. Watkin's remarks relating to my article I would say that I am not aware of any regulation I.E.E. or otherwise which demands an earthing terminal at any lighting point which is out of ordinary reach, (usual room lighting) except sockets for portable apparatus. The third terminal in a three plate rose is not usually intended for the earth wire; the purpose for which they were designed is to allow the required switching of say a three light fitting, in the order of one, two, or three lights from two switches. The provision of the earthing wire in the rose is to my mind dangerous, as sooner or later connections would be made to the earth wire instead of the neutral.

I noticed Professor Chaddock's remarks in his report on General Engineering Models regarding Mr. Buckle's scale model of the engine of the S.S. *Great Britain* when expressing some doubt as to authenticity of this model; I described this engine in my article of 2nd January 1970. The description and dimensions from the notes of T. R. Guppy who was greatly concerned with the construction of the Great Britain were as follows:— "The steam engine had four cylinders 88 inches bore × 72 inches stroke the piston valves were 20 inches in diameter, and the cut off 1/6th stroke. The propeller finally adopted was 15 ft. 6 in. diameter geared up from the engine shaft through four coarse pitch chains in the ratio 3 to 1, designed to make 53 r.p.m. In the trials in the Bristol Channel the speed of 12.1/3 knots was obtained with engine revolutions 18 per minute."

It will be noticed that Guppy mentions piston valves, whereas Professor Chaddock mentions slide valves in his report on the engine. As originally designed as a paddle steamer, it is possible the engine consisted of two 2 cylinder units, able to be disconnected from each other to enable independent use of either paddle wheel, and were coupled in line when the propulsion was changed from paddle wheel to screw, hence the need for the 3 to 1 gear up to the propeller shaft.

Three boilers were used to provide the steam at 4 p.s.i. The boilers were fired from each end, that is four furnaces at each end making eight furnaces for one boiler. All the products of combustion were passed to a single uptake. The experiments which decided the adoption of screw propulsion in place of the paddles, were carried out on the S.S. *Archimedes*.

E. H. Jeynes.

Cutting Brass Sheet

Sir,—Some time ago a description of the construction of "Como" was given in *Model Engineer* and a technique new to me on how sheet brass was cut, to avoid curling the edges when hand shears were used (p.595, Vol. 140). Apparently, a "parting tool" was run over the line to be cut. Can anyone help me with details as to how this can best be done, to ensure success? Also, a description of the tool used?

Los Angeles — James A. D. Walsh

Balanced Slide Valves

Sir,—I read the article by Mr. F. M. Collins with very great interest as the valve he first made, shown in Fig. 2 as "original Ewitch 'O' ring type", was virtually identical to those fitted some six years ago, to my 5 in. Stirling Single.

Mr. Collins' article made me curious about the behaviour of my own valves, so when the engine came in for overhaul and repainting over this last winter, I decided to strip the valves and have a look. Mr. Collins' description of his valve could well have been written about mine, especially as on reassembly the valves both refused to reseat themselves.

I therefore made precisely the same modification that he made as shown in his Fig. 6, "final design of Stuart Valve". However, I did not take the precaution of leaving the seating surface of the "O" ring proud of the spigot of the I.D. so that it would be bearing against the valve chest cover plate. On assembly, the valves refused to seat at all. On dismantling again, the "O" rings were left slightly proud so that initial contact with the covers was ensured. All was now well, and the "O" rings never failed to reseat though sometimes the steam chest pressure gauge indicated nearly 15 p.s.i. before seating took place. The resulting blow up the chimney did not inspire much confidence and would, no doubt have produced some caustic comments.

I considered the suggestion to provide a minimum clearance behind the "O" ring, but decided against this, mainly because accurate measurements were difficult to obtain in the restricted space available between the engine frames. The use of a very light corrugated washer also seemed to present problems —I've tried to make these before without much success. Eventually I decided to try tapering the spigot on the back of the slide valve so that the "O" ring resilience would provide its own spring towards the rear cover. After some experimenting I found that a taper of 20 deg. total included angle provided the best result. The valves now seat immediately, but the rings will still release to allow a free overrun.

I can confirm too Mr. Collins' findings on the lack of wear in the valve gear and eccentrics; none of these parts required any adjustment after six seasons running—they seemed to be as tight as they were on original assembly. This is in strong contrast to the eccentrics on another locomotive, *Lion* (Titfield Thunderbolt) which, after much the same amount of use, suffered wear of from .002 in. to .027 in.

I do think, however, that Mr. Collins has missed the main advantage, apart from lack of wear, that these ported slide valves produce. On the Stirling Single, and to a far greater extent on my model Aerolite as built in 1851, the configuration of the cylinders is such that the arrangement of the usual milled and drilled exhaust ports is complicated and results in passages of inadequate cross section area. With the ported valves the exhaust connections are about as simple as can be imagined. In the case of Aerolite with outside cylinders, and valves between the cylinders and the frames, the total thickness of the valve chest is only $\frac{1}{4}$ in. No way can you provide an adequate D valve in this space, let alone find room for the return exhaust passage in this case.

There is another argument in favour of the ported, or balanced, valve that Mr. Collins' experiments did not reveal, or if they did he makes no mention of the matter. On both my engines fitted with these valves, the very sharp exhaust has enabled me to increase the size of the blast pipe orifice by about 50 per cent above the normally accepted figure of 1/7 x the cylinder diameter.

I think, and hope, that "Twitch" may provide Mr. Collins with some unexpected and pleasant surprises when he finally makes his deput.

High Wycombe — M. H. Cox

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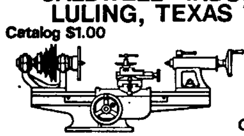

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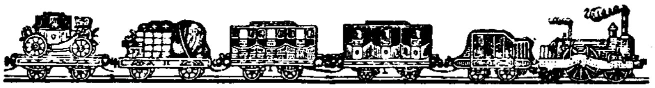

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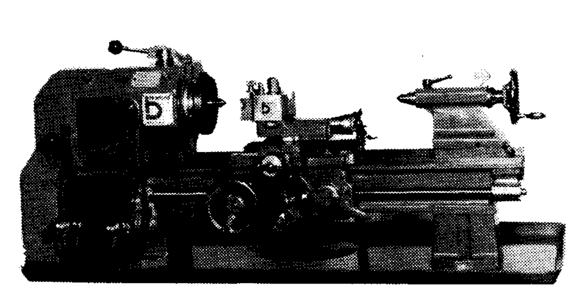

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