have fared reasonably well; brass has not dezincified and bronze pumps it is said are as good as new and copper firebox sheets likewise. Diving operations are restricted to just a very few weeks each year and all this happening near where Robert Stevenson built a lighthouse and from the spelling you will perhaps have concluded that it is not the same Robert Stephenson of early Railway and Locomotive building fame, but in fact the father of the writer Robert Louis Stevenson; the writer amongst other things of the book 'Treasure Island'. Well we might say treasure island indeed with the recovery of these early locomotives! I might have stayed longer on the island had it not been for the fact that I found myself competing for housing with pop music stars looking for retreats; one of the Beatles had discovered nearby mainland Mull of Kintyre you'll perhaps remember. My lodgings incidentally were adjacent to Bowmore Distillery and a farm cowshed and I spoke earlier about nasal efficiency!

I once received a letter at my lodgings addressed Isle of Islam, Argyllshire and I can only imagine that the Gaelic name of the house had defeated the sender, my address being C/O Mo Dachaidh which is Gaelic for 'Our Home'. Did somebody really think Mo was short for Mohammed! It really did happen I tell you and the surprise was that I received the letter at all! The pop star I believe who was looking for a 'pad' on Islay was called Donovan and it just occurs to me that Donovan was also the name of an A3 Gresley Pacific, next to 'Doncaster' as it happens, but before I start making associations between the names of pop stars and locomotives I had better return to the mainland and Hyde Park and be ready next time to continue my story, for already I have thought of the connection between Fury (the high-pressure Royal Scot) and the name of a pop star. We had better perhaps keep the stories of interesting locomotives till after I reach the end of my story!

Introducing

POM-POM A Great Central 0-6-0 in 5 in. gauge.

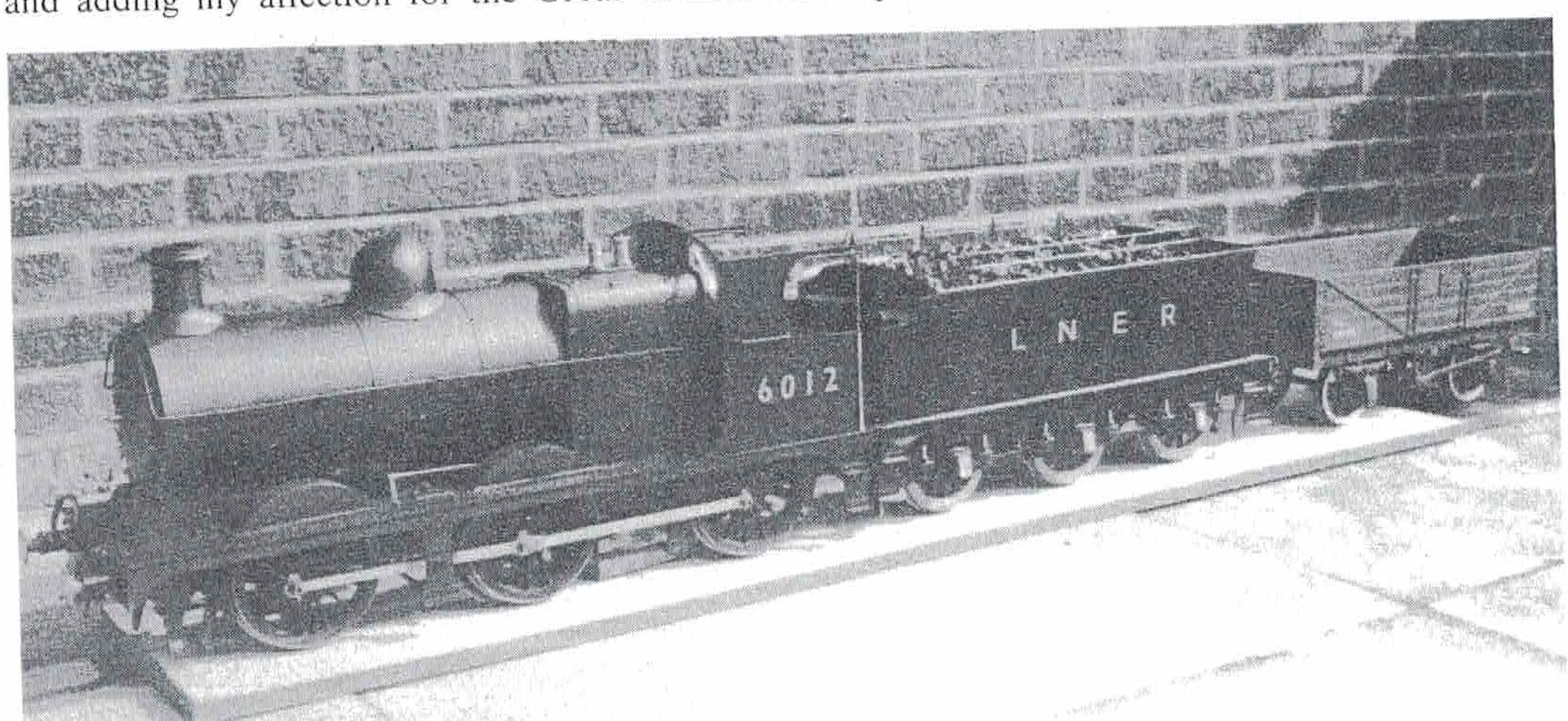
by: **DON YOUNG**

There are still some of my more popular designs that have yet to be described in any Magazine, engines like the BR Standard Class 2 No. 78000 and the LMS BLACK FIVE, both of which I intend to feature as series in LLAS in the future. I have put the 5 in. gauge BLACK FIVE lower on my list for the moment, this after the GALATEA series in "Model Engineer" by Tony Allcock; Tony is an honorary life member of LLAS and deserves my support rather than competition at this stage. MOLLY as introduced in our 1987 Catalogue was top of my list for a while, until I realised that as well as the GEORGE series still running, three other 0-4-0's have already been featured. I promise though to come back to MOLLY before too long, though it would help if a prototype builder will come forward in order to provide the all-important photographs as illustration. Such would also give me incentive to have the balance of the patterns made.

My most successful series in "Model Engineer" back in the 1970's was JERSEY LILY from a prestige point of view, and DERBY 4F in terms of immediate popularity, though this rapidly faded on my demise from those pages. Mixing the two and adding my affection for the Great Central Railway, I came up with POM-POM, a series which will have the added bonus that at least three engines are well advanced, indeed one could be in steam ahead of publication; let me set the scene.

Background

Mexborough in the early 1950's was a thriving freight depot and had a majority of ex GCR engines of Robinson design. I had seen the 2-8-0's on the Doncaster avoiding line hauling huge loads at moderate pace, heard them too at night as they passed hard by my lodgings — the best lullaby I have ever heard! At Mexborough though were also 0-6-0 tender engines that were both extremely spritely and possessed of a very loud voice; like a gun and hence the POM-POM description. Uncle Frank Young who had worked on the Great Central, first at Leicester and then graduated to Mexborough before moving on to Doncaster, spoke extremely highly of the POM-POM's, but I was at an age when I thought of everything relative to a Gresley 'Pacific', so what appeared to be a diminutive 0-6-0 did not impress me. I should have listened to Fred, good friend and fellow apprentice at The



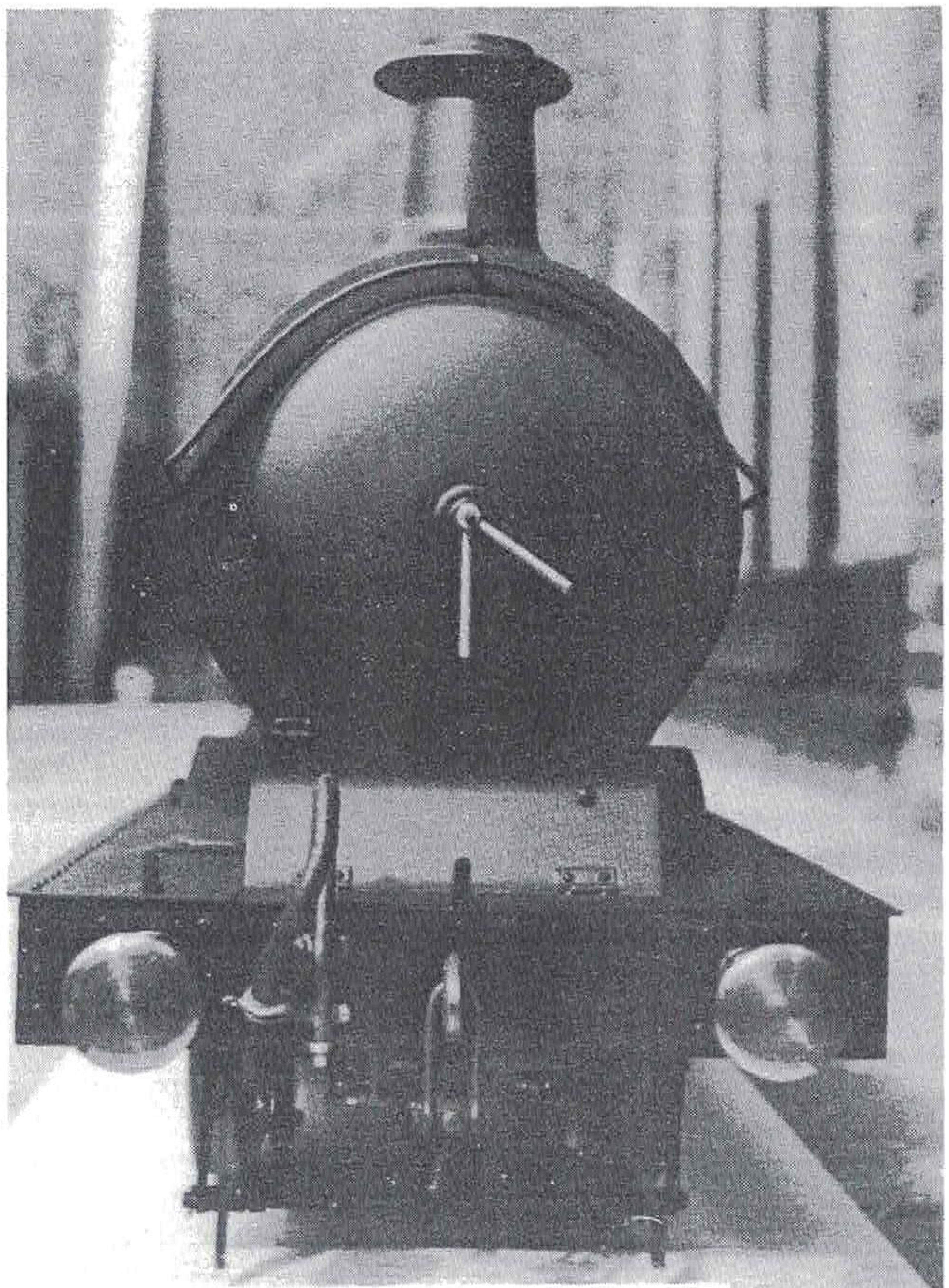
Readers will perhaps realise that Dave Johnson is in the building trade, though if I say anything more about bricks, this will be the last photograph I will ever see of his superb POM-POM!

Plant, for his father was Shedmaster at Mexborough and knew of the prowess of the POM-POM's, but by then I was firing the B1 Class 4-6-0's through Mexborough.

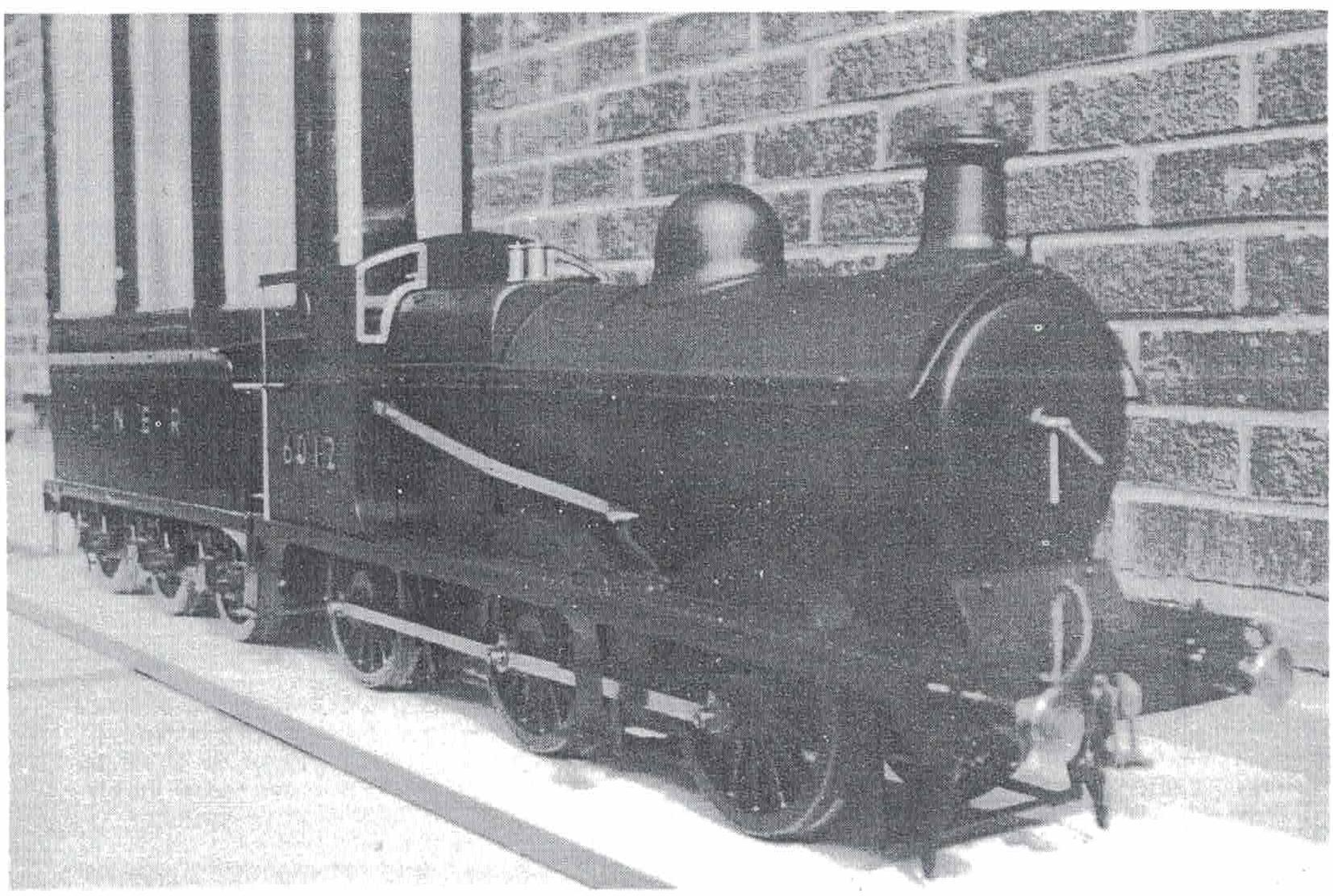
Twenty years on I was to ride with Allan Garraway on 'his' LINDA, when one of my many questions was why was not this engine fitted with a whistle off an A4 'Pacific', or perhaps another LNER engine? "But she is" said Allan "and from one of the finest of LNER engines, a POM-POM". Allan went on to tell me some of the exploits of these engines and later sent me a few photographs, all of which kindled my interest sufficiently to obtain some Works drawings.

I knew of course that Robinson had been a GWR man, having been Works Manager at Swindon before moving onwards and upwards at Gorton. What did surprise me about the POM-POM though was that in 1901 when first introduced, she had Churchward/Stephenson valve gear, this at a time before that CME had employed it, hence the good valve events. It was important for me to reproduce the explosive sound, so allied to a close copy of the full size valve gear, I have specified balanced slide valves exhausting through their backs directly up the blastpipe. This then is the first positive feature of POM-POM, but there are many more. Incidentally, Charlie Purinton in the USA wrote only today that a noisy engine was also a thirsty engine, having been held up on his local track by noisy engines ahead which kept stopping for water. I count myself very fortunate that great engineers like Chuchward and Chapelon were ahead on me in exploding this myth, provided the steam circuit was opened up; all I have done is apply those teachings in miniature. There have been five DYD Rallies now when most of my designs have performed and never yet have I heard complaint of being held up by a queue for the water tower, though just occasionally lack of steam has been a problem; I freely admit to being such a culprit!

Something that became more clear as the 2D drawings were translated into 3D engine, and I have been acquainted with Dave Johnson's POM-POM almost blow by blow, is that the boiler almost completely fills the chassis, it is enormous. Such is not apparent from looking at the full size engines, pity the evidence is only photographic these days, the reason being that the boiler is pitched very low in the frames, hiding that deep, deep firebox. One thing that appealed to me right at the outset was that this boiler was very much akin to those fitted to my other four GCR engines, sufficiently so that after checking with Reeves, it was possible to employ the same flanging formers; some astute person had allowed for the deeper POM-POM firebox.



The shapely Robinson chimney sits well atop the smokebox, far better than the Gresley 'flowerpot' ever did!



Readers will have opportunity for a closer look at Dave Johnson's POM-POM at the Model Engineer Exhibition at Wembley over the period of 1-9 January 1988.

Another plus was that although GCR 'Standard' tenders were anything but uniform, the differences between them would fill this Magazine, attaching one as drawn for JERSEY LILY was correct for at least some of the class. I have to be careful here, in fact at all times on the Great Central theme, for several authorities on the subject are LLAS members, including Doug Yarnell who put me straight on JERSEY LILY; she is the better for Doug's intervention. To me it is an honour for such authorities to be members, for they are my supporters rather than critics, though I know they will correct my mistakes!

Back on the engine and starting at the front end, notice how close the smokebox door and its fitments come to the front buffer beam, just enough room for the fireman to clean out the smokebox comfortably; no, thats the wrong word! Inside the smokebox is E11 draughting and the spearhead superheater elements of JERSERY LILY days have been replaced by coaxial ones as recommended by Alec Farmer. The greatest advance has been inside the cab, the backhead being cleaned up to include two water gauges. Siting the boiler lower means an upright turret can be fitted, though this is not strictly GCR and the other point the fans will criticise is the firehole door; I bow to such criticism on the grounds of practicality.

Having talked of these finer points, POM-POM does in fact come within my 'work horse' category. As example on Sheet 1, the axleboxes and their springing is pure LBSC and frills such as sandboxes are conspicous by their absence.

Very little alteration befell the POM-POM's throughout a very long working life; the most noticeable, not notable!, being the Gresley 'flower pot' chimney substitution for the graceful Robinson edifice.

The other most prominent feature, the dome casing, was of variable height and for some engines the JERSEY LILY casing can be used without alteration. The other change on the boiler top was the safety valves, which became Ross 'pop' in later days.

Let me next set down a few of the more interesting dimension — not the 42-24-36 kind!

Leading Dimensions

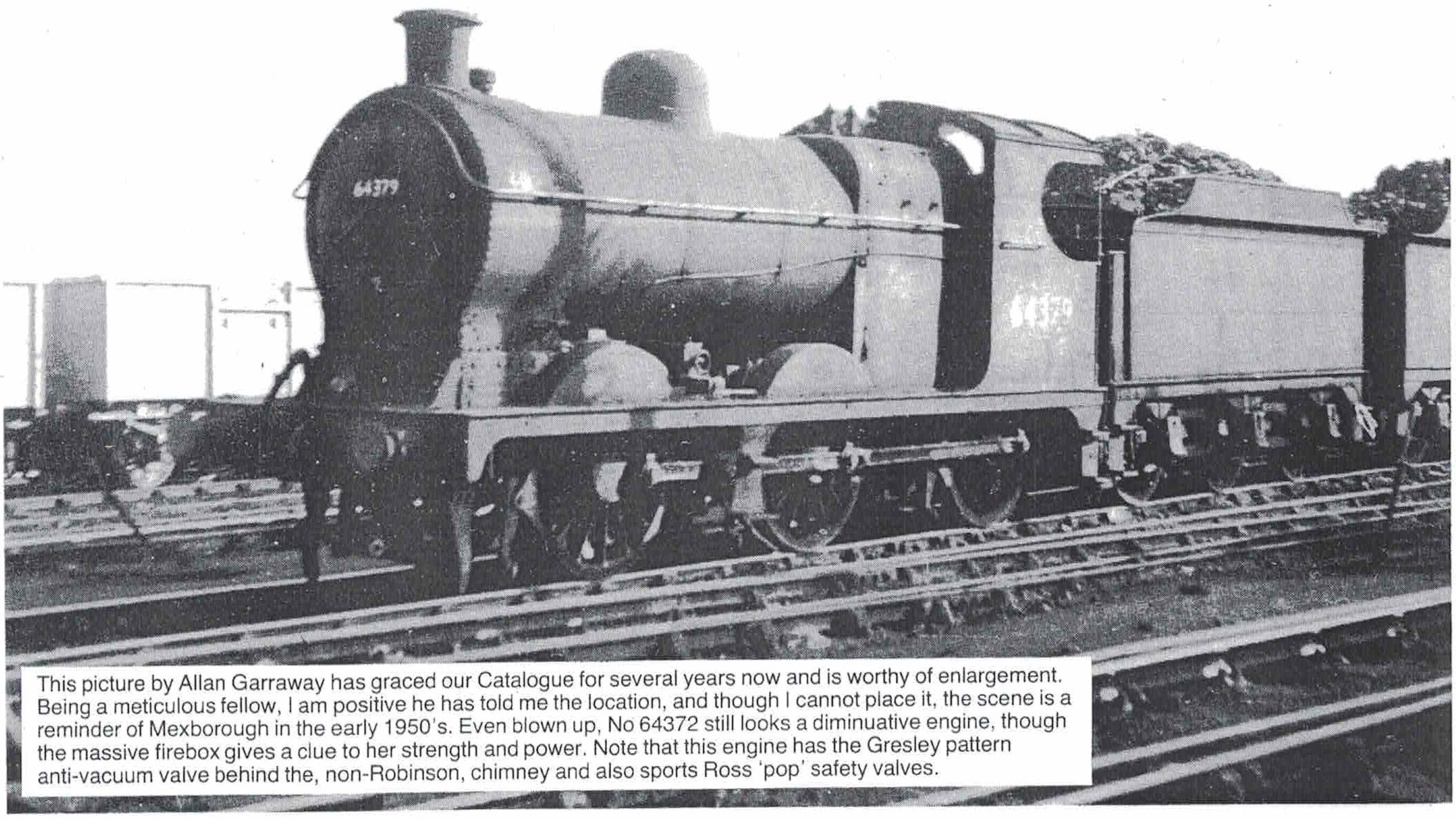
The mainframes are 29³⁄₁₆ in. long, the boiler occupying 18½ in. of this length, a goodly proportion. The 1⅝ in. bore x 2¼ in. stroke cylinders drive on to 5⅜ in. diameter coupled wheels. Grate area is approximately 15½ in^2, the firebox being so deep that a fire up to 3 in. thick can be built on said grate. When I designed the boiler for four GCR locomotives, I was dazzled by Alec Farmer's rolled barrels with their castellated joints, which of course meant there was no limit as to the diameter. I have learnt better since, so POM-POM has a 5½ in. o. d. barrel, a commercial tube size, indeed the other four engines could be so modified. The estimated weight in working order is 105lb, all of it available for adhesion.

Variations on a theme

Although POM-POM has thus far proved the most popular of my GCR designs, the series should be much more useful than covering a single design, the machinery lay-out as instance being a classic which will modify for any number of British 0-6-0's. The boiler too will readily modify to a round top firebox; just roll the outer wrapper to suit the barrel and omit the cross stays above the firebox. Talking of the boiler, Dave Johnson has promised me an article on its construction, so I shall be able to combine "Builders Corner" with the series.

Next time we will look at the tender, but for now we must delay making the leading and trailing axles for lack of the coupled wheels.

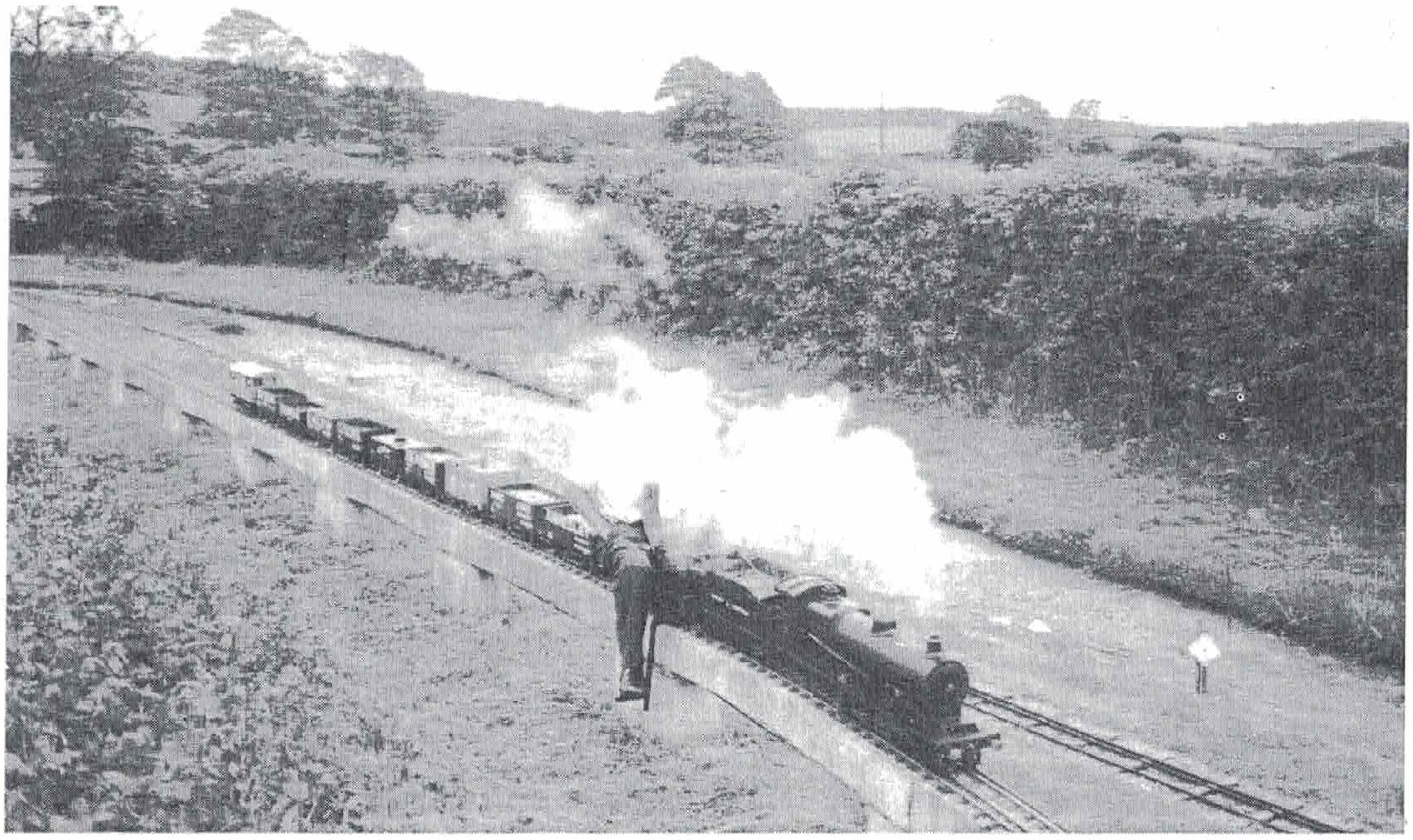
WANTED: Photographs of POM-POM's large and small.



This picture by Allan Garraway has graced our Catalogue for several years now and is worthy of enlargement. Being a meticulous fellow, I am positive he has told me the location, and though I cannot place it, the scene is a reminder of Mexborough in the early 1950's. Even blown up, No 64372 still looks a diminuative engine, though the massive firebox gives a clue to her strength and power. Note that this engine has the Gresley pattern anti-vacuum valve behind the, non-Robinson, chimney and also sports Ross 'pop' safety valves.

her Father, Brothers, Uncles and Cousins were all employed on the East Lancashire section of the L&YR, and two of their sons (My Father and Uncle) were both on the L&YR at Accrington Shed. When I came along, I was taken most Saturday afternoons to Stubbins Jct., north of Ramsbotton, to watch L&Y engines tackling the around 1 in 60 bank up the summit at Baxenden, so is it any wonder that with a background like this that I should be mad on steam and start the Bala Lake Railway? Next time I will start with some tales of L&Y engines at work from the 1930's onwards, leading up to the beginnings of the BLR and its development in 1972 to the arrival of MAID MARIAN in 1974, the first Hunslet.
George Barnes, Tamworth, Staffs.

(Ed: There was an amusing sequel to George's sampling of the 5 in. gauge HOLY WAR, for almost immediately after he detrained, it was announced the 18.30 Barbeque Special would be leaving early. Dave Johnson and I jumped to the rescue, HOLY WAR had her fire dropped and was blown down in record time, then we helped Peter carry the engine into the station building; it was the most poundage I had lifted, never mind carried, for some months. Dave and I then reboarded the Special, but no sign of Peter in his pristine white boiler suit; when he did emerge he was in his proper togs, and took a bit of stick for holding up the train to remove his boiler suit, which now had the instruction 'go when ready'!)



This Ted Avery masterpiece I was hoping would grace the front cover, but it just wouldn't work. Yours truly with Bill Holland's ROD at Bellany Green

POM-POM A Great Central 0-6-0 in 5 in. gauge.

by: **DON YOUNG**

Part 2 — Starting the Tender

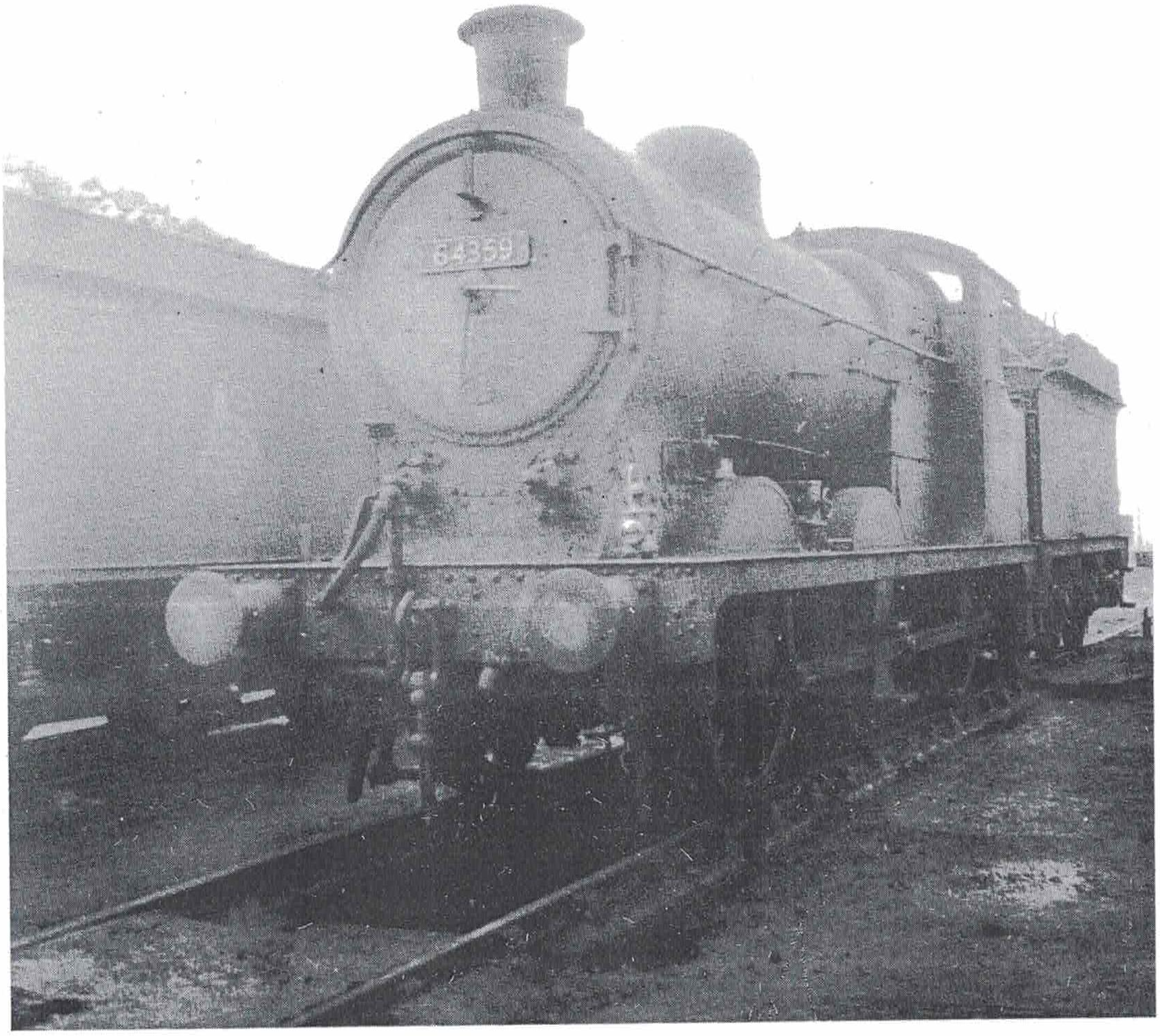
If my introduction of the engine was brief, that for the tender will positively spartan, the saving grace being that we shall cut metal before the end of this session.

I suppose I could go back 15 years or so to the JERSEY LILY series as published in 'Model Engineer', but I have never thought it right to refer to earlier work, though you the reader may care to do so and discover how much my memory has dimmed over the intervening years.

My earliest recollection of GCR tenders was on my first visit to Doncaster back in 1947, when on the journey up, only it is always Down, I noticed rows of them alongside water treatment plants at the various water troughs, striped white from the lime they carried. Even in their dappled matt black, there was majesty in their lines, which was reinforced when I saw my one and only JERSEY LILY, attached to her tender of course, at Doncaster. The pair were a grimy grey and it was only later that I learnt of their earlier and resplendent livery from Uncle Frank, but at least some of the ROD 2-8-0's passing on the avoiding line had been newly repainted, so I was able to see glossy black tenders.

When it came to consider JERSEY LILY as a 5 in. gauge design, thanks to Mr. Scholes and Mr. Cogger at the Transport Museum, Clapham, I was able to view vast bundles of Works drawings; two distinct sets as produced by Gorton and Beyer Peacock. For that visit, I had along with me Hugh Grayson, a good friend and fellow draughtsman, first at J. S. White and then Plessey Radar on the Isle of Wight. I remember that Hugh had just bought a Mini and proceeded to frighten the pair of us with his cornering, to the extent that by mutual agreement, I drove us home. At the Museum, we were met by Mr. Cogger and shown into a large room which was dominated by the huge GER Boardroom table; this became our working surface for the day. After sorting through our respective bundles, Hugh started on the ROD 2-8-0 of which there were myriad GA's, whilst I started the 'Atlantic'; we worked like beavers through the morning. It would have been nice to have dyeline printed those linen tracings, in fact I had made arrangements with Messrs Peabody locally to do same, but it was decreed that the tracings should not leave the building, rightly so in retrospect, so it was a case of tracing paper, pencils, straightedges and curves. Over lunch, when Hugh found he was not a fan of Spaghetti Boulangnaise, we discussed our progress and decided to concentrate on the tenders as the next step. I came home with over 30 sheets covered in lines and notes, but before leaving the Museum there was another shock for us.

My plea for photographs of POM-POM's large and small has not fallen on deaf ears, though my mention of bricks seems to have backfired as far as a certain 5 in. gauge example is concerned! I arrived home today from putting this issue together to find a fine selection waiting for me from the camera of Tom Greaves, so there are more pleasures to come. Allan Garraway has ensured this issue is well illustrated, starting with No. 64359. Where there are myraid variations over the years, I always take the cowardly approach and go back to Square One as built, so 64359 is somewhat different from what I have drawn, with her outside admission piston valve cylinders. Allan thinks the location is Lincoln, that at least was her shed allocation in 1950, and goes on to berate me for not saying that Thompson intended that the POM-POM's become one of his standard classes, hence the piston valve cylinders



Having just traced the tenders, the details were crystal clear in our minds, but when we were allowed to board the 'Director' Class 4-4-0 No. 506 BUTLER HENDERSON it was to find something rather different, especially the coal plate and its surrounds.

As has happened on another occasion since, when I came home I decided to put to paper what the Works drawings had depicted, rather than what I had subsequently seen, and these were in due course published in 'Model Engineer'. Generally they found approval, but Doug Yarnell pointed out that the coping around the top of the tender body was on the outside and not on the inside as I had drawn. Looking back at what Hugh and I had traced, it was a sectional view of the tender body and the coping was shown as a full line, hence my error. It is now thought possible on reflection over those 15 years that the coping might be fitted to both inside and outside faces, at least on the particular batches of tenders that we traced from. The tender now depicted is an accurate version of GCR 'Standard'.

One other point springs to mind from that series in ME and this concerns the tender axleboxes. I was fortunate in being assisted from several quarters with photographs, including the then Editor, Martin Evans, which greatly enhanced my writings. When it came to the axleboxes though I received a very irate letter from Alec Farmer of Reeves to the effect that I had correctly detailed a GCR tender axlebox, but that the illustration of same was of a later LNER pattern; what was I playing at?! It was a case of being guilty by default, for although the picture appeared under my name it was nothing to do with me; I don't have that excuse today!!

It will pay rich dividends to spend time looking at the GA of the tender and perhaps save some expensive brass later on. The only really significant feature is the low front coal bulkhead, far lower than was later practice. Having tried to negotiate that flap coal door on BUTLER HENDERSON and found it nye impossible when stationary, never mind what it would be like on the move, it is obvious that the fireman went over that front coal bulkhead into the coal space to bring coal forward as necessary; there is a very little self-trimming on such a tender. With that thought in mind, let us start construction.

Outer Frames

For the outer frames we require two 22 5/16 in. finished lengths from what must be 3½ in. x ⅛ in. section steel flat. It is likely if your purchase of same is from Reeves that the material will be cold rolled pickled quality, which I much prefer, even though some work will be necessary on the sheared edge to form a first datum. Actually that cold rolled pickled plate takes a scriber line that is perfectly visible under artificial light and I have not found the need for marking off blue fluid, though you may find otherwise. Deal with the profile first, then mark on the hole centres and centre pop them lightly. Bring up the second frame and clamp together with datum coinciding, then drill through 3/32 in. diameter in about 4 places fairly equi-distant along the length of the frames. Fit 3/32 in. diameter snap head copper rivets and hammer them well down; it does not matter in the least about making a mess of the head.

Start by sawing the bottom profile roughly to line, removing the burrs as you proceed so as not to do yourself harm, then drill a row of ⅛ in. holes along the top of each horn slot, opening up as necessary so that the holes begin to break into one another. Now saw down each side of the horn gaps, grip in the bench vice close to the top of the gap and either break the redundant material out with a 'Mole' wrench, or use a chisel to similar purpose. You can now either transfer the frames to the machine vice, on the vertical slide, to mill the side flanks to a piece of 1 in. square bar as gauge, or file to said gauge. In either case, remember there is a wee radius of the order of 1/16 in. at the top of the gaps, so be careful when milling or filing this third face to your gauge. Now you can complete the bottom profile, including the projections which will accept the hornstays later on. Next drill all the holes to their specified sizes and we are ready to deal with the three cut-outs.

Mark off the cut-outs and if you are happy that you can drill ⅝ in. holes without the drill wandering about, then we can take a giant step at the first hurdle; that doesn't sound right somehow! Drill, say, a 3/16 in. pilot hole, then change to the ⅝ in. drill and see how you get on as you approach the full diameter; change to a 9/16 in. drill if the ⅝ in. one is wandering. Deal with this at the five positions, then use a square file to elongate the hole locally so that you can get a hacksaw blade in and start sawing out the surplus roughly to line, completing with files. When satisfied, start removing the rivets and open out any hole that was drilled the wrong size, then separate the frames and remove all burrs and sharp edges.

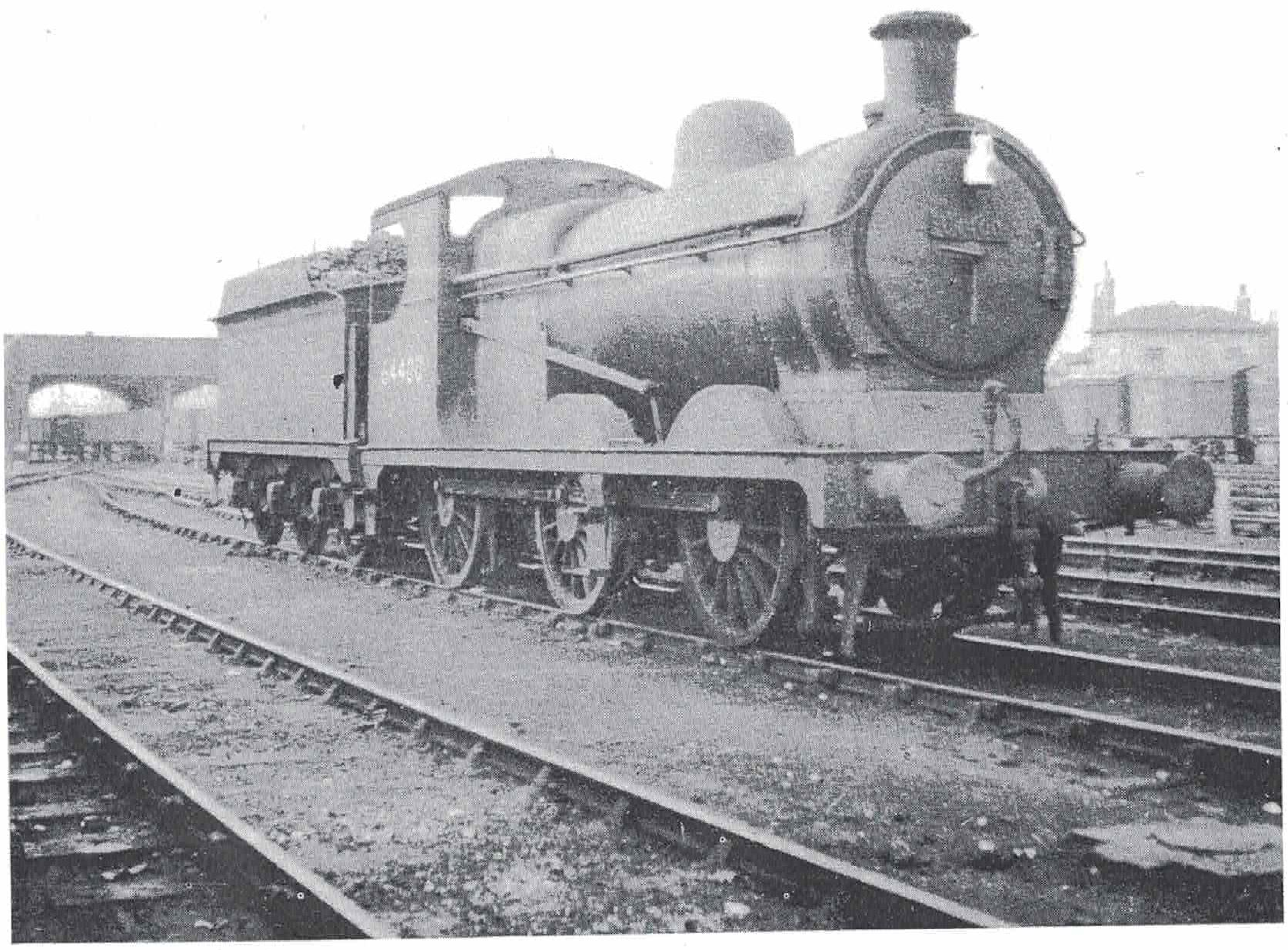
Inner Frames

Perhaps readers can begin to realise the stiff task I set JERSEY LILY builders back in 1972 by the 1 7/16 in. width of the inner frames, whereas 1½ in. x 3/32 in. section is available commercially. As those inner frames are barely visible, it would be easy to leave the section 'as purchased', and I am going to suggest that POM-POM builders do just that. Really the length should be determined once the box castings have been fabricated, again I am confusing builders!, but I must assume the latter exist, when you make the inner frames to suit. Mark off and drill the eight No. 41 holes at the ends, then offer up to the outer frames and drill through the other eight No. 34 ones for the intermediate stretchers.

These initial sessions on POM-POM have not been very productive, but next time we shall begin to make real progress.

Some weeks after I had typed up the main body of the notes for Part 2, Norman Lowe wrote to say his E. S. COX was in the Paint Shop and thát he was looking around for the next project. When I telephoned, Norman confided he would like a 5 in. gauge LNWR 'Precursor' or 'George the Fifth' to be the next engine in his workshop and asked if I had ever considered such a design. I had to tell him that right from the completion of LANKY, I had been looking towards Crewe as the Webb 2-4-2 radial tank was quite similar to the L&Y one, and it is always attractive if the same castings can be used on several occasions. I had also looked at the 'Claughton' several times, partly on the behest of David Palmer, but did not think the valve gear would scale. It was a little upsetting to learn from Norman that he had a set of Works Drawings for the 4-4-0's and had lent then to Harry Clarkson many moons ago when the latter had expressed interest in either a 'Precursor' or a 'George the Fifth'; oh that I had access to them today.

As I have done on occasions in the past, I began looking at photographs to see if it were possible to work from same, but I found them utterly confusing, for so called 'standard' engines had myriad differences. I also discovered that the late and great J. N. Maskelyne had made errors on his GA for the 'George the Fifth', which really shook me, having taken his work for gospel over the years. Anyhow, what my magnifying glass discovered, much to my surprise, was ROD tenders fitted to both 'George the Fifth' and 'Claughton' engines, so just possibly this can be taken as the start of an LNWR project?: I wonder how many fans will wear it!



At least Allan has provided me with one illustration that looks something like I have drawn, though No. 64400 is fitted with the taller flower pot chimney which mars her appearance in my eyes. This Mexborough shedded engine was captured in a favourite spot at Doncaster by Allan in August 1949. Besides that standard Gresley snifting valve behind the chimney, the dome on #4400 looks squat enough to have come straight from a JERSEY LILY

POM-POM A Great Central 0-6-0 in 5 in. gauge.

by: DON YOUNG

Part 3 — Tender Chassis

At long last we can make real progress on the tender, so let me press ahead without further delay.

Front Box 'Casting'

I remember that when I first drew up such a fabrication for my K1/1 tender that I was not too sure how things would work out; I need not have worried.

For the top and botton pieces, square off two lengths of 1¼ in. x ⅛ in. BMS flat to a full 5⅞ in. overall. Mark on the lightening holes on one piece, clamp the pair together, then drill a lot of 5/16 in. holes to remove the bulk of the surplus metal. Now grip the pair in the machine vice, on the vertical slide, and use a 3/16 in. end mill to complete to line. For the partition plates, cut 1 in. lengths from the 1¼ in. x ⅛ in. BMS flat, you will need four of them, and square them off to 31/32 in. overall. You may cut lightening holes in these partition plates if you wish, to leave 3/16 in. of metal all round, or simply leave them plain. The end plates are from 1½ in. x ⅛ in. BMS flat, squared off to exactly the same length as the top and bottom plates, then reduce in width to 17/16 in. as per drawing. The idea now is to join the pieces together for brazing with a minimum number of 8BA brass round head screws. There will be tapped holes in the front face, as shown, so mark off for the 8BA screws to be clear of same, and at 1/16 in. from the top edge, 9/32 in. up from the bottom; drill them all at No.44. Offer up to the top plate, spot through, drill No.49 to 5/23 in. depth and tap 8BA; secure with the round head screws. Slide in the partition plates, sitting the bottom plate on same, clamp firmly together and fix the bottom plate to the front one. If the partition plates are not firmly held in place sandwiched between the top and bottom ones, then use a single screw in each face to teach them manners.

I should have said earlier about cutting the ⅞ in. x 9/16 in. slot for the drawbar; do it now.

On the back plate, drill an 11/32 in. hole in the position shown, then chuck a length of ⅝ in. square steel bar truly in the 4 jaw. Face, centre and drill 11/32 in. diameter to 5/16 in. depth, them remove from the chuck to file the scallop before parting off a 3/16 in. slice. Offer up to the back plate and fix as for its front partner, then deal with the end plates to complete the structure; we are ready for brazing.

Mix some flux into a stiff paste and apply with a wee paint brush, the artists sort rather than a domestic one, to every joint to be tackled. Take your time and don't miss anything. Stand on the brazing hearth, fit a No.2943 burner to your torch and heat up the whole fabrication very rapidly, feeding in spelter which can be Easyflo No.2, even brazing rod. Don't waste a second in getting the spelter to run right through all the joints, for the flux only provides limited protection against the steel from oxidising, then allow to cool and pickle to remove the excess flux. Wash thoroughly and dry with the blowlamp, then clean the external surfaces and file all the 8Ba screw heads flush. All this must be done very quickly, for the pickled steel will rapidly rust if zinc plate from an aerosol can is not applied in double quick time. Once the zinc protection is applied though, all is well, and if I scratch the same fabrication today for my K1/1 that was made all of 20 years ago, it reveals bright steel; all I need now is the rest of the tender! To complete the front box 'casting', all that remains is to lightly face the ends to arrive at the 6⅛ in. dimension.

Rear Box 'Casting'

This time the top and bottom plates are from ⅞ in. x ⅛ in. BMS flat, complete with lightening holes, the partition plates being from the same material and 31/32 in. deep as before. Cut the end plates as for the front box, cut the 11/16 in. x ¼ in. slot in the rear one, and drill the pair of ⅜ in. holes for the buffers.

The front plate requires a 9/32 in. hole for the coupler, plus the brake hanger brackets have to be made and attached. Take a length of ¾ in. x ⅛ in. BMS flat and at 3/16 in. from one end and 3/16 in. up from one edge, drill No.11; saw off at a full ⅝ in. and repeat another three times. Bolt the four brackets together, to first mill to length, then saw and mill the sloping face, completing with the 3/16 in. radius. Next chuck a length of 5/16 in. steel rod, face, centre and drill No.11 to ⅝ in. depth before parting off two full ⅛ in. slices; bolt a pair of brackets to each. Offer up to the front plate, mark off, drill and tap 8BA, when a single screw will be sufficient to hold each bracket in place. Now you can build up the rear box as we did for the front one, to braze up and complete as before.

Frame Stay

At this stage you can clamp the two boxes to the mainframes, but don't drill through as yet, at least not until the frame stay has been made.

Take a 7½ in. length of 1¼ in. x ⅛ in. black steel strip and mill the edges to 1⅛ in. width. At about ½ in. from one end, grip in the bench vice and hammer over to form the flange. At the other end, scribe a bend line at about ¼ in. from the end, assess what you think the width overall the pair of flanges is likely to be, then make the bend and check if you were right, or more likely wrong. You will however know the amount of your error, so saw away this odd end and scribe on another bending line to give you an overall dimension of around 6 5/32 in.; bend. To complete machining, grip in the machine vice and mill the end flanges to match the box 'castings', then saw and file away the centre portion as shown to complete — clamp in place. Although you can check for flatness and squareness of the frames assembly, the final check will be the axles and if they turn sweetly.

Buffer Beams

The buffer beams are each 8 9/16 in long and 17/16 in. x ⅛ in. section, with a 5/32 in. radius on each bottom corner, at which stage they part company.

For the front beam, cut a ⅞ in. x 9/16 in. slot to match that in the box 'casting', then mark off and drill the eighteen holes at No. 34. The final result wants to be akin to snap head rivets, so use 6BA round head screws for fixing, drilling the box 'casting' to suit, or you can of course use proper ⅛ in. diameter snap head rivets.

For the rear beam, cut a piece 1 1/16 in. long from ⅝ in. x ⅛ in. BMS flat, then drill and file the 11/16 in. x ¼ in. slot. Secure to the beam with four 1/16 in. countersunk iron rivets, then braze together and if you get a decent fillet along the edges, then so much the better. Next drill through and complete the slot in the beam before dealing with the ⅜ in. holes for the buffers; you may attach the beam to its rear box 'casting' with a few 6BA countersunk screws.

Brake Hanger Brackets

Between main and inner frames are four wee stretchers, only they double as brake hanger brackets. Start by squaring off four 1⅜ in. lengths from ⅞ in. x ⅜ in. BMS bar, then mill to form a channel section, with wall uniformerly ⅛ in. thick.

Now make a top closing plate from 1/4 in. x 1/8 in. BMS strip to a tight fit in the channel. the brackets themselves are from 1/2 in. BMS flat, so first mark off and drill the No.11 holes, saw off into full 1 in. lengths, bolt together and finish as for the rear box 'casting', using the spacers we made then for assembly and brazing up.
Pickle, clean off and zinc plate as for the other fabrications.

Wheels and Axles

Two distinct patterns of wheel are available, that detailed being ex JERSEY LILY and is as dimensioned. However, a finer spoked wheel of correct oval pattern is also availale ex E. S. COX and apart from being slightly more expensive, also varies slightly in some of the minor dimensions. I mention the oval spoked wheel because it better matches those I shall provide for the engine, but really it is a case of you pays your money and takes your choice.

In either case, chuck a wheel in either the 3 or 4 jaw and check that it is running true; you chuck by the tread. Assess the machining allowances, it seems I can never repeat this too often, then face across the back of the wheel, in back gear and using a tipped tool. Turn the flange down to 4 13/16 in. diameter and take the sharp corner off with a file, in fact it wants to be a true radius. Now centre, drill through in stages to 39/64 in. diameter, boring out to around .61 in. diameter if you do not possess such a drill and finally reaming at 5/8 in. diameter.

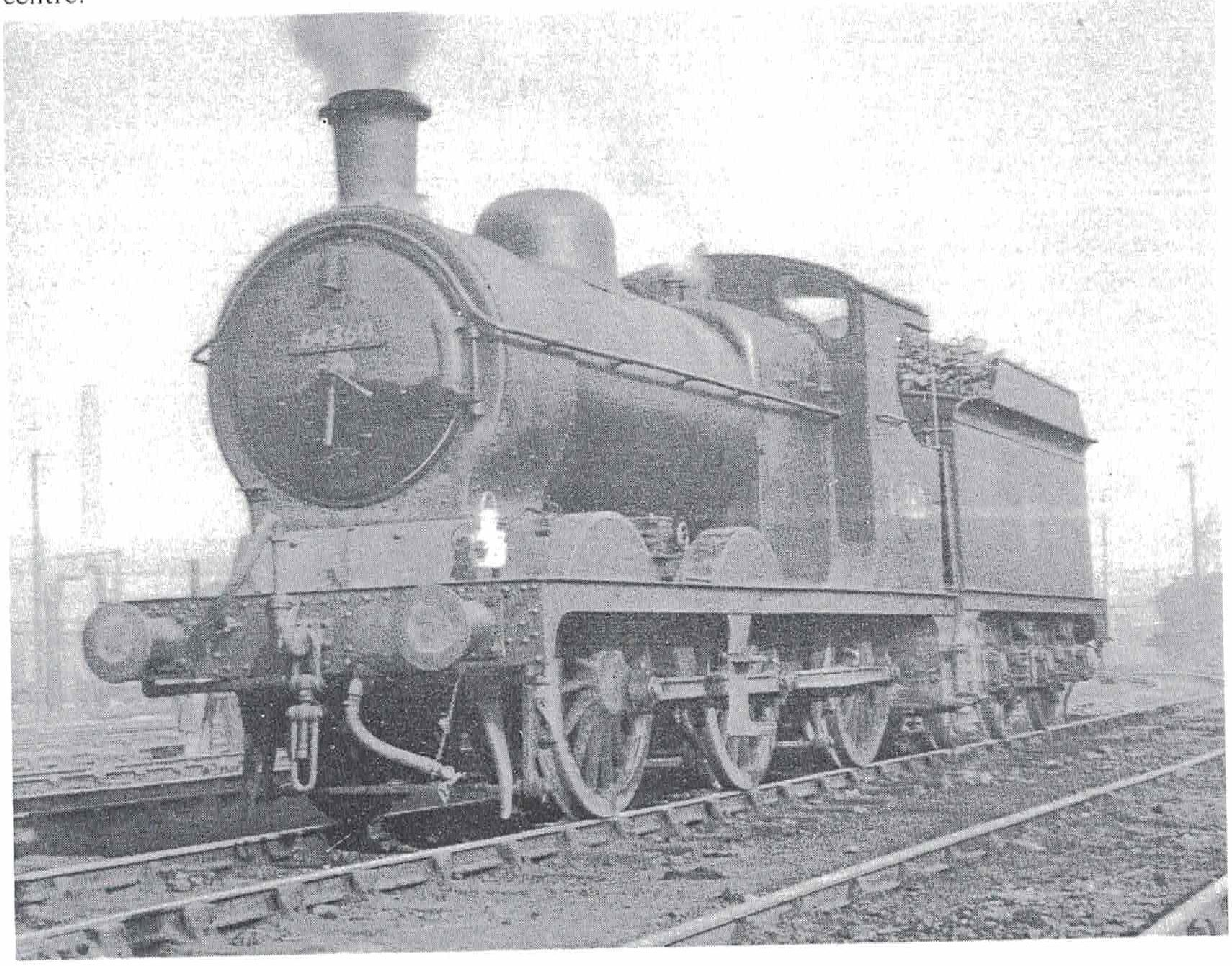
Take an old drill of 11/16 in. diameter or greater and with shank to match your headstock mandrel; many scrap metal merchants have boxes of used drills, then saw the drill portion away at the end of the flutes. Fit the remaining stub in the headstock and turn down to 5/8 in. diameter, a tight fit in the wheel boss. Now fit the faceplate and bolt a wheel to same, using countersunk screws with a large washer under the head to sit on the spokes. Turn the tread off to 9/16 in. overall thickness, then pull the tool post out by 3/32 in. to face off the boss. Change to a parting off tool, set it along the lathe axis, and take a 1/16 in. cut on the inside of the tyre to about 1/16 in. depth, this to represent a separate tyre fitted to the wheel centre.

Back in 1970, most tracks in the UK were made from rectangular section black steel bar with virtually square corners, so it was pointless specifying a large root radius between tread and flange. Now though a lot of track is laid with proper section rail, in either aluminium or steel, and this will accept a decent root radius to help properly centralise each wheelset, that is until David Hudson tells us how to make a better job of our wheel profiling. Anyhow, grind a tool so that you can deal with tread and root radius at one go, then reduce each wheel in turn to around 4 33/64 in. tread diameter. When the last wheel is turned to this size, apply a final cut to arrive at around 4 1/2 in. diameter, and leaving this setting well alone, deal with the other five wheels to be identical. Now fit each wheel in turn again over the mandrel, turn on the 1/16 in. x 30 deg. chamfer, and file the flange radius to complete.

For the axles, chuck an 8 in. length of 3/4 in. diameter bright steel bar, face and centre one end, then reverse and face off to 7 31/32 in. overall and centre this end also. Mount the axles between centres and gently tighten the 4 jaw chuck onto same to act as the 'driver'; I find this works just as well as the traditional carrier and driver plate. Start by reducing over a 5 in. length to 11/16 in. diameter, then concentrate on the end 11/16 in., turning down to .490 in. diameter, to be an easy fit in the axleboxes.

Although after the bad experience of some builders of DYD locomotives, my faith in Loctite products was somewhat shaken, I am convinced that if their No.35 Retaining Compound were still available to us today, there would not have been any problem, plus of course there is recommendation in LLAS No.28 to use instead Permabond A118, with the provisons in said article, so perhaps I can progress away from the press fit alternative once again?

Back to the axles, where the instruction is to turn the next 43/64 in. down to .623 in. diameter, and this must be an accurate micrometer reading. Move on another 1 19/32 in. and turn down to 1/2 in. diameter over a 1 1/2 in. length, then turn the topslide over roughly 3 1/2 deg. to turn on the tapered portion.



A 64360 was one of Darnell's best POM-POMs. Built at Gorton in 1908, she retained slide valves into BR days. Photo by Tom Greaves

If you are worried that you will not finish correctly to drawing, turn the taper to 4 deg. initially and then ease the topslide just a fraction; it does not matter if there is a wee flat left at the wheel seat shoulder on completion, but do retain the same setting for all axles ends, in fact you can now turn this axle end for end and do just that. When all three axles have been completed, degrease throughly, apply the Permabond A118 and fit each wheel in turn, pushing hard against the shoulder. Remember though the tip about wee chamfers on the journal end and at the back of the wheelseat, so as not to squeeze out the A118.

Horn, Axleboxes and Hornstays

These are the three most exacting items that we shall make this session, so take care with them and you will be well rewarded.

The horn castings I have by me at the moment still have part of the riser attached, so first saw this off and file what will become the working surface nice and flat as your datum; these horns are cast in pairs. Grip in the machine vice, on the vertical slide, with the flat face sitting on the botton jaw, set square across the lathe axis; I do this quickly against the 4 jaw chuck body or the faceplate. Mill the bolting face, rotate through 180 deg. and with the freshly milled face hard against the back of the machine vice, complete to the 11/16 in. dimension. Turn again, this time through 90 deg., to mill the working surface to size, then arrive at the 5/8 in. dimension. Saw in halves and complete the profile, including the 15/8 in. overall length.

The axleboxes are cast in threes and much of the machining can be completed before they are separated. Uppermost are lugs on which the oil lids are hung, so first rub them with a file to be flat as a start. Grip in the machine vice with these lugs hard against the back of same, to mill the inside face of the cast stick to arrive at the 15/32 in. dimension. Turn through 90 deg. to clean up one side face, then deal similarly with the other, keeping the cast feature on the front of the boxes nice and central. Measure the overall width, which will still be greater than 1 in. and remove half the excess metal. Now with a 1/2 in. end mill, form the slot to 23/32 in. width and 3/32 in. depth; reverse and repeat to obtain the 1 in. overall dimension, a neat fit in the frame gap, and 13/16 in. between slots. Now you can separate into individual axleboxes and turn them to 11/8 in. length in the 4 jaw, again keeping the cast features to drawing.

Back in 1970 when Sheet 3 first saw the light of day, I was still gainfully employed on the drawing board in industry. Also I had just bushed the steel axleboxes for my K1/1 tender, so bushes were in. Today I would vary the specification to plain bored axleboxes, but you the builder can have the final say.

Cut two 1 in. lengths from 3/4 in. x 1/8 in. BMS flat and mill down to 23/32 in. width, a nice fit in the axlebox slots. The idea of these pieces is to protect the delicate flange when we chuck the axlebox in the 4 jaw to bore out, so mark the centre on the first box and chuck to run true. Centre and drill out to 31/64 in. diameter and 3/4 in. point depth, then either bore to size, or more simply use a 1/2 in. 'D' bit to said 3/4 in. depth. Release two jaws only, rechuck the next box and continue until all six are complete; we must turn our attention to the front face.

Although you can lightly mill the seating for the oil lid, a file will be much quicker, at which time you can tidy up the lugs for the hinge; mark off and drill the No.57 hole in one lug only. Back to the machine vice to produce the oil pocket from front face to bore and I suggest you first drill as many 1/8 in. diameter holes as you can to remove most of the surplus metal before changing to an 1/8 in. end mill to complete. There remains to relieve the flanges at the top by 1/16 in. as shown, either by milling or simply filing.

For the axlebox oil lid, first chuck a length of 1/8 in. brass rod in the 3 jaw. Face, centre and drill No.56 to 11/16 in. depth, then part off a full 23/32 in. slice, checking against an axlebox until it is a nice fit between the lugs. For the wee knob at the bottom, chuck the 1/8 in. rod again and with files, deal with the 1/8 in. spherical portion, undercutting to 3/64 in. diameter. Turn the next 3/16 in. of rod down to 3/32 in. diameter, and leaving a 1/32 in. thick collar, reduce again to 3/64 in. diameter, though this need only be approximate, before parting off to leave a 9/64 in. long spigot. Cut the lid itself from 1.6mm brass sheet, mike the spigot just turned and drill the lid to accept same, peening over. At the top, chamfer the lid to match the hinge, then off to the brazing hearth to join the two with Easyflo No.2. Pickle and polish, then offer up to the front face of an axlebox, clamp in place and drill through the second lug at No.57. When I was building rather than describing how to build steam locomotives, I found bicycle spokes ideal material for hinge pins, in fact my Rudge was one of the first models fitted with stainless steel spokes, 18 swg. ones. The problem was that they went brittle and snapped in service, that could be exciting!, but of course they then had other uses.

For the moment, cut six lengths of 1/4 in. square steel bar and square them off to 113/16 in. overall; clamp them over the frame extensions. This locates the bottom of the horns, so clamp a pair of horns to an axlebox and bring the whole assembly up to a frame gap, clamping the horns firmly in place in turn. Drill back from the frames at 3/32 in. diameter, feed a snap head rivet in from the front, support the head on a dolly and use a 3/32 in. rivet snap to form another head on the inside; repeat to secure both horns. Release the clamps, and if the axlebox is tight between the horns, likely the horn faces are just slightly tripped, and can easily be corrected by filing. Next scribe from the frame extensions onto the hornstay bars and go back to the machine vice, first to mill the slots to size, checking to place and remembering these slots have to be 5/32 in. deep initially, then when the required fit is obtained, reduce the thickness by 1/32 in. to 7/32 in. Offer up to the frames, spot through, drill No.50 and tap 8BA for hexagon head screws.

SPRING GEAR

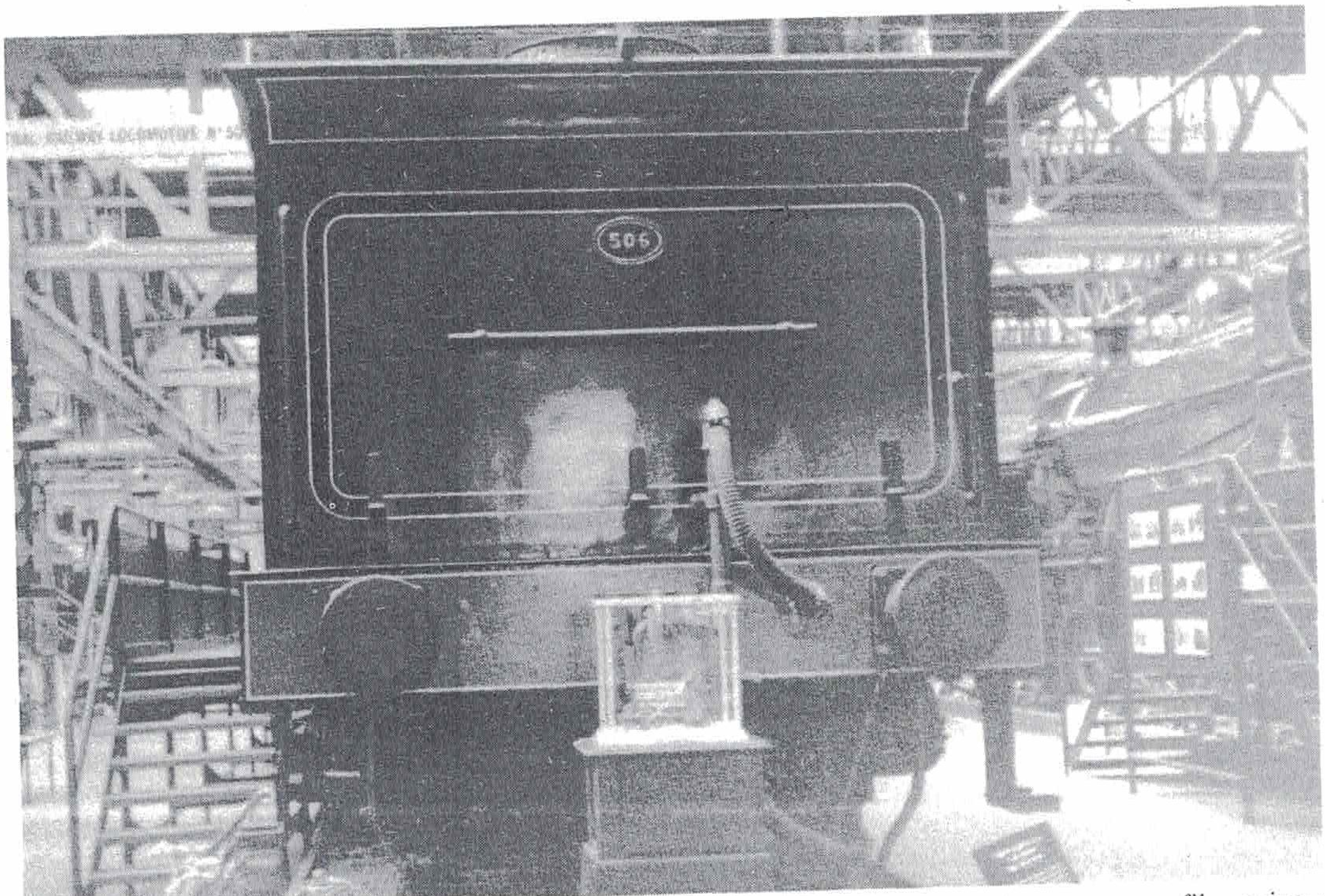
Spring Rubbing Plate

The springing of a Robinson tender is extremely neat as I have come to expect from that great CME. To provide some sideplay on the tender axleboxes, a separate spring rubbing plate is provided and although it can be machined from a gunmetal casting, I reckon it is simpler to fabricate from brass sheet and bar. Take a piece of 2.5 mm sheet, mark off, saw and file to line, then at the centre, drill a 5/32 in. hole. Next chuck a length of 7/16 in. brass rod in the 3 jaw, face, centre, drill and 'D' bit 7/32 in. diameter to 5/32 in. depth. Set a round nose tool over 7 deg. and turn the taper over the 7/32 in. length, finishing with a nice radius, then begin to part off, but on reaching 5/32 in. diameter, move on another 3/32 in. before parting right off. Fit to the plate, silver solder together, pickle and clean.

Spring hanger brackets come next, which will probably have to start life from 3/4 in. x 3/4 in. x 1/8 in. steel angle. Saw and square off twelve 11/16 in. lengths, then mill one face down to 5/8 in. width. For the other, mark off for the No.9 hole, scribe on 3/16 in. radius, drill the hole and then saw and file the profile. If you are very careful, it is perfectly possible to cut the 1/16 in. radius scallop with an 1/8 in. end mill, taking a small cut and feeding the end mill into the bracket, otherwise file same. Clamp to the frames, drill back 5/64 in. diameter and secure with snap head iron rivets.

Spring Hanger

Spring hangers next, and for a change I will do the easy bit first; coward! Chuck a length of 3/16 in. steel rod in the 3 jaw, face and screw 2BA over a 3/8 in. length, then part off at a full 121/32 in. overall. Reverse in the chuck, lightly face and turn



I went to Clapham Transport Museum in 1970 to obtain details of four GCR designs, and afterwards I managed to take this picture of the tender as fitted to BUTLER HENDERSON, which should be useful for POM-POM builders

down to .14 in. diameter over a 5/32 in. length, screwing 4BA; now for the fork end.
Chuck a length of 5/8 in. x. 3/8 in. BMS bar in the 4 jaw and face off, then mark off 3/16 in. from this end on the 3/8 in. face and cross drill No.31. Take the bar to the machine vice and mill the 7/16 in. slot to 15/32 in. depth. If your bar is long enough and you are careful, it is possible to produce the 5/32 in. radius over a mandrel with an end mill, but do file the corners off first; alternatively you can use filing buttons as I have recently described for DERBY 2P and others. Now file or mill the flanks down to either 1/4 in. or 7/32 in., depending which looks better to your eye, then chuck again truly in the 4 jaw. Centre, drill No.33 to 1/4 in. depth and part off to leave the base of the fork end at 5/32 in. thickness as per drawing; tidy up with files before brazing up as for the box 'castings'.

Shock Absorber

I am told I am wrong in that the shock absorbers fitted to GCR engines were square in section with generous radii on the corners, instead of having rounded ends as I have drawn, my informant being Muir Gordon. Muir thought that such a shape was unique to the GCR, but had only recently discovered same on the GNR. What I had not realised then was that the shock absorbers I had detailed the GCR "Standard" tender were in fact dummies, and not fitted with rubbers as is my later practice; little wonder Muir said that square ones were easier! Whatever shape is chosen, the starting point is 1 in. x 1/4 in. BMS bar; twelve pieces finished to 7/16 in. overall. First mark on and drill the No.11 hole centrally, then file on your chosen profile at the ends. Reduce the height to 15/32 in. and then continue another 1/8 in. to start forming the 'pip', though you will have to complete this latter with files against the hanger brackets as your gauge.

Spring Buckle

Back to the 5/8 in. x 3/8 in. BMS bar for the spring buckles; first chuck centrally in the 4 jaw, face and turn down to 7/32 in. diameter over a 3/16 in. length, just knocking off the sharp corner with a file. Next centre, drill No.44 to 3/8 in. depth and tap 6BA; this thread must be good as it will be well loaded. Start forming the slot to accept the spring leaves by drilling though at 3/8 in. diameter and although you can remove some metal with an end mill, to finish the job properly you will need a decent square file, using your spring leaf material as gauge.

Laminated Springs

By the time I came to detail the springs for JERSEY LILY, I already had three years experience of them on my K1/1, all of it good. By today the K1/1 has sat on its springs for all of 20 years, and although she is just slightly down by the stern, it would take but a few minutes only to adjust her level again. There is but one problem in arriving at this happy state in that I bought my spring steel in a coil by weight from E. A. Knight at Potters Bar back in 1964 when I was buying literally tons of spring steel for my work, and this meant that the radius was pre-set. Now our good friends A. J. Reeves & Co (Birmingham) Ltd supply our needs in spring steel, but their lengths are supplied flat. We don't want a very big radius for our springs on this tender, but they will require some pre-set, and if you have the luxury of bending rolls, then try these to see what results you get, otherwise gently hammering on the reverse side to what you think will result in a radius, just like panel beating. The other point I have to make is that the intermediate spring is longer than its partners, so watch out!
Cut the spring steel to the lengths as given in my table, and if you use a small chisel on each face, break the piece off and then grind the ends, you will get a satifactory end result. For the top leaf, chuck a length of 7/32 in. brass rod in the 3 jaw, face, centre, drill No.30 to 1/2 in. depth and part off a 7/16 in. slice; repeat another eleven times. Select a large potato and poke the top leaf through same; it wants to stick out about 1/2 in. Sit the little brass ferrule on top and silver solder together; the potato will ensure that neither you or the spring steel will lose its temper! Assemble the spring leaves, centralise them in the buckle, this really calls for patience, then use a 4BA socket grub screw, one with a cup point, to firmly hold the leaves in place. Assemble to the spring hangers with lengths of 1/8 in. steel rod and you can erect the spring gear complete; on to the brake gear.

BRAKE GEAR

Brake Hanger

Brake gear has proved my Achilles heel over some years now, I guess I begin to relax after sorting the machinery out, and I suppose this laxity started with LANKY, where a brake beam fouled the valve gear. Luckily my GCR "Standard" tender came before such a calamity, and according the Bill Holland DONCASTER is OK in this respect. For those of you like me who are itching to learn how his CALL BOY performs on the track, my last message from Bill is that he is busy adding the 'trimmings', things like sandboxes and drain cock operating gear, and this is proving very time consuming, as I had found earlier on the drawing board.

Back to POM-POM, to chuck a length of 5/16 in. steel rod in the 3 jaw; face, centre and drill No.22 to 3/8 in. depth before parting off a 1/4 in. slice. The hanger itself is from 1/2 in. x 1/8 in. BMS flat; mark off the datum edge and drill the No.11 and 30 holes, when you can radius at the top over a mandrel with an end mill. Saw and file the profile, then scallop the bottom end to suit the turned boss. Lay on the brazing hearth with a piece of 1/16 in. packing to get the boss in the right place, and braze up as per those box 'castings', though this item is far easier.

If one wants to use a headed pin to secure the brake hanger at its top end, then the outer frames have to be drilled for same. The alternative is to cut 7/8 in. lengths 3/16 in. steel rod, which will be positively trapped in position when the stretcher is erected.

Brake Shoe

Tiny iron castings are non-starter these days as most foundries have a minimum charge, plus the cost of putting a multitude of them on a 'spray' is rather prohibitive. Accepting this limitation, I have found them easier to make from BMS bar, preferable even to a cast ring. Cut six lengths from 7/8 in. x 3/8 in. steel bar and square them off to 1 3/4 in. overall. Scribe on the profile, mark off and drill the No.30 hole, then file the scalloped face to suit the tender wheels. Saw away as much excess metal as you can at the back of the shoe and file to complete. Grip in the machine vice, on the vertical side, to either slit or end mill the back of the shoe to accept its hanger, checking to place as that .166 in. dimension is important; it stops the shoe 'tripping' and seizing on the wheel when the brakes are fully released.

Brake Shoe and Gear Pins

I will describe how to make the brake shoe pins, and apart from the sizes, this procedure can be followed for all the pins we shall require. Chuck a length of 1/8 in. steel rod in the 3 jaw, face and then chamfer the end 1/32 in. or so at 30 deg. for ease of entry of the pin into its chosen hole; part off at 17/32 in. overall. Now chuck a length of 7/32 in. steel rod, face, centre and drill No.31 to about 3/4 in. depth, parting off 1/16 in. slices. Press one of these onto the end of the pin, braze it up, then chuck in the 3 jaw to clean up the head to drawing and remove any excess spelter. Now all you have to do is erect the brake shoe to its hanger and then drill through the pin for a 3/64 in. split pin.

Brake Beam

Square off three lengths of 1/2 in. x 1/8 in. BMS flat to 5 in. overall, then chuck centrally in the 4 jaw to centre and drill each end No.47 to 5/32 in. depth. Next chuck a length of 5/32 in. steel rod in the 3 jaw, face and turn down to a good fit in the beam end over an 1/8 in. length; part off at a full 15/32 in. overall. Reverse in the chuck, clean up to length and lightly chamfer the end; make six of these stubs and then braze into the beams. Mark off and drill for the brake gear pins at No.22, omitting the central one from the rear beam, then snape the ends down to 5/16 in. as shown; erect all the pieces made thus far and clamp the brake shoes firmly to the tender wheels.

Pull Rods

Start with the front pull rod that can be made strictly to drawing dimensions, by chucking a length of 1/8 in. steel rod in the 3 jaw; face and screw 5BA over a 5/8 in. length. Part off at 4 1/4 in. overall, reverse in the chuck and turn a 5/64 in. diameter spigot over a 1/16 in. length.

Many years ago I became quite proficient at bending up fork ends from 1/16 in. steel strip, bending them first over an 1/8 in. steel rod, then clamping an odd end of 1/8 in. thick material in the fork to drill the necessary holes and then simply filing the outline. The alternative is to start from 3/8 in. x 1/4 in. BMS bar, a fairly long length, first marking off and drilling the holes, then making the radii over a mandrel with an end mill. Now comes the bit I could never master properly, that of cutting the 1/8 in. slot; I tried using an end mill and it always wandered, then tried two hacksaw blades in the frame and tidied the slot up with a key cutting file, but the end radius never looked right. Some of you of course will do far better than I, so how about giving us a few tips? Saw from the parent bar, radius the end, drill a No.47 hole to accept the spigot and braze up. Clean up and the way I have found to protect brake gear parts and make them still look realistic is to paint them black undercoat only.

For the intermediate pull rod, start by making the fork end, which is much simpler than the front one; pin it to the intermediate beam. Next chuck a length of 5/16 in. steel rod in the 3 jaw, face and turn down to 9/32 in. diameter over 1/4 in. length. Next centre and drill No.22 to 1/4 in. depth before parting off an 1/8 in. slice; fit this to the front pull rod. Take a length of 1/8 in. steel rod, turn on a 5/64 in. spigot over a 1/16 in. length and fit to the fork end. Bring up to the boss in the front pull rod end. Measure and cut to length, then braze up.

The pair of trailing pull rods have fork ends identical to that on the intermediate rod, so you can mass produce all five of them if you so wish; cut the rod to suit and braze up.

Brake Adjuster

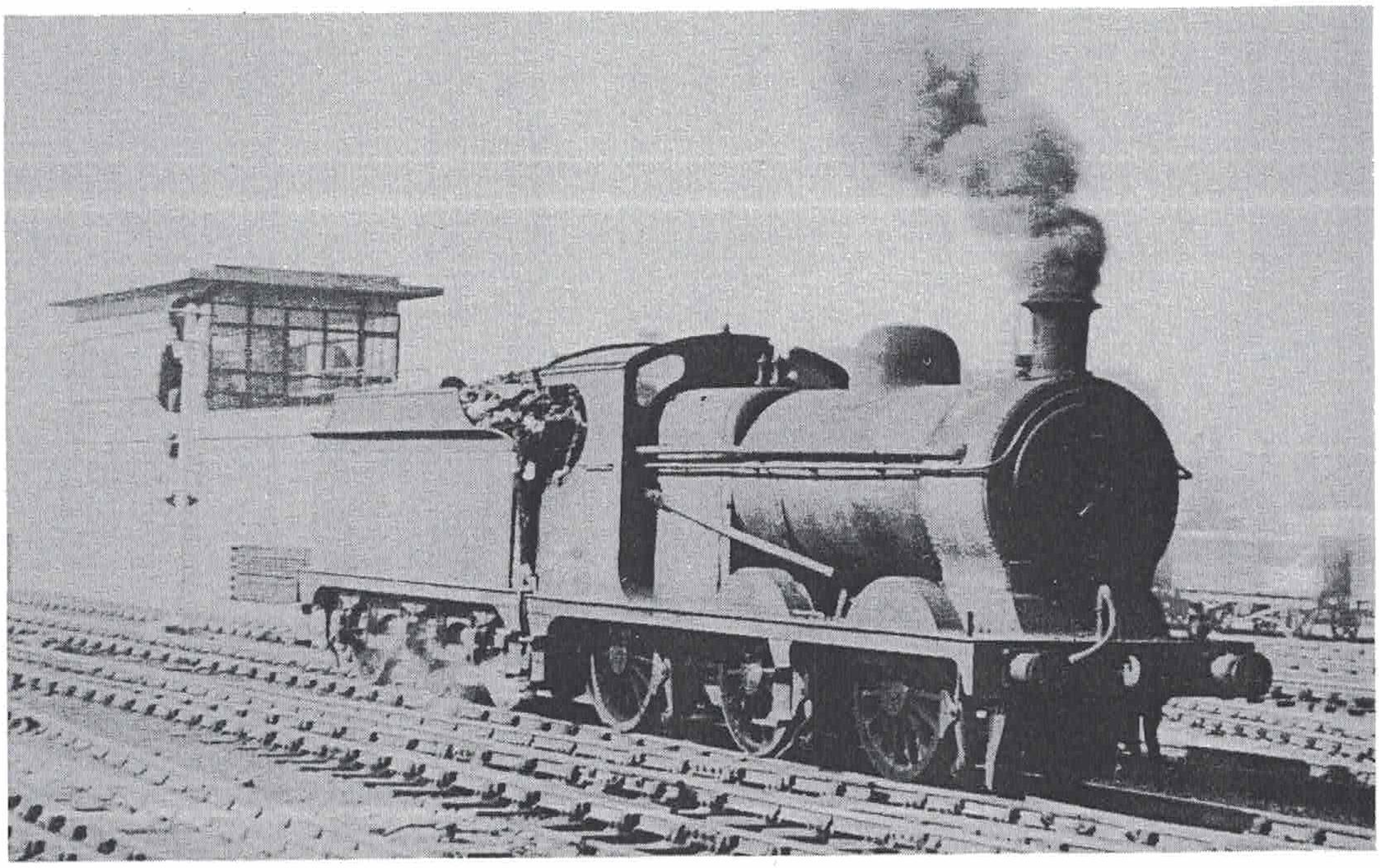
Adjuster next, for which we first require a length of 5/16 in. square steel bar. Mark off and drill the pair of No.22 holes, then radius this end over a mandrel with an end mill. Saw for the slot and complete with a key cutting file, then saw off to a full 13/16 in. overall, making this end radius with files. Chuck truly in the 4 jaw, to centre, and drill through the end at No.47. Next chuck a length of 4BA steel hexagon bar in the 3 jaw, face, centre and drill No.47 to 5/16 in. depth, parting off a 1/4 in. slice. Scallop the end to suit the main body of the adjuster and use a length of 18 swg. wire to hold the bits together for brazing. Rechuck truly in the 4 jaw, centre again and drill through at No.34, tapping 4BA to complete.

Brake Shaft and Trunnions

The trunnions are from 5/8 in. x 1/4 in. BMS bar; at 1/4 in. from one edge and 9/32 in. from the end, centre pop and drill through at 9/32 in. diameter. Radius the end over a mandrel with an end mill, the saw off at a full 7/8 in. overall. Transfer to the machine vice, on the vertical slide, to mill the top square and to length, then mill the 5/16 in. step to 1/8 in. depth. Tidy up the profile with files and we had better progress the brake shaft.

Chuck a length of 3/8 in. bright steel rod in the 3 jaw, face and turn down to 9/32 in. diameter over a 7/16 in. length, a good fit in the trunnion. Saw off at a full 6 13/16 in. overall, rechuck and face off to length, then turn this end also to 9/32 in. diameter, but only over a 1/4 in. length.

For the arm, take a length of 1/2 in. x 1/8 in. BMS flat and at 9/32 in. from one end, mark off and drill through at 3/8 in. diameter. If you do this in the machine vice, then you can move the cross slide on by 7/16 in. to drill the second hole at No.22; radius the large end over a mandrel with an end mill. Next chuck a length of 5/16 in. steel rod in the 3 jaw, face, centre and drill No.22 to 5/8 in. depth before parting off two slices about 5/32 in. thick. Heat these to a bright red and roll them around in casehardening powder. Assemble each side of the arm with a stub of 5/32 in. rod and simply file down to the position shown, and if your drilled hole is sloppy fit over the shaft, just nip with the bench vice to hold the two pieces



Neilson Reid built POM-POM, retaining sight feed lubrication for her piston valve cylinders, at Doncaster circa 1952. Photo by Tom Greaves

together for brazing; we know how to tackle small steel fabrications by now.
Slip a trunnion over each end of the shaft and erect to the frames as shown on Sheet No.2, clamping in place and checking that the shaft is square across the frames; spot through, drill No.50 and tap 8BA for hexagon head screws.

HANDBRAKE

I think when we have made the handbrake components that their assembly will cause no bother, but for those uncertain of what fits where, please refer back, say, to DERBY 2P.

Handbrake Column

The starting point can be either 5/8 in. diameter or 7/16 in. square mild steel bar to your choice; chuck truly in either the 3 or 4 jaw depending on your chosen material. Centre and bring the tailstock into use to turn down over an 1/8 in. length to 3/8 in. diameter, then with a round nosed tool, turn the next 3½ in. down to 7/16 in. diameter. Set the tool over a bare 1½ deg. and start turning the tapered portion, the critical dimension being ¼ in. diameter at the top, then drill 7/32 in. diameter to 2⅝ in. depth. Part off at a full 3 13/16 in., reverse in the chuck and grip by the 3/8 in. spigot, to centre the top end. If you do not possess a steady that will support the outer end for centering, then grip initially by the top portion, be it round or square, to centre before bringing the tailstock into play. Face across to length, and if you have centred deeply enough, then you will be able to go straight to a 9/32 in. 'D' bit to produce the 3/32 in. deep recess; drill No. 19 to break into the 7/32 in. hole.
The base is from ¾ in. x 1/8 in. BMS flat; at 5/16 in. from one end and on the centre line, centre pop and drill through to 3/8 in. diameter, then radius the end over a mandrel with an end mill. Mark off and drill the pair of No. 30 holes, then saw off to length and shape with files before fitting over the column and brazing the joint; clean up and paint black.
If you are fortunate enough to have an odd end of 7/16 in. square brass bar for the retaining plate, this will be a great help, for we can first chuck it truly in the 4 jaw to face, centre and drill No. 29 to 3/16 in. depth. With a knife edges tool, lightly scribe a 7/16 in. circle to locate the fixing holes, then part off a 1/16 in. slice. Mark off and drill those four No. 50 holes and just radius the four corner to look neat and I must assume the brake screw has already been made, it soon will be(!), in order to complete the column.
Drop the brake screw in place, followed by the retaining plate, to spot through, drill the column No. 50 and tap 8BA for hexagon head screws. If the column was made from round bar, you can file the top square and flush with the retaining plate; if both items are square, then just tidy them up if they are eccentric to each other.

Brake Screw

I must say that I prefer free cutting stainless steel rod for handbrake screws, our requirement being an 8½ in. length at 5/32 in. diameter. Chuck in the 3 jaw, face and turn down over a 9/64 in. length to 3/32 in. diameter, then screw the next 1 in. length at 32T. Reverse in the chuck, face off to length and turn the first 3/32 in. down to 1/16 in. diameter and screw 10BA. Reduce the next 19/32 in. length down to 1/8 in. diameter and we need the collar. For this latter, chuck a length of 5/16 in. brass rod in the 3 jaw, face and turn down to 9/32 in. diameter over a ¼ in. length and begin parting off a 3/32 in. slice, just enough so that you can produce the radius to drawing. Centre and drill No. 30 to ¼ in. depth, then part off, fit to the brake screw and silver solder together. To complete the machining, rechuck and clean off any excess spelter; the square must await the brake handle.

Brake Handle and Collar

For the boss, chuck a length of 5/16 in. brass rod in the 3 jaw, face and turn down to 13/64 in. diameter over an 1/8 in. length; continue and turn the next ¼ in. length down to 9/32 in. diameter. Centre and drill 3/32 in. diameter to 3/8 in. depth, then follow up with an 1/8 in. drill and 'D' bit to 1/8 in. depth; part off at a full ¼ in., reverse and clean up. Bend up the handle from 1/16 in. stainless steel wire, cross drill the boss No. 51 to accept same, fit and braze up. Chuck the boss again and run a 3/32 in. 'D' bit through to remove the wire at the centre and we have to produce the square to complete. I will freely admit that when I was building rather than describing how to build miniature steam locomotives, my breakage rate of carbon steel taps of 6BA and smaller was greater than it should have been. A reason for this is that as an engineer, I liked full depth threads and my tapping drill coincided with the core diameter of said tapped hole; in these pages except in odd instances, I specify tapping drills that do not result in 100% threads. Anyhow, I found by grinding the squares on the broken taps to slightly relief them, I ended up with very good broaches, ones that I could simply press through round holes and finish up with a perfect square. I cannot really ask builders to do this, for there is danger in the rest of the tap smashing when being pressed into a boss, the alternative being to use 3⁄32 in. square silver steel and make up a wee punch, one that is hardened and tempered before use. Now use the handle as your gauge to complete the square on the brake screw; assemble with a 10BA brass nut.

If 7⁄32 in. steel rod is no longer generally available, at least we can use 6mm as alternative. Chuck in the 3 jaw, face and apply the wee chamfer, then centre and drill No. 42 to 1⁄4 in. depth. Start parting off, but before completing same, file on the second chamfer. There are many ways to cross drill such a collar, but I go back to the machine vice and vertical slide. Chuck a centre in the 3 jaw, sight it by eye to be as central as you can get it, then make only a little more than a dimple, just enough to align the drill. Change from the centre drill to a No. 60 one, it will be in the same alignment, and carefully drill through. Offer up to the end of the brake screw, drill through from both sides, and secure with a 1mm spring dowel pin. I had a hundred of these wee fellows given me more than 20 years ago now and did wonder then as to their use. When I came to building the RAIL MOTOR No. 1 though, I soon found they were invaluable for fixing collars and the like, no more taper pins or grubscrews.

When you erect the brake, remember to allow 1⁄16 in. for the tender soleplate; set the handbrake vertical and secure the column to the front box 'casting' with a couple of 5BA screws.

Coupling Hook

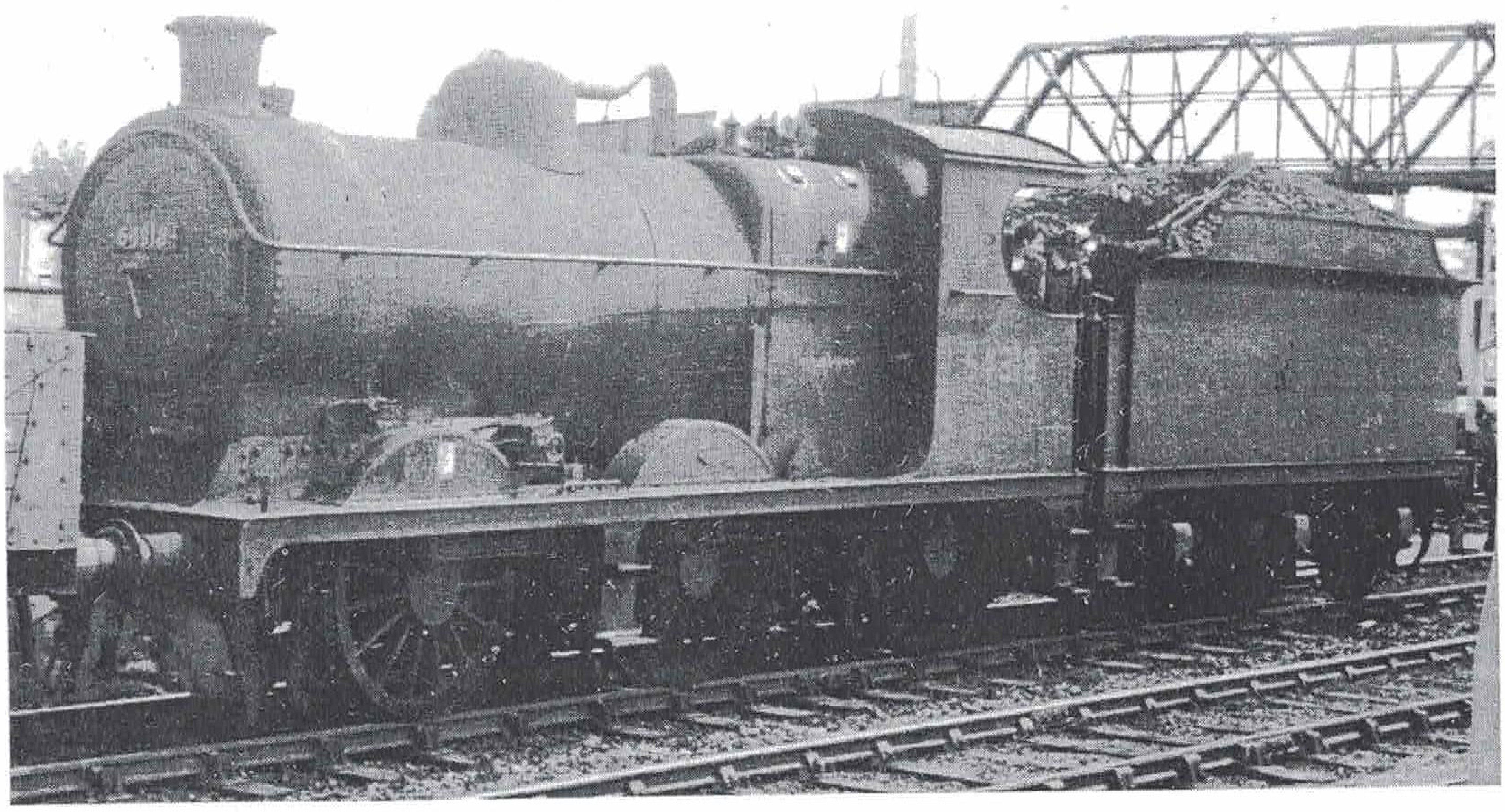
The coupling hook is perhaps the most vital item of all to ensure the safety of your POM-POM at the track, for a breakaway would be very serious. Unlike DONCASTER which I correctly fitted with vacuum braking, where a break-away would result in the vacuum hose between tender and train being pulled off, thus automatically applying the brakes on both engine and train, POM-POM is fitted with steam brake. I suppose it would be possible to use a vacuum ejector for the train, in fact it would be more than a good idea, but the graduable valve for the vacuum to control the steam brake would be a bit tricky; the easier way is to make the coupling hook from a decent piece of steel, 1 in. x 1⁄4 in. section. Mark off on a 4 in. length of bar, then chuck in the 4 jaw and start turning down to 1⁄4 in. diameter over a 2½ in. length a little at a time, not worrying if there is a wee flat left in conclusion; screw the outer 3⁄8 in. at 32T. Drill a No. 30 hole for the coupler and simply countersink each side if you are unable to bell-mouth same, then move on and drill a No. 11 hole to start forming the hook. Now it is a question of sawing and filing the profile as shown, then dealing with its section. The two photographs by Allan Garraway in LLAS No. 34 will be found particularly useful in arriving at the correct shape; as I write this I have not had the opportunity to closely look at the ones that will appear hereabouts from the camera of Tom Greaves, though knowing Tom, there is bound to be a lot of useful detail in them. I think my little note covers the coupling hook spring very nicely, so we can move forward to the drawbar.

Drawbar

Of course it is equally important for the drawbar to be as soundly constructed as the coupling hook, which to me indicates a welded joint between shank and boss, rather than a brazed one, or if you are a real glutton for punishment, it can always be machined from the solid! For the shank, chuck a length of welding quality steel, 5⁄16 in. diameter of course, to face and turn down over a 3⁄16 in. length to 7⁄32 in. diameter. Screw the next ½ in. length or so at 32T, cross drill 7⁄32 in. diameter for the split pin, and saw off at 9 in. length for the moment. Chuck a length of 5⁄8 in. steel bar for the boss, face and turn down over a ½ in. length to 9⁄16 in. diameter. Centre and drill 17⁄64 in. diameter to ½ in. depth before parting off a 5⁄16 in. slice. You will have to wait until your POM-POM engine is complete to check the drawbar length, afterwards saw the shank as necessary, file the scallop and weld together.

Drawbar Spring Collars

Chuck the 5⁄8 in. diameter steel bar again in the 3 jaw, it should be well faced by now(!), only for some obscure reason I have specified brass this time around!! Turn down to 9⁄16 in. diameter over a 3⁄4 in. length, then further reduce to 7⁄16 in. diameter over the outer 1⁄4 in. Centre and drill 5⁄16 in. diameter to 3⁄4 in. depth, then part off a ½ in. slice. Although it is possible to mill at least a part of the register, as much of it has to be done by hand and with files, it is not worth setting up for the little we could achieve. To complete the assembly, we require a further washer which is 9⁄16 in. o.d. x 5⁄16 in. bore x 3⁄16 in. thick and scalloped to suit a spring collar; assemble with a pair of 5⁄16 x 32T nuts, from 7⁄16 in. A/F hexagon bar and 3⁄16 in. thick, followed by the 'belts and braces' 3⁄32 in. split pin.



Piston valve POM-POM at Lincoln, being No. 64318. Despite Tom Greaves concentrating on the engines in these photographs, they do give a lot of useful tender information

POM-POM A Great Central 0-6-0 in 5 in. gauge.

FFESTINIOG STEAM 125 1863-1988

by: DON YOUNG

PART 4 — COMPLETING THE TENDER

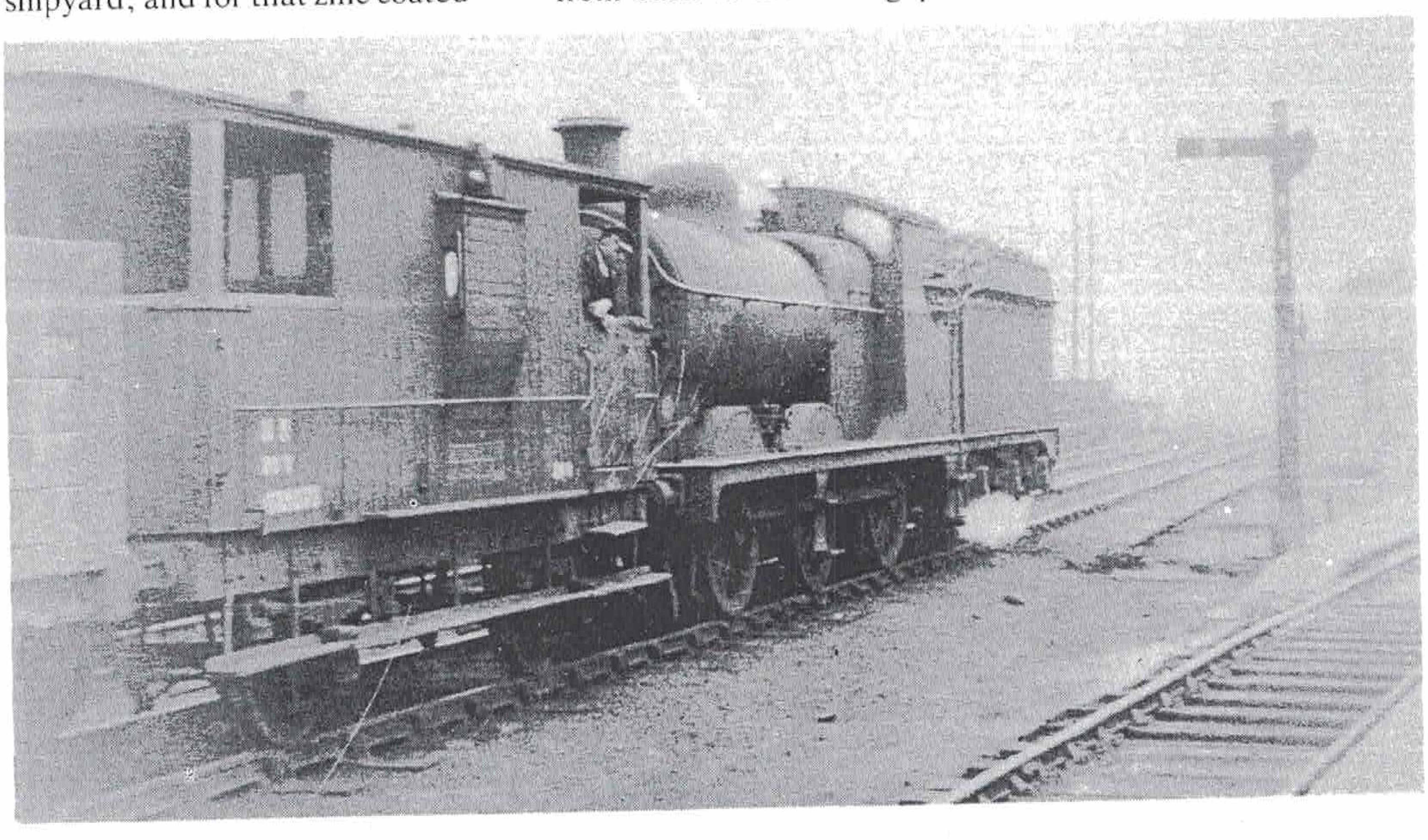
TENDER BODY

The late maestro LBSC was ever the practical model engineer and would deviate from full size practice for ease of construction. Such a point was in the reduction of tender wheel diameter where it would save piercing the soleplate to fit splashers. Whilst I have described an 8-wheel tender as fitted to the LNER 'Pacifics', and the Southern Railway also had 8-wheel tenders as a pair of 4-wheel bogies, the standard tender in UK practice was one of 6 wheels which might vary in diameter from 3 ft. 6 in. to 4 ft. 3 in. If said wheel was 3 ft. 9 in. diameter or less, then there was no need for any splasher in the soleplate, but for wheels of 4 ft. 0 in. diameter or greater, splashers became mandatory. I was perfectly aware of all this in 1970 when I came to draw the tender that first graced JERSEY LILY and now POM-POM, the decision being taken to fit correct sized wheels, with splashers, describing their contruction rather than detailing them, and this has caused a few builders problems over the years, one I hope to lay to rest in this issue, so let us start cutting metal.

The soleplate is 22⅞ in. x 8¾ in. from 1.6mm brass sheet. I know back in 1970 this was by far the larger tender I had then drawn, other than the 4,200 gallon LNER one for my own use behind my K1/1, and indeed I was working on that latter tender at the material time, material being the operative word. I was working in the shipyard at Cowes whilst building FISHBOURNE, my 5 in. gauge Isle of Wight locomotive, and checking some sheet then in stock with Len Gentle, the Turbine Shop foreman, we discovered two blackened 4 feet x 2 feet sheets, which on rubbing with a file, revealed they were Muntz metal. Needles, to say, no more bright metal was revealed and one sheet was purchased as scrap, I became blackened as that sheet began to shine!, and that sheet was devoured to complete FISHBOURNE. By 1970 I had moved from the shipyard into radar, brass was at a premium, but there were supplies of treated steel, zinc or plastic coated, and the former seemed to suit my purpose for the K1/1 tender body, at least on price! That tender body still remains to be built in 1988, another job for retirement, but in the interim I spent three years in another shipyard, and for that zinc coated steel has been substituted 1.6mm brass, with which I am infinitely happier. It happens that only this morning I heard from Doug Wilkinson in Seattle who is buiding a LUCKY 7, and Doug has substituted brass for his water tank for the zinc coated steel that I specified as alternative, his source being "the local junk yard that had a sizeable piece at a very good price". Now I do not want to discourage builders from purchasing pristine material from Reeves, such is the sensible answer, only to say that there might be a solution for those with shallow pockets without deviating from brass.

Mark off for the 14⅛ in. x 4 in. opening for the well, drill a few ⅛ in. holes and open them into a slot with a Swiss file, a slot that will accept a hacksaw blade. Fit the hacksaw frame around said blade and saw out the well opening, and if you do this carefully it will give you another useful piece of brass for later on. Cut the end pieces 3⅞ in x 1⅝ in. from 3mm brass, produce a 7/16 in. radius at the bottom corners, then drill the three holes, tapping the outer pair ⅜ x 32T as shown, this in the front plate only. Take a piece of 1.6mm brass sheet size 14⅛ in. x 7 in., scribe a centre line along the longest face and scribe further, bend, lines 1½ in. each side of the centre line. Grip in the bench vice, soft clams please, along with a length of ¾ in. diameter bar and pull around. If your material is in half-hard condition, which is usual, then it should be possible to pull the brass sheet around the bar without annealing, with a little help from a wooden mallet, and in conclusion the radius should match that of the end plates. Deal with the second bend similarly, but check to place as you proceed so that the well will match the end plates. Erect to the soleplate, when the end plates should hold the whole assembly solid, then trim off any excess where the well projects through the soleplate.

Fit packing to get the tender axleboxes hard down onto the hornstays, sit the soleplate on top of the frames, position it correctly as shown on Sheet No.2 and clamp in place. Now scribe along from the outside of the inner frames and the inner edge of the outer frames, then mark further lines 1/16 in. inside from these to give the splasher width. Next mark up from each of the horn gaps to show the centre line of each



I had to send Tom's original photographs back to him before his retirement from BR, I trust it is proving enjoyable Tom, so do not know either the number of the POM-POM or its location. It's an attractive picture though with the guard in pensive mood waiting for the signal to clear whilst the fireman attempts to start his injector.

pair of tender wheels and scribe right across. Now we must determine the shape of the splashers we shall be fitting. Take a look at any of the POM-POM engine pictures and you will see the splashers are nicely curved and this is also the correct profile for the tender. However, we can make ours square box shaped if we prefer, as nobody is going to look underneath to examine them once the tender is assembled, and box shaped ones we can make up as we have just done for the well. Whatever shape you choose, make the cut-outs for the splasher initially 2½ in. x ¾ in. and check by allowing the wheels to rise until the axleboxes are at the tops of their slots, easing the slots if necessary. Now you can build up the splashers, checking again that there is clearance and we have to make our first decision.

I should have said at the outset that the first requirement is that the soleplate be perfectly flat and this is the way we must keep it throughout as the 'building board' for the rest of the tender body. Now we can either leave the well and splashers to have their joints sweated when we come to seal the rest of the joints in the tender body, or we can silver solder these joints as a first step. I much prefer this latter course as it gives a solid foundation and indeed did just that with my RAIL MOTOR tender body, but there is more than a risk of distortion, it is a virtual certainty! The amount of distortion can be reduced by carefully heating the whole area of brass sheet as evenly as you can, and of course this anneals the soleplate so that it can be flattened again to suit the frames, but I guarantee I will not be popular whilst you achieve this, so you may well prefer to sweat the joints later on.

Decisions, decisions, the next one being in how many pieces to make the tender side sheets and coal sheet — one, two or three? With three piece construction, you make the tender side a plain $4\frac{9}{16}$ in. high, then add the flare, and finally the coal sheet, joining with lengths of ¼ in. x 18 swg. brass strip. I much favour the two-piece construction, with separate coal sheets, and this is what I will describe.

Cut two pieces each 20¾ in. x 5¾ in from the 1.6mm brass sheet and mark on the bend line $4\frac{9}{16}$ in. up from the bottom. Grip in the bench vice with a length of 1¼ in. diameter bar and pull over a little at a time until you arrive at the $\frac{17}{32}$ in. dimension, it being more important to get an even flare on both pieces rather than the exact dimension. Trim away the excess at the top and get a nice flat edge for the coal sheet to sit on. Cut this latter from the 1.6mm sheet, offer up and cut a 16 in. length from ¼ in. x 18 s.w.g. brass strip, bending to fit coal sheet and flare. Now trim away the flare at the front end to arrive at the shape as shown, one or two of the photographs will help you achieve this properly, then clamp the jointing strip to the top of the side sheet, trimming to a fit, and drill No. 57 at about ¾ in. centres, countersinking for copper rivets. Offer up the coal sheet, again drill No. 57 at about ¾ in. pitch and secure with the $\frac{3}{64}$ in. copper rivets. If you have the confidence to silver solder this joint it will greatly increase its strength.

Cut the back sheet 9⅛ in. x 5¾ in. from the 1.6mm sheet and bend the flare to match the side sheets. Now you have to cut away the excess metal at the corners to arrive at the $8\frac{1}{16}$ in. overall width at the tank and 20¼ in. length. This is a tricky operation, so take your time, as it saves adding corner pieces at the flare. Next mark the position of the front coal bulkhead on the side sheets and start adding ¼ in. x ¼ in. x $\frac{1}{16}$ in. brass angle along the bottom edges, from said front coal bulkhead to within ⅜ in. of the back edge. Do the same at the rear sheet, then add vertical pieces of angle to extend no more than 4⅛ in. up from the bottom edge; 4 in. up is sufficient as we have yet to add the top supporting angle. Fixing of the ¼ in. brass angle to the sheets is by $\frac{1}{16}$ in. copper snap head rivets with heads inside and at about 1 in. pitch. When it comes to fitting the side sheets to the back one, drill the $\frac{1}{16}$ in. holes as before, but secure temporarily with 10BA bolts, then erect on the soleplate. Position correctly, clamp firmly in place, and we must fasten the angle on the bottom of the sheets to the soleplate with 8BA countersunk screws. The idea when building something like a tender body is to rivet as many of the pieces together as is possible, for rivets are both cheaper and easier to fit. At some point though it becomes less easy to fit rivets, for one cannot sit the rivet head on a dolly, so screws become the answer, plus one needs to take the body off the soleplate at times to add more pieces. If you are at all uncertain as to the required method of fixing a joint, then drill through initially at $\frac{1}{16}$ in. diameter and fit 10BA bolts. If rivets are the final answer, you just substitute them for bolts, and if screws are indicated, you drill the sheet at No. 44 and countersink for 8BA screws, tapping the angle to suit, so nothing is lost.

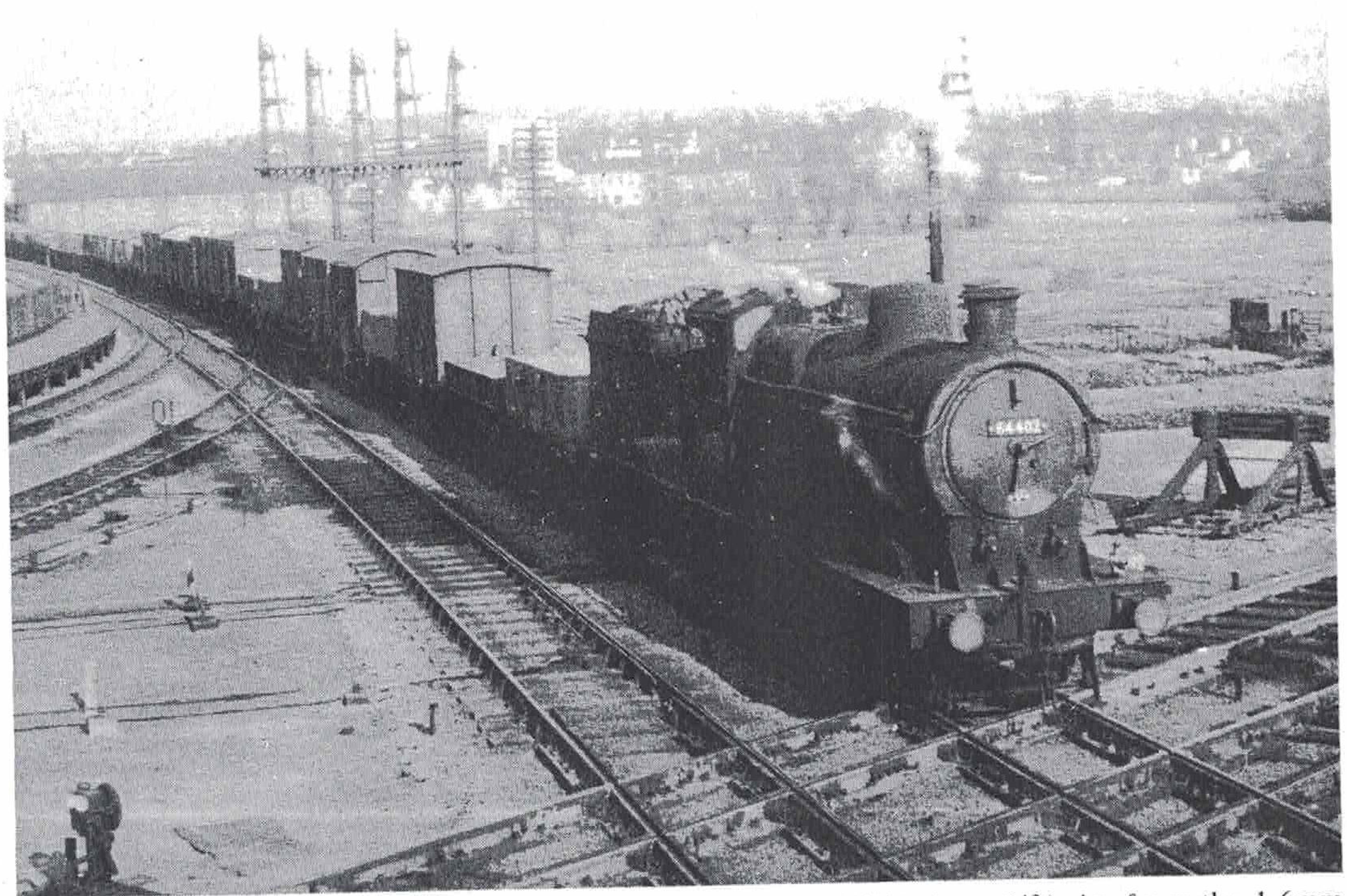
Coal bulkheads next, to start stiffening the structure. The rear one is 9 in. x 2½ in. x 1.6mm sheet, shaped at the ends to match the flare and coal sheets, indeed it can be secured to the latter on the inside of the coal space with a wee piece of the ¼ in. brass angle. Position it correctly first though as it is important for the removeable section of tank top to fit snugly and later it requires a length of the ¼ in. brass angle rivetted to the bottom to help support the tank top. The front coal bulkhead starts life as a piece 8½ in. x 5⅞ in. from the 1.6mm brass sheet. If you cut it from a larger piece, it will be possible to scribe on the 13¾ in. radius at the top much easier, then cut away to fit the tender sides. I have shown the coal door opening at $3\frac{11}{16}$ in. high and extending right down to the soleplate, but on reflection this weakens the bottom of the bulkhead, and I now suggest you cut the opening $3\frac{1}{16}$ in. x 2¼ in., leaving that ⅝ in. piece at the bottom. Again the bulkhead is secured to the tender side sheets with length of ¼ in. brass angle inside the coal space, only it is **water** space!

Talking of water, it is time I described the tank construction. The traditional tender shape was like a horseshoe, with coal in the middle and water around the outside. As locomotives became more efficient, the coal requirement reduced in proportion to the water, thus the tank took up more space at the centre of the horseshoe, leaving only small wing tanks as on this tender we are building. Water also extended full size right up to the front coal bulkhead along its full width, but under the coal space the capacity is so limited that I have substituted a void space with wooden floor over. Let me restart with the tank tops.

The removable portion of the tank top is $7\frac{15}{16}$ in. x $3\frac{9}{16}$ in. from 1.6mm brass sheet, these sizes being checked to place. Next cut a piece 6 in. x $1\frac{13}{32}$ in. from the brass sheet and fold it up to drawing, cutting away the excess. Clamp to the tank top, scribe around to saw and file away, then cut a piece 2¾ in. x ⅞ in. as the fixed portion of the filler. Clamp the three pieces firmly together and either sweat or silver solder the joints. The filler itself is marked out on 1.6mm brass, sawn and filed to line, then a couple of No. 52 holes drilled at $1\frac{1}{16}$ in. centres for the wire handle, bent up from 16 swg. brass or stainless steel wire and silver soldered together. Whilst I have made many small brass hinges over the years, like for the cab doors on FISHBOURNE, I have never been very happy making them and when I found some lengths of hinge in a DIY shop, I found cutting them down and peening over the hinge pin far better. Then if you tin the mating faces with a soldering iron, all you have to do is apply the soldering iron to the faces of the hinge to fuse the joint and allow to cool. Although you can secure the removeable section of tank top with a few 8BA countersunk screws, it will sit there quite happily on its own and give you immediate access to the duplex hand pumps underneath.

Talking of hand pumps, these will not be illustrated for POM-POM, though this poses no problem, for a full description of one appeared on Page 29 of LLAS No. 32 for DERBY 2P. The second pump has an identical body and

No problem with location in this picture, No. 64402 crossing the East Coast main line at Retford with a decent load behind the tender. Bill Holland tells me that the diamond crossings have been replaced by an underpass, thus removing for all time a once familiar sight. Note the 'hot spot' on the smokebox door. Photo by Tom Greaves.



ram, but instead of its own lever and links, is connected to its partner by links between the rams. It has the beauty of being double-acting as a pair, but if neither of the injectors on the engine worked, I certainly would not revert to the hand pump, but go home in disgust!

The fixed portion of tank top comes next, being roughly 14⅞ in. x 7¹⁵⁄₁₆ in. from the 1.6mm brass, though you must check these dimensions to place. The flat portion of tank top of full width is 8 in. long, after which you must cut away to 4⅛ in. width to form the coal bunker. Support the tank top on pieces of ¼ in. brass angle along its full length and at the front coal bulkhead and we have to close in the coal bunker. Although the inner walls of the wing tanks can be cut sloping at their rear edges to match the sloping top plate, I would simply cut them 8 in. long and about 4⅜ in. high to fit the tank top, adding lengths of ¼ in. brass angle at the top, bottom and front. That leaves the sloping tank top, which although dimensioned with a 35 deg. slope, simply wants to be made to place with more pieces of ¼ in. brass angle added as shown. If you have employed 10BA bolts to hold the pieces together as you proceed, now you can decide which joints to rivet and which to screw, leaving the locker area to tidy up the bodywork.

Cut the locker fronts 3¹⁵⁄₁₆ in. high and of width to fit between the side sheet and coal opening, then mark off and cut the locker openings. Cut the top and side pieces of the locker to place so the locker front is flush with the front edge of the side sheet, then fit short pieces of the ¼ in. brass angle to fix sides and tops to the front coal bulkhead. The locker fronts are going to be secured by 8BA countersunk screws, so rivet lengths of angle in place for the fronts to sit on, but before fixing same we must seal the tender tank.

Pour some Bakers fluid into the tank space, heat the whole up gently with a propane torch or similar, and feed in soft solder, swilling it all around when it has properly melted to seal all the joints. When you are satisfied, wash out thoroughly with warm, soapy water, rinse and then fill with clean water to check for leaks, dealing with any major ones with a soldering iron. Minor ones are no problem, for the next instruction is to dry out the tank, pour in some white gloss paint and swill this around, draining off the excess. This way seals any minor gaps and leaves the tank clean so that the slightest bit of muck can be readily detected.

Locker doors next, cut 2¹⁵⁄₁₆ in. x 1¹³⁄₁₆ in. from the 1.6mm brass; mark off and drill the No. 40 hole for the latch. For the latter, take a length of ³⁄₁₆ in. x ¹⁄₁₆ in. brass strip and drill No. 40 and No. 51 holes at ⁵⁄₁₆ in. centres. Radius around the No. 40 hole and turn up a wee knob from ³⁄₁₆ in. brass rod with a ¹⁄₁₆ in. spigot to fit the latch; peen over or sweat in place, then saw off to length and rivet to the door. Hinges are similar to those for the filler, so tin both surfaces, erect the doors to the locker front and sweat in place. the catch can either be bent up from ⅛ in. x ¹⁄₁₆ in. brass strip, or more quickly can be machined from the solid. As the locker front is still separate, the catch can be rivetted in place.

There is a ²⁷⁄₃₂ in. extension to the tender sides which fixes to the locker front, and the same 3⅞ in. high, which I would sweat directly onto the locker front and then use a wee piece of the ¼ in. angle to screw down to the soleplate. Offer the whole lot up to the lockers, to drill through No. 50, open out the locker front to No. 44 and countersink, then tap the pieces of angle 8BA to match.

Handrail stanchions are not the easiest item to machine, my method being rather crude. Chuck a full 7⅞ in. length of ¼ in. steel rod in the 3 jaw with about ¼ in. projecting, face, centre, drill and tap 8BA to ⁵⁄₆₄ in. depth. Reverse in the chuck and face to length, checking against the tender side, then reverse again gripping by the last ³⁄₃₂. At the outer end, fit the tailstock chuck and tighten this onto the ³⁄₁₆ in. diameter portion, only I forgot to include this instruction when tapping that end 8BA! Put plenty of grease at the outer end as we do not want to wear the tailstock chuck jaws, then use files to deal with the tapered portion. If you use a round file to start off and then change to a wide, fine cut, flat file you should arrive at something that looks good if not quite to drawing, the secret being to get them both alike. Now you can reverse again to centre, drill and tap the bottom end at 6BA, fixing in place with a countersunk screw. To finish off at the top end there is a fancy strip, shaped as the plan view on the tender, secured with a 8BA screw to the stanchion and then sweated to the side sheet.

That was the first piece of beading, so we had better go on and fit the rest, this being ³⁄₁₆ in. half round beading available from Reeves and our requirement being at least 10 feet. Fit one piece at a time, tin both the beading and its mating surface, then hold in place and run a soldering iron along the

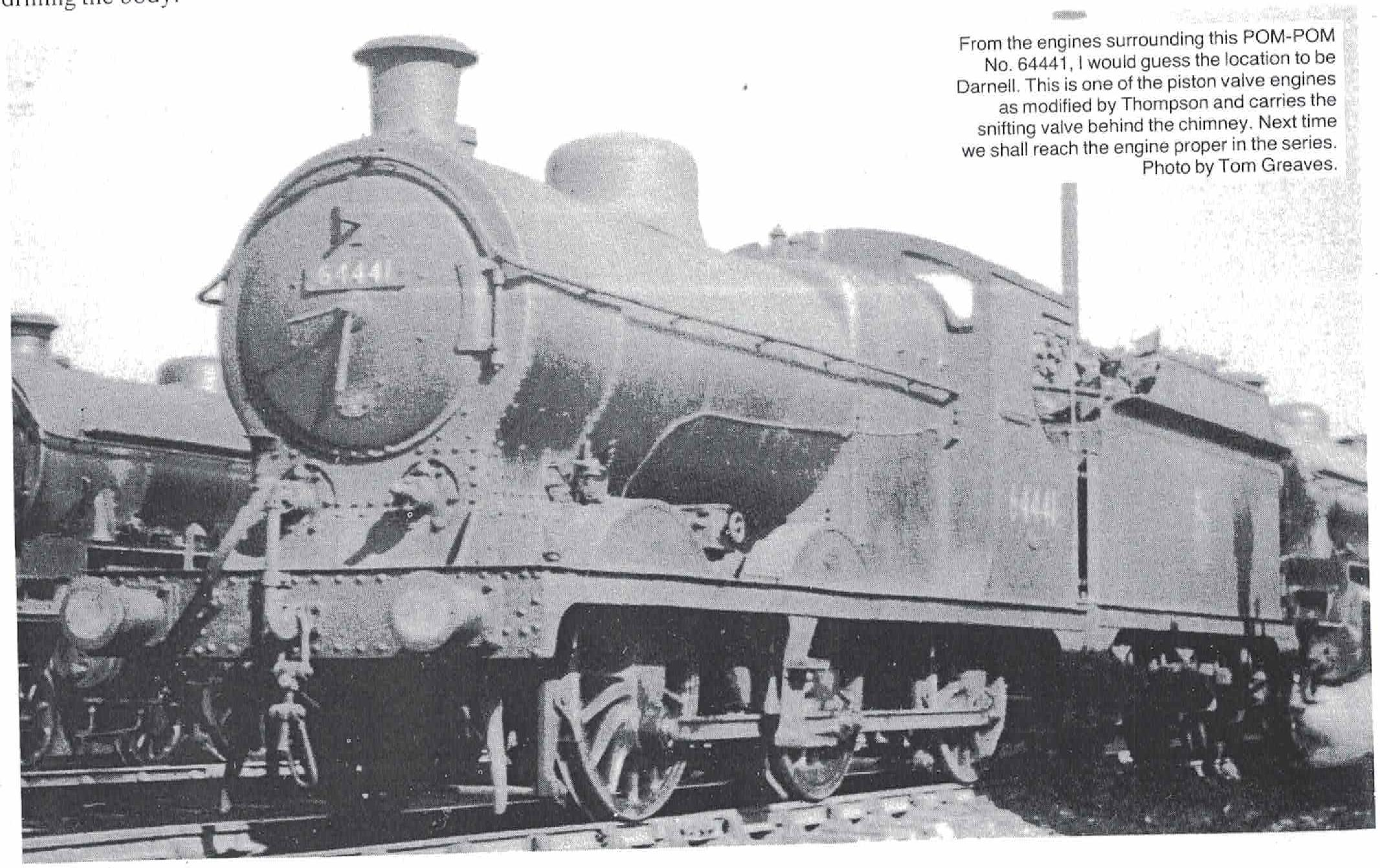
beading. You want just enough heat to fuse the joint, too much and the solder stays liquid for an eternity, so judge the pace of your soldering iron so that the solder sets soon after you have passed, a case of practising making perfect!
That gaping coal opening has to be partly filled by the coal door, it being 2 11/16 in. x 2½ in. from the 1.6mm material. Bend up the 16 swg. wire handle as for the filler and sweat into a couple of 1/16 in. holes, then fit another pair of hinges. Remember that the coal door is fitted inside the coal space and lifts inwards and upwards into same, though I have a feeling it will be a nuisance when running and could better be made detachable.
Lamp irons next and these can best be machined from 5/8 in. x 3/16 in. BMS bar. I say machine, but the fitter in me says saw and file, so maybe a compromise by milling out the top of the iron and then sawing out the bottom. Complete the profile with files, including the taper on the upper portion from 3/16 in. to 5/32 in., then mark off, drill and countersink the pair of holes for 1/16 in. copper rivets. A total of four irons are required, three across the bottom and one on the centre line at the top and this latter will need its lower portion bent to suit the flare. That leaves just the side handrails on the back of the tender to tidy up the body, and if at all possible, these should be bent up from 3/32 in. nickel silver wire. The collars can be from ¼ in. stainless steel rod, so chuck in the 3 jaw, face, centre, drill No. 43 to ½ in. depth and part off four 1/16 in. slices, pressing them onto the ends of the handrail. Teach the collars manners with a wee drop of silver solder and if this forms a fillet at the back of each collar, so much the better, for this will be more authentic. To complete, screw the end spigots 7BA, which is not easy with the ordinary die-holder, but a piece of cake gripping the 7BA die in the 3 jaw. Drill the back sheet of the tender body at No. 41 and secure with brass nuts.
The horizontal handrail also wants to be 3/32 in. diameter, which calls for the standard 3½ in. gauge handrail stanchions, ones which we can supply, but do check the thread size before drilling the body.

Erecting the Tender Body

The first item that will help secure the tender body to the chassis is the hand brake column, so mark off and drill the ¼ in. hole, offer up the column and drill the other pair at No. 30; re-assemble the hand brake. There are plenty of places to secure the soleplate without having to pierce the water tank and I suggest four 6BA countersunk screws each end, tapping the box 'casting' to suit. Now we have to plank the very front of the coal space and then continue across the front of the tender as explained in the note. The piping from the duplex hand pumps is self-explanatory and I have described the injector connections with their mesh gauzes several times in LLAS.
The valance is a superb ½ in. x ½ in. x 1/16 in. section brass angle and the steps we shall deal with when we come to the engine; not long ahead now!!
I feel a bit guilty about the, dummy vacuum brake pipe, for it would be no bad idea to fit a working vacuum brake, or at least the means of braking the passenger trucks, as I have described for several engines now.

Painting

At the moment I do not have George Dow's great work on the Great Central before me, so cannot say exactly what the goods livery of the POM-POM's was in GCR days; it was certainly not the elaborate scheme as in my notes, which are for the passenger engines. An educated guess is that everything is black except the beams and inside the frames. Even a humble goods engine had GREAT CENTRAL written boldly along the tender side sheet with the coat of arms in the middle.
It was good to see Dave Johnson's POM-POM exhibited at Wembley, and though his use of bright red paint in places it should not have been incurred the displeasure of the judges, so what! I think any engine should reflect what pleases the builder, and leave the rest of us to argue the merits or otherwise!!
Next time we shall make real progress on the engine.



From the engines surrounding this POM-POM No. 64441, I would guess the location to be Darnell. This is one of the piston valve engines as modified by Thompson and carries the snifting valve behind the chimney. Next time we shall reach the engine proper in the series. Photo by Tom Greaves.

POM-POM A Great Central 0-6-0 in 5 in. gauge.

by: **DAVE JOHNSON and DON YOUNG**

Part 5 — Starting the Engine

Introduction

The weather has broken, the long fine spell appears to be over, the garden is about as tidy as I can get it, so a few days ahead of the DYD Rally at Yeovil I can get on with my notes on building POM-POM. 'With a lotta help from my friend' Dave Johnson, help I don't really deserve. Why so? When Dave was building his POM-POM boiler, he volunteered an article on its construction as varying from my own descriptions, an offer that was immediately taken up. On one of his visits to the Island, Dave left his draft copy with me, which I read and generally tidied up, passing it back to him with my approval. It must have been at a DYD Rally that Dave handed over the final manuscript and accompanying photographs, which were placed on the back seat of my horseless carriage, never to be seen again, and though replacing the manuscript posed no problems, it is likely the photographs will, so any omissions from the sequence of events are entirely my fault; my apologises Dave.

Just before I hand over, I will list Dave's complaints about the POM-POM designer after his initial runs, these over the telephone. She burns too much coal and elicits such comments as 'Crikey!' from friends watching Dave shovelling desperately to keep up, literally sucking it from the shovel! She also makes steam by the bucketful and as Dave has yet to master the pair of Arthur Grimett injectors supplied, he is hard pressed to keep up with her appetite for water. The engine is so powerful that she has already broken her crank axle, though as Dave had the misforture to run over points set against him and derailed spectacularly, this could well have been the culprit. Finally, the chimney makes so much noise that earmuffs are needed to protect delicate ears. It all sounds like a recipe for success to me, all the ingredients I put into POM-POM are beginning to gel. Over to you Dave.

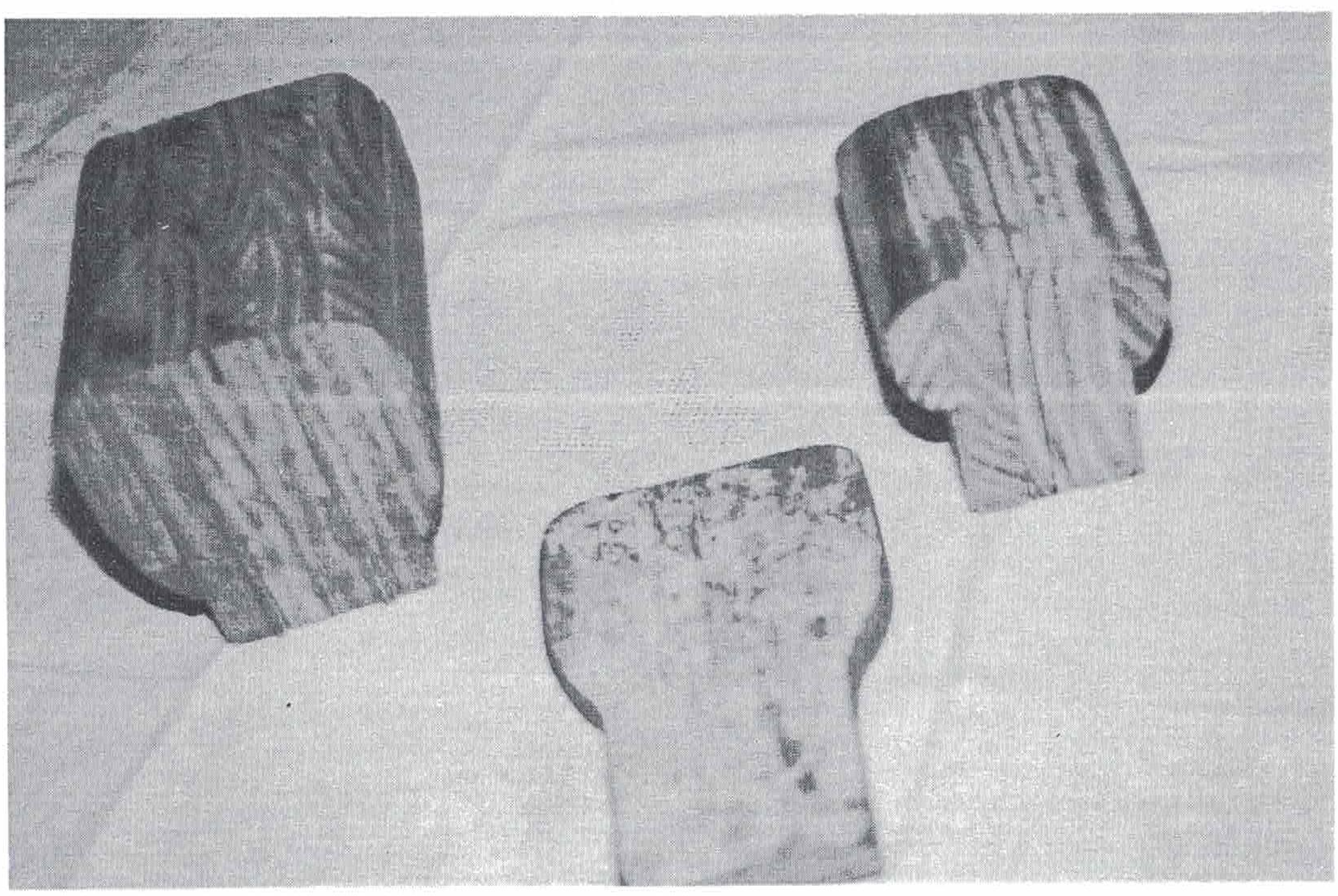
A BOILER FOR POM-POM

The construction of miniature copper boilers has been covered many times in this and other well known journals. However, since the days of the late lamented LBSC the basic construction specification and procedures vary little from the maestro's well tried and tested methods. It should be remembered that in the pre-war and early post-war era that the most common form of heating apparatus was the five pint paraffin blow-lamp which by current day standards can only be described as an antique and horrific weapon. With such a heat source it was impractical to consider hard solders within the firebox areas. Hence the use of screwed and nutted stays caulked with soft solder. Obviously with this form of construction any further silver soldering operations on the boiler in later life is impossible and even a minor accident with regard to water content of the boiler would have a catastrophic effect on the soft solder caulking.

Today, most budding boilermakers will resort to propane gas equipment with a variety of burners for different situations. A fully silver soldered boiler can be readily accomplished using this equipment. More recently the market has seen the introduction of competively priced oxy-propane equipment, which if available, can be usefully employed.

It is not the purpose of this article to offer instruction in the art of silver soldering or the techniques working with copper. This has been well covered over the years by those far better qualified to do so than the writer and should information of this nature be required the reader is advised to study the excellent 'words and music' by DY in these pages.

The following is an account of the practices used by the writer, none of which are claimed to be original, but is a collection of ideas from various sources combined in order to make boiler construction a considerably more straightforward project.



Some of the wooden formers employed by Dave Johnson in the making of his POM-POM boiler; mundane objects perhaps, but extremely useful ones!

Although the POM-POM boiler is that featured in these notes, needless to say the principles can be applied to most other designs.

A study of Don's drawings will reveal a slightly foreshortened 'Jersey Lily' with a parallel barrel and Belpaire firebox. For the barrel a 12¼ in. length of 5½ in. o.d. x 10 s.w.g. seamless copper tube will be required, which if purchased from one of the recognised model engineering suppliers, can be obtained with the ends cut sufficiently square to avoid the necessity of turning in the lathe. Should this be unavoidable the method has been described elsewhere, but usually a light dressing with a smooth file will be all that is required. A centreline should scribed the length of the tube and the dome centre popped 6³⁄₁₆ from the front end. To cut the hole for the dome bush a 'Conecut' can be used if available of sufficient diameter (2½ in.); if not the well tried method of a series of holes and cleaning out with a half-round file will do the trick. Whichever method is resorted to, it is advisable to have the dome bush pre-turned so that the fit can be checked during the operation.

We now need to produce the flanged plates, for which three formers will be required; those who wish to avoid this particular stage will find that Messrs. Reeves offer preformed flangeplates for POM-POM and most of Don's other boilers and if this service is utilised the next few paragraphs will not be required. Those who are still with us will have probably read the many words written on the subject of flanging plates and should note that the method described is that which has been used successfully by the writer. The preferred material for the formers is Parana Pine. This material is easy to work, sufficiently durable for a single boiler, and offcuts suitable for our purpose can usually be scrounged from any local joinery shop which makes staircases. Ideally, we need six pieces about 8 in. wide by 1 in. thick and 10 in. long. Next access to a photocopying machine will save time, as we can make three copies of each plate from the drawing, and one each of these can be pasted onto the timber blocks to save marking out. Should a copier not be available then we will have to resort to tracing paper, or carbon paper, to transfer the shapes to the timber. Don't forget to mark a flanging allowance around the edges of the sections, ⅛ in. all round for backplate, smokebox, tubeplate and throatplate, ³⁄₃₂ in. for the firebox plates; we shall need two off each. The backplate and throatplate will use a common former, as will the front and backplates of the firebox. The reason for duplicate formers is so that we can sandwich our copper between them whilst flanging and obviate bellying of the plate. If a bandsaw is available cutting the timber formers will be a matter of minutes; if not the use of handtools will produce the same result, albeit with a little more effort. The process of flanging copper has been described many times but too much emphasis cannot be given to re-annealing the metal as soon as there is any indication of hardness. This is simply detected by the sound produced whilst hitting the metal, which when soft produces a soft 'thud' and changes to a 'ringing tone' as work hardening takes place, indicating that re-heating is necessary.

Having produced the plates to satisfaction they should be trimmed and pickled so that further work can take place on clean copper. The remaining photocopy should then be pasted onto the plates as this will save a lot of marking out and possible errors. Don's drawings always show centre lines and each hole to be drilled in the plates should be centre popped before drilling. A 'Conecut' can be a great time saver in cutting the flue tube holes and also the firehole in the firebox backplate; do not cut this hole in the backplate at this stage.

In order to shape the wrappers to the inner and outer fireboxes we shall require two wooden formers. These can be fabricated from Parana Pine offcuts laminated together and final shaping carried out with a surform. The annealed copper wrappers can then be formed over the blocks to produce a good fit to the flange plates.

Mention should be made on the subject of copper rivets for the prior assembly of components. Technically, a rivet, when fixed, should totally fill the hole in which it is fitted and produce a close fit. With a joint which is to be silver soldered neither of the foregoing requirements are desirable, and can in fact be disastrous. Therefore holes for rivets should be well countersunk on both plates and the rivet lightly tapped into place, the silver solder can then flow through, around and completely fill the joint. A tightly rivetted joint will not allow space for the silver solder and therefore remain dry. However, when pressure is applied movement is certain to take place and a leak will appear. Rivets therefore should only be used where any other method is unavoidable.

The outer shell of the boiler can now be assembled using a minimum number of copper rivets. It should be remembered that every hole drilled and rivetted is a potential leak and be treated to a liberal coating of silver solder during the brazing operations. Don has specified 6mm copper top corners to the outer firebox but the writer found difficulty in obtaining this at the time of building POM-POM's boiler. The corners were flanged from ⅛ in. copper using the corners of the backplate former. Before assembling the outer firebox to the barrel a centre line should be scribed along the top. This must then line up with the centre-line scribed on the barrel and form a straight line the length of the assembly, as an out of line boiler assembly will make mounting to the chassis a frustrating task.

As previously stated, instructions in the art of silver soldering is not within the scope of this article. However, it should be mentioned that the following points are basic essentials to any operation, namely the job must be clean and sufficient heat be available. The joint should be brought up to silver soldering temperature fairly rapidly, and if more than five minutes is spent trying to get things hot enough then you have not enough heat.

In the construction of the writers' boilers two torches were used in the major assembly work, the Seivert 2944 head providing the background heat and a smaller head giving the final temperature to each section in turn. Sufficient spelter should be applied to completely fill the joints and flow through to the inside of the job, the heat of the copper melting the silver solder, not the flame.

Having assembled the outer shell we now turn our attention to the firebox. The front tubeplate can be fitted and silver soldered to the wrapper. Again a minimum of rivets, the backplate at this stage should only be clamped, in order to retain things into shape. The girder stays can now be fabricated, a former from wood will help keep things equal, and silver soldered to the top of the firebox. Avoid using rivets to fix girder stays, as in this situation they have a habit of causing leak problems at a later stage. The girder stays can usually be held in place on top of the firebox with a piece of scrap steel as a weight whilst silver soldering.

The POM-POM boiler will require 23 ⁷⁄₁₆ in. x 20 s.w.g. tubes, and two 1 in. diameter x 18 s.w.g. flue tubes, all 12 in. long. Several methods have been recommended to locate the tubes in the Firebox tubeplate, such as turning a small step at the end. The writers preference is to use a small swageing tool to raise a small lip at the end of each tube which acts as a stop when locating the tubeplate for silver soldering.

The tool is quite simple to construct and consists of a piece of steel of suitable section to fit the toolholder of the lathe. In the case of Myford, a piece of ⅜ in. sq. mild steel about 4 in. long is ideal and a slot cut ³⁄₁₆ in. wide at one end about ½ in. deep. A ⅜ in. diameter wheel as per the photograph is mounted on a silver steel axle into the slot. The inner forming bar is a simple turning operation from a piece of scrap bar. The time taken to raise the lip on each tube is quicker than the time taken to describe. The inner forming bar is placed in the 3-jaw chuck, and the wheeltool placed in the tool holder at centre height. The lathe is run at a fairly low speed. The groove in the wheel must line up with the raised part of the inner former. Each tube loosely held in the right hand is placed over the former and the cross slide advanced to grip the tube with its wheel. The tube will revolve and the swage appear, release the pressure, remove the tube, and in with the next. Each tube should be a loose fit into its hole in the tubeplate. The tubeplate holes can be countersunk for the silver solder to flow around each tube with full penetration each side of the plate. The swage stops the tube falling through and becomes integral with the silver soldered joints.

We are now ready to assemble the inner firebox complete with tubes into the outer shell, which should have any bush holes drilled ready to receive the bushes.

With the shell 'laying on its back' the tubes can be inserted into the barrel and the inner firebox located in its correct position. The front section of foundation ring is required at this stage and is clamped into position to provide the correct location. The crown stays can be checked for contact with the outer wrapper and any adjustments made with the aid of a light hammer and steel bar. When satisfied all is correctly located, apply heat to the underside of the upper wrapper and gently bring the temperature of the whole assembly up to just below silver soldering temperature. A second smaller flame or if available an oxy-propane or oxy-acetylene torch directed onto the crown stays will ensure a full flow of silver solder around and between the stay joints. Next turn attention to the front foundation ring section and silver solder ensuring a full penetration, lastly turn the boiler over and insert the bushes into the pre-drilled holes and silver solder into place. Allow to cool, pickle, clean-up, and inspect the assembly for any suspect joint. There should not be, but if there be any reason for doubt, ring the area with a felt-tip pen as a reminder to re-treat at the next heating.

Turning attention to the stays, which will be ⅛ in. diameter copper rivets at least 1 in. long, this length should provide about ⅜ in. excess which will be cut off flush after silver soldering, and will be of advantage for heat transfer during the operation. The stay positions should be accurately marked-out from the drawing, and the positions of the long cross stays marked so as to pass through the girder stays. The method of arriving at the position of these stays has been adequately covered in these pages and will not need repetition. Drill all the stay holes for ⅛ in. rivets with a No. 30 drill and countersink deeply on the outside. The writer uses a well worn centre-drill in a handbrace for this purpose, thus avoiding the risk of going too far. With all the holes drilled, deburr inside and out and insert the rivets.

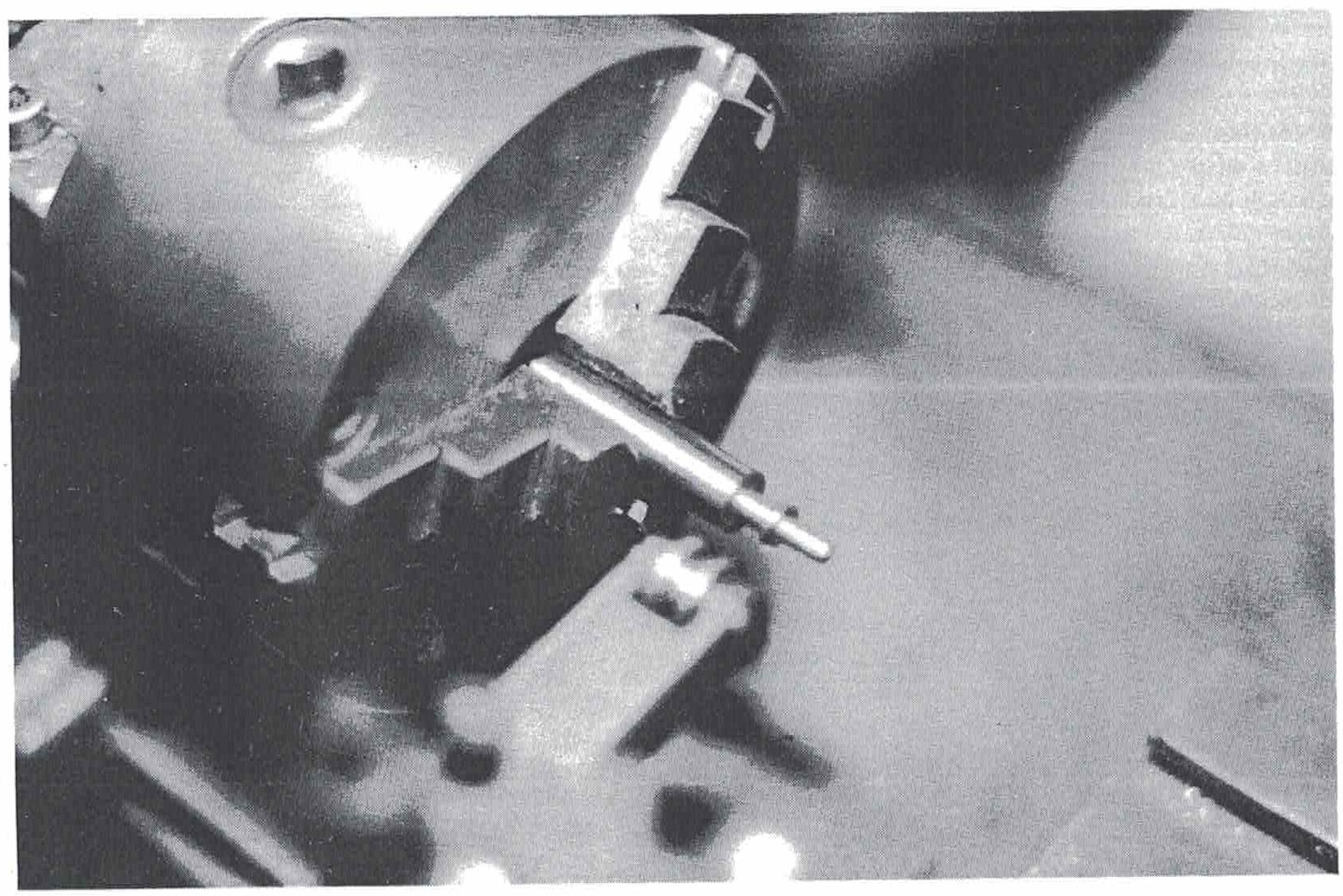
To silver solder the stays on the inside, a necked burner will be required, unless one of the oxygen fed types of apparatus is available. Before heating it is recommended that protection of the tubeplate area is provided. A deflector plate cut from a rusty piece of 16 s.w.g. steel plate is sufficient to cover the tube ends and prevent any build-up of heat in this area. Apply silver solder methodically to each stay head in turn working to a systematic pattern, if possible find an assistant to provide background heat to the outer shell during this operation. When satisfied with the inside, repeat the operation on the outside including the long cross stays. Having completed this rather lengthy and hot operation allow the assembly to cool off before pickling. The assistant will also come in useful to buy the much needed pint to help the builder cool down as well!

A thorough inspection should be made of the work so far and any doubts as to the sealing of any stays put right before venturing any further and whilst still accessable.

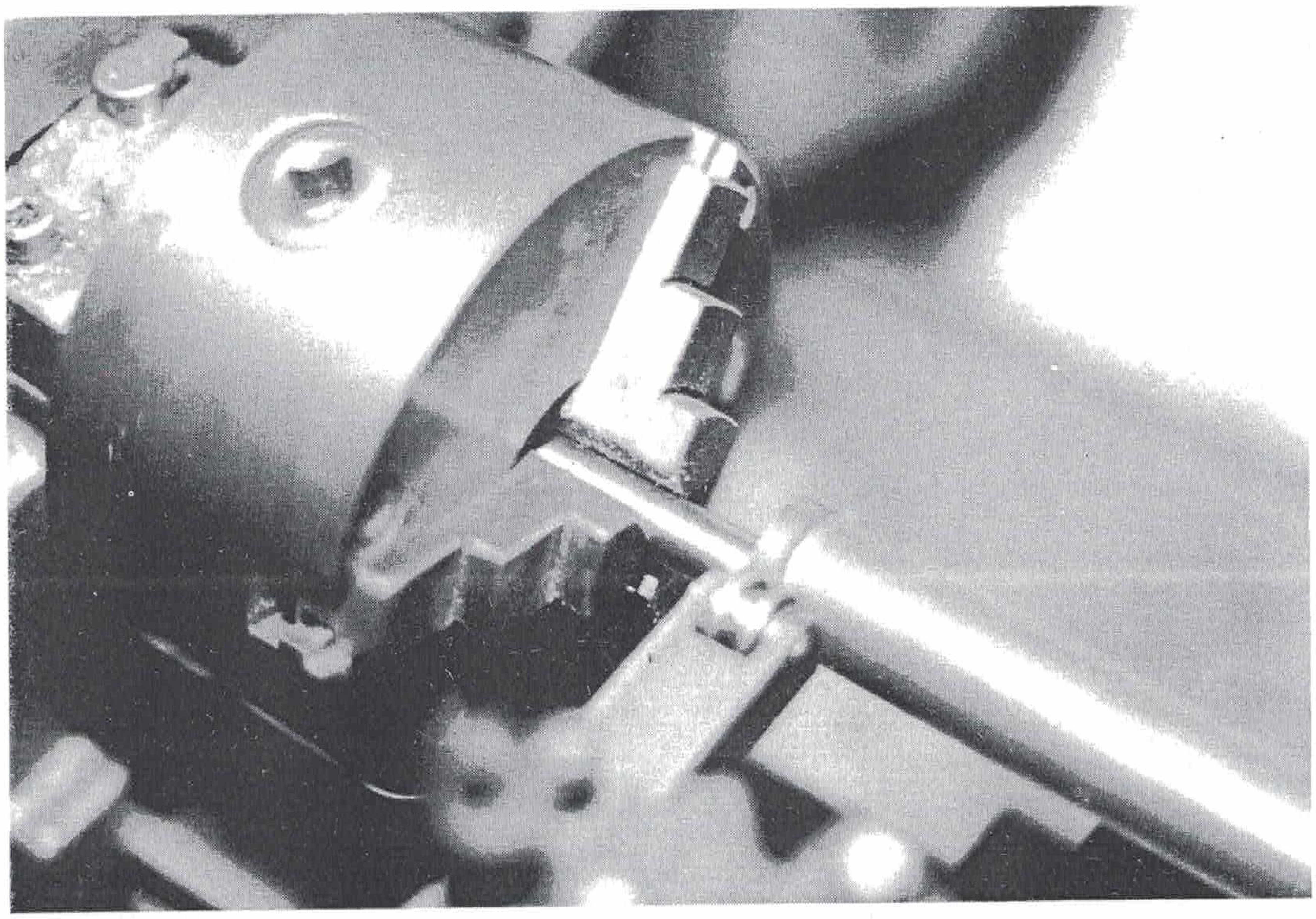
If all is well we can consider the fitting of the firebox back and backplate, but first we must prepare the firehole tube. This is a simple turning job in accordance with the drawing, and the principle is to reduce the wall thickness at each end by 50% with the full thickness the same width as the water space and foundation ring. When finished, a spell in the pickle tank will ensure cleanliness, particularly if cutting fluid was used in machining.

Next we turn our attention to the backplate, and the hole for the firetube can be cut in accordance with the drawing and using the tube to check size and clearance. This hole should be countersunk on the faceside to about 45 degrees with a half-round file, this is to enable us to produce a neat flange around the opening on assembly. All the holes can now be drilled in the backplate for the bushes.

A few comments with regard to bushes at this stage would not come amiss. In most boiler designs the bushes are detailed to be of sufficient size to accommodate the specified thread, however, the writer being of a pessimistic nature always



Dave's simple set-up for swaging tubes on the Myford



The beauty of Dave's swaging tool is that it will deal equally easily with both fire and superheater flue tubes; here we see the successful result on the latter

makes the bushes a size up from that shown. This is to ensure, in the event of a thread being stripped there is still enough meat to re-tap to a size larger which means a new fitting but preferable to having to scrap the boiler. There appears to be two schools of thought with regard to bushes. Most designers follow LBSC, drill and tap the bushes whilst turning, necessitating screwed plugs to be fitted for testing. Most professionally produced boilers are fitted with plain bushes which are merely centred allowing for drilling and tapping in situ when the boiler has been tested.

With the LBSC method, provided the bush is fitted squarely to the plate all should be true and in line; however, there is always the risk of silver solder running on to the thread during fixing and a chance of a stripped thread during the rectification process. The blind bush saves time, obviates the need to plug for testing, and avoids the aforementioned accidents. Great care is needed when finally drilling and tapping to ensure that the threaded hole is at right-angles to the plate. In order to escape from these pitfalls the writer uses a compromise bush. The bush is drilled two-thirds of its depth with a appropriate tapping drill, and the lead end of the appropriate tap entered as far as is practical, normally about three turns. The bush is still blind for testing but the subsequent operation of drilling out and threading being already started square should stay that way with normal care. Before leaving the subject of bushes, the depth should always be deeper than the male end of the fitting. If the fitting protrudes past the bush into the water space of the boiler it will collect scale, making it difficult to remove the fitting for maintenance purposes, and risks a stripped thread in the process.

We return to the backplate and finally drill and countersink the stay holes. De-burr all the holes, and clean up the backplate, paying particular attention to the outer face, as when the bushes are fitted it will be difficult to burnish.

The firebox backplate should be now placed in position and its fit checked with the firebox wrapper; any distortions which may have taken place should be dressed back with the aid of a light hammer and a piece of steel bar. Next insert the backplate in position and tap down towards the firebox so that the firehole position and stayholes can be marked in their correct positions on the firebox back. Repeat the cutting out operation for the firehole in the firebox back and drill the stay holes, this time countersink the firehole on the inside. Place the firehole ring into place well fluxed and gently flange the lip around the countersink to produce a neat opening. A high melting point silver solder such as B6 should be used and with the firebox back flange downwards on the brazing hearth, run a good fillet around the firehole. Turn over and insert well fluxed stays into the stay holes and give a liberal coating of spelter to each; at the same time check that the solder has run right through the firehole joint, and if required treat accordingly.

Whilst the firebox back is cooling, insert the well fluxed bushes into the backhead, silver solder from the back using B6. When cool, pickle and clean up together with the firebox backplate.

Place the backplate into the firebox in the correct position and silver solder into position, again ensuring full penetration of spelter around the joint.

All is now set for a final brazing operation, but before we fit the backhead we must prepare the final three sections of foundation ring. Although rectangular section copper is specified for this purpose the removal of all four corners by filing a bevel will be of advantage to the silver soldered joint. If when fitting, any small gaps are left between the sections, pack these with small pieces of scrap copper, as the silver solder will not act as a filler. The backhead can now be placed in position and the outer wrapper gently dressed around to ensure a good fit.

The assembly can be temporarily stood aside whilst we turn our attention to the remaining flanged plate, namely the front tubeplate. This should be drilled and prepared for the tubes and bushes in the same way as the previous plates, then checked for fit into the front of the barrel; if slightly over size, set up in the lathe and gently skim the outer flange until it will enter without undue force. When satisfied, the plate should be gently tapped into position, ensuring each tube enters its respective locating hole.

Two longitudinal stays are now required, as POM-POM does not utilise a hollow stay for the blower. Phosphor-bronze rod is preferred for these and the previously fitted stays across the firebox. Cut to length, leaving any excess to be trimmed off at the backplate. Roughen the ends with a piece of coarse emery

cloth, flux and push through the boiler into position. The stays should be sufficiently held into position without further assistance whilst brazing, but if any doubts occur, ensure that some form of support is provided so that they do not drop through when the boiler is inverted.
We have now arrived at what is hopefully the final brazing operation, for a boiler of POM-POM's size an assistant for this operation is both desirable and necessary.
Stand the boiler on end in the brazing hearth or a suitable safe place and ensure that it is well supported. A few bricks can be utilised to effect and also ensure all the necessary implementation is to hand. During this operation it will be required to lift and change the position of a very hot and heavy assembly on two occasions. When ready, gradually raise the temprature of the whole assembly as evenly as possible. When all is hot, and whilst your assistant keeps the background heat moving over the assembly, concentrate your attention to the backhead joint, at the same time giving attention to the backhead stays, longitudinal stays, and filehole. Lay the boiler on its back and carry on around the foundation ring, ensuring a good fillet of spelter all the way round. Finally stand the boiler on its backhead and silver solder the front tubeplate into position, making sure that each tube gets a fair share of the treatment. When all is to satisfaction allow the boiler to cool-off during which time your assistant will probably remind you that he paid last time and it has been very hot work. The writer prefers to carry out major brazing operations during darkness out of doors; it is ill advised to do this within the workshop, as condensation on the machinery is difficult to control. Also out of doors we do not have to worry about ventilation. When the boiler has cooled sufficiently it should be pickled and given a good clean-up with steel wool. Carefully inspect all the joints for flaws and if all appears well fill the boiler with water and stand on a clean sheet of newspaper. If after about an hour the newspaper is still dry we can approach hydraulic test with confidence, but if a wet patch has appeared investigation as to the source must be made. A leak that will run without pressure will need re-silver soldering. The whole assembly will have to be gently reheated and the area to be silver soldered kept as localised as possible. The small oxy-propane torches are particularly useful for rectification purposes, also argo-flow silver solder as sold by Messrs. Reeves has greater gap filling properties than Easy-flo.
A hydraulic test is required before the boiler can be put to use and if performed by club boiler inspectors will provide a certificate for insurance purposes. However, it would be very wasteful of time if we didn't check for ourselves before submission. The dome bush will have to be either blanked-off or the dome fitted, and one bush suitably tapped for connection to a hand pump and pressure gauge. Completely fill the boiler with water and with the hand pump stood in a tray of water, apply a few initial strokes to raise the pressure to about 20 p.s.i.g., if all is well the gauge needle will hold steady. If the needle drops back to zero investigate the reason. A very small leak will cause a rapid pressure drop, but need not be detrimental to the structural safety of the boiler. If all is well gradually increase the pressure to the specified test pressure, hold for ten minutes and check for structural distortion. In a modern well designed boiler, using correct materials and good workmanship, there should be no problems in this direction. Despite all our care during silver soldering, it is possible that a few weeps from stays may make themselves known. If one is satisfied that no re-silver soldering will be necessary, these can be sealed with Comsol or similar high melting point soft-solder. A small weep from an otherwise sound silver-soldered joint can usually be stopped by gently tapping with a centre-punch.
It should be stressed that despite the optimistic writings of LBSC, Martin Evans and Sch-h-h you know who, a new boiler not to have the odd leak initially is a rarity and even in professional circles a first timer is an event.
On a number of occasions the writer has listened to tales of woe from builders of their first boiler who have spent considerable time chasing leaks around a firebox. Unfortunately heating an area to seal a leak has caused the silver solder adjacent to run and create another leak. The localised flame from a oxy-propane torch together with Argo-flow will usually settle matters, but before any work is commenced the whole assembly must be raised in temperature evenly, keeping uneven expansion to a minimum.
If the pitfalls of testing a boiler has been over-emphasised, this is probably because the 'words and music' by most designers do not seem to recognise the fact that most builders do not produce a pressure tight vessel straight from the brazing hearth. The satisfaction, however, of receiving a crisp new boiler certificate from the club inspectors makes it all worthwhile and if this modest treatise on the subject has encouraged anybody to 'have a go' for the first time, then all is worthwhile.
It could be that some boilermakers either disagree with or can add further suggestion, should this be so the writer would be happy to discuss these via the correspondence columns of this magazine, as it is by exchange of ideas that we can all benefit.

I should have said in my introduction that Dave's notes were intended as a separate article rather than a part of my series, for when written there was no plan for a POM-POM series, but then I do know how to delegate . . .

The Regulator

The 'traditional' regulator body first saw service on JERSEY LILY, the body being a gunmetal casting, for which first check the machining allowances. This is the Stroudley type of regulator much loved by the late maestro LBSC and yours truly likewise, the only really precise machining required being to the valve seating, so let us tackle this first. Chuck by the main body in the 4 jaw and set the raised seating face to run true, in fact you can use an ordinary turning tool to reduce it to 1¼ in. diameter before facing across; only lightly initially. Centre and drill No. 40 to ⅜ in. depth, countersink the end and then tap squarely at 5BA, which means holding the tap in the tailstock chuck; now face to dimension. Although the main portion of the body can be left 'as cast', it is preferable to lightly mill the surfaces so the body can be gripped squarely in the machine vice for the subsequent operations. Turn the top of the casting towards what will now be the 3 jaw chuck, mill across the top then centre and drill ⅜ in. diameter to 2⅜ in. point depth, finishing with a 'D' bit or end mill. Turn the steampipe boss towards the chuck, mill the face then centre and drill again at ⅜ in. diameter into the vertical bore. Follow up at 29/64 in. diameter to ½ in. depth and tap ½ x 26T. Next turn the boiler mounting face towards the chuck, milling down to the 25/32 in. dimension and undercutting the first ½ in. from the main portion of body to clear the dome bush; file the rest of the face to match the inside of the boiler barrel.
Two things remain to complete the body, the first the top plug turned from ½ in. gunmetal rod to be a tight fit in the bore. Unfortunately there is no boss cast on to accept the end of the regulator rod, so we must rectify said omission. At this stage, I would simply sit a 7/32 in. length of 5/16 in. bronze rod on the body and silver solder in place, at the same time dealing with the top plug; pickle and clean up. Check the working face has not distorted and if you are unlucky then chuck again and take a wee cut, then back to the machine vice and vertical slide. Mark off for the 9/32 in. diameter ports and drill them into the main bore, lightly countersinking the entrances to remove any burrs, then move down to drill the regulator rod boss at ⅛ in. diameter, milling off to the 5/32 in. dimension; we can now begin to fit out.

The regulator valve is a slice from gunmetal bar and we can supply a cast stick that is suitable for boiler bushes, regulator valves and the like. Turn down over a 5/16 in. length to 1¼ in. diameter, face across very carefully, then centre and drill No. 30 to 5/16 in. point depth before parting off a full 5/32 in. slice; reverse and clean up. Mark off and drill the two steam entry ports, again countersinking lightly, then drill and tap a pair of 6BA holes for the operating links at 1 in. centres, orientating as shown on the drawing detail. Chuck a length of ⅛ in. stainless steel rod in the 3 jaw, face and screw for about 5/16 in. length at this end, using the tailstock die-holder, then part off to leave 27/32 in. standout as shown and screw this end also over a ¼ in. length; the nuts can be thin commercial brass ones. To hold the valve firmly on its face, we need a 20 s.w.g. stainless steel or bronze compression spring, one of about ⅝ in. free length, when we can erect the valve.

Operating arm next, and 4mm brass will do at a pinch here, though another slice from the gunmetal bar will be better. Mark on the profile and the three hole centres, drill the centre one at No. 27 and the other pair at No. 43, tapping these latter 6BA. Saw and file to profile and complete by filing the No. 27 hole into a 9/64 in. square. In the days of 70/30 brass one could happily make the links from such material knowing it would last the lifetime of the engine, but now I would recommend 1/16 in. thick phosphor-bronze strip as available from Reeves, which will have to be annealed to be worked. It will be better if the regulator rod is made and tried in place first, when you can check the centre distance of the links, marking them off and drilling No. 30. Leave the profiling for a moment whilst we deal with the special stepped screws, for which we need a length of 6mm bronze rod. Chuck in the 3 jaw, face and turn down to .110 in. diameter over a 9/64 in. length and screw 6BA then turn the next 5/64 in. down to ⅛ in. diameter, a fairly easy fit in the links. Part off to leave a 3/32 in. thick head, one that you must slit with a hacksaw as the screwdriver slot. I should have said earlier that the thread must be a tight one in valve and operating arm, so open out your 6BA die to achieve this, then no other fixing will be required. Assemble and check the operation and it is permissible to slightly elongate the holes in the links to avoid pulling the valve off its face, after which you can complete the profile.

Steam Pipe

Away on its lonesome on the RH side of Sheet No. 5 is the steampipe detail, which uses yet more of the close grained cast phosphor-bronze bar that I can supply, so chuck same in the 4 jaw, face and turn down to 1¼ in. diameter over a 1¼ in. length. Further reduce the end ⅝ in. to ⅝ in. diameter and screw 26T and we have our first decision to make. Ideally the actual steam pipe wants to spigot about ¼ in. into the flange, if only to locate if for brazing, though it could well extend the full 1 in. length of flange. On your decision depends if the flange will be drilled ½ in. diameter to only ¼ in. depth or to a full 1 in. depth, after which you can part off at a full 1 in. overall, reverse and clean up. The steam pipe must be from 16 s.w.g. copper tube to accept the 26T thread without making it too weak, such screwing being carried out in the lathe and using the tailstock die-holder, after which it must be tried to place, checking against the regulator body, before being parted off to length and being brazed to the flange; pickle and clean up. Erect the regulator through the dome opening once more, feed in the steam pipe and engage the threads, screwing in only by hand to positively locate the regulator. Drill through the boiler shell on the top centre line to come over the foot on the regulator body casting, spot through one hole only, remove the body to drill No. 43 to ¼ in. depth and tap 6BA; countersink the boiler barrel and erect again with a 6BA screw. Now you can tackle the second hole in situ. We played with soft solder for a while on the tender, now all we need is the soldering iron to tin over the countersunk screw heads, just to stop them from leaking. The steam pipe can now be finally assembled with liquid jointing compound on the threads to seal them also.

The regulator rod is from 3/16 in. stainless steel rod and I suggest its initial length be 14 in. so that you can check it later for the regulator handle to be well clear of any of the boiler fittings. Chuck in the 3 jaw, face and turn down the end ⅛ in. to ⅛ in. diameter to be a nice fit in the regulator body boss provided, then reduce the next 5/32 in. to 11/64 in. diameter and file on the square to suit the operating arm. Next chuck a length of 5/16 in. stainless steel or bronze rod, face and reduce to 19/64 in. diameter over a ¼ in. length, then centre and drill No. 13 to the same ¼ in. depth before parting off a 5/32 in. slice. I have a 3/16 in. taper reamer which allows me to ease the No. 13 hole to a tight sliding fit on the regulator rod, otherwise you will have to ease the fit with a No. 12 drill; just slip it over the end of the rod for a moment.

The neck ring is from ½ in. bronze rod so chuck in the 3 jaw face and turn down to 7/16 in. diameter over a ⅜ in. length, checking it is an easy fit in the backhead bush. Further reduce the end 5/32 in. to 5/16 in. diameter, this time a close fit in the boiler bush, then centre and drill No. 10 to ⅜ in. depth. Part off at a full ¼ in. overall, revers and clean up to length. Assemble the regulator rod from the backhead, engage the operating arm and boss in the body, then tap the neck ring into place, pushing the collar on the regulator rod ahead of it. Scribe the position of the collar on the regulator rod then move it on another 1/32 in. both for luck and expansion, brazing in place and then chucking to turn off any excess spelter.

I can supply a nifty gunmetal casting for the gland, for which chuck by the boss in the 4 jaw and clean up the chucking spigot, then rechuck by the latter, and I should have said to clean up the outside face fo the gland when dealing with the chucking spigot, though it can be done later. Lightly face and turn down the boss to 7/16 in. diameter to be a nice fit in the boiler bush, clean up the flange to thickness, then centre and drill through at No. 10 which will likely remove the chucking spigot, so be careful! Mark off and drill the pair of No. 40 holes, then complete the profile with files. The gland has to be horizontal across the boiler bush, so erect it so, spot through the No. 40 holes, drill the bush at No. 47 and tap 7BA; the studs are from 3/32 in. stainless steel rod to complete as we shall not pack the gland yet awhile.

THE CHASSIS

Main Frames

Boiler out of the way and if I stuck to the sequence in which I used to build, it would be cylinders next as I reckoned if those two major items were successfully completed then the rest simply had to follow. Those exciting cylinders will have to wait until the next session, but in the meantime we have another equally exciting prospect, that of dealing with the main frames.

Unlike the tender frames for No. 78000, this time there is no option but for 4 in. x 3mm section steel flat for these engine frames, though we shall be using most of the material; our length wants to be 29½ in. initially and cold rolled pickled quality for preference. Very few of the mating parts are shown on Sheet No. 5 so I had better identify the holes for later, for as Ron Kibbey will doubtless tell me, I am short of sub-assemblies as usual! The front buffer beam is secured with three No. 34 holes or rather 6BA holes through same and at the bottom extremity of the frames at the front are the guard iron fixing holes, again No. 34 as I have learnt from hard experience with the RAIL MOTOR that 8BA ones have a habit of sheering off. Above the guard iron holes are a group of ten at No. 30 for cylinder fixing, the centre line of motion extending to that ⅝ in. dimension at the front. In the middle of the cylinder group is a lone ¼ x 40T tapped hole, the first of three for the brake hanger brackets. All four leading and trailing horns are each secured with 13 3/32 in. snap head soft iron rivets, so should not come loose in service! Whilst the motion plate is similarly 'belt and braces' fixed by 12 6BA bolts. Lest anyone be tempted to reduce the number of fixings for the motion plate, let me say that the one specified by LBSC for his MAID OF KENT fitted with rockers similar to POM-POM was seen to move in service and completely destroy the valve events.

Moving next to the top of the frames, moving aft all the time, we come to a 5/16 in. reamed hole for the weighshaft, with a group of four No. 34 holes around it for the weighshaft bearings. The driving horns are also adequately secured by 14 1/8 in. snap head soft iron rivets, whilst immediately behind are a group of seven No. 34 ones for the boiler stay. The rear brake hanger bracket and trailing horns we have already covered, which brings me on to the group of 14 at No. 34 for drag box fixing. That leaves just three at the same size towards the bottom edge for the brake shaft trunnions; let us mark them out and drill to the specified sizes. There are no lightening holes, Robinson knew what he was doing! His frame profile closely mirrors BR Standard practice of half a century later, though the great man has seen that you have plenty of sawing and filing to be done to emulate his masterpieces. Deal with the horn gaps as I described for the tender for No. 78000, only I forgot one very important instruction, which is to remove all burrs and sharp edges on separating the frames when complete.

Drag Box

This was a massive casting full size, but if I provided such a lump of iron for builders, I am sure I would be asked in the politest terms what to do with it! A fabrication is much easier to deal with anyhow.

Cut the backplate 4 5/32 in long from 1 3/8 in. x 1/8 in. or 3mm steel flat and the side plates 3 3/8 in. long from the same material. Top and bottom plates are 3 3/8 in. long and of width to arrive at the 4 5/32 in. overall dimension. Clamp the plates together and if you are at all unhappy with the result, secure with a few 8BA round head brass screws then braze up, quench, clean and zinc spray, when you can machine the side faces and deal with the drawbar hole at 1/4 in. diameter in both plates. I have deliberately omitted mention of the drawbar slot in the rear face as this can be dealt with from the drag beam, one we are about to tackle.

Front and Drag Beams

To my mind, we in the UK have never benefitted yet from metrication; it has all been so half-hearted, something imposed upon us that we really did not want, other than in specific industries. On the drawing board it bothered me not, for any scale is simply a comparitor and one rule is as easy to use as the next, but when it comes to acquiring the materials as drawn it is a different story. As a general example, ours was the first metric dwelling built on the Island, it seemed the right thing to do at the time, but things like cookers, washing machines, refrigerators and the like that did not fit properly back in 1974 are still the same in 1988. Such is equally true for us model engineers, as instance the beams we are just about to make, for whilst 35mm x 3 or 4mm section BMS would save us a lot of work here, I cannot find such section in any Catalogue, even the major steel stockists, indeed it is more likely the 'imperial' section of 1½ in. x 1/8 in. is still more readily available, so much for progress, the first instruction being to square off two lengths to 8¾ in. overall and reduce the width to 1 3/8 in.

Concentrating first on the front beam, mark off and drill all the holes as specified, then file the coupling one to a 1/4 in. square against an odd end of bar as your gauge. Because of the close proximity of the massive cylinders, the front beam adds little to the structural strength of the chassis, thus can be attached to the frames by medium of 3/8 in. x 3/8 in. x 1/16 in. brass angle; square off four pieces to 1 3/8 in. overall. Clamp each in turn in its correct position to the mainframes, to come flush with the front edge of same and level with the bottom front corner, drilling through at No. 34 and securing each pair in place with 6BA bolts. Attaching the angles to the front beam should await erection of the chassis, with the cylinders in place, when you clamp the beam to the angles, drill through the 1/16 in. holes and fit snap head iron rivets with heads inside, when if I have got my sums right, the heads will come clear of those 6BA bolts.

The drag beam at least we can make and fit to the drag box, so first mark off and drill the 20 holes, now you know what I mean about belt and braces!, then drill a couple of 3/8 in. ones and open out to form the drawbar slot. Offer up to the drag box, spot through the 14 No. 34 holes, drill the drag box No. 43 and tap 6BA, then deal with the slot to complete.

Hornstays, Spring Pin and Plate

Whilst the horns and axleboxes must remain outstanding this session, at least we can make some of the mating parts, starting with the hornstays. Again ½ in. x 1/8 in. section BMS flat is the more likely material, saw and square the six pieces off to length as shown then mark off and drill the four holes in each. I would recommend initially the central pair for the spring pins be drilled No. 11 and opened out after the spring pins have been fitted into the axleboxes. The spring plates are from the same section material, drilled to match the hornstays and then radius at the ends to complete; that was easy!

For the spring pins, chuck a length of 3/16 in. steel rod in the 3 jaw, face and screw 2BA over 7/16 in. length, then part off at 2 in. overall, reverse in the chuck and screw this end 40T over a 3/16 in. length, opening the die out a little so they are a tight fit in the axleboxes.

Coupled Wheels

I love machining cast iron, so before describing these wheels for POM-POM, I retired to the workshop and indulged myself, being extremely happy with the finished article!

Anyone possessing the luxury of a 6 in. 3 jaw chuck is laughing here, for it is simply a matter of chucking by the extremely even tread, though on the sample I chose, the fettler had taken advantage of the generous machining allowance provided and had really gone to town on the flange, leaving it slightly uneven. I found though that there was just sufficient room on the inside of the tyre to locate my d.t.i. clear of the spokes and though it bounced about a bit as I pulled the 4 jaw chuck round, it did give me a good enough indication, one I was able to confirm by substituting a turning tool, again just pulling round by hand as no metal needed removal here, just the sight of clean metal all the way round.

With a tipped tool and at the lowest speed in back gear, turn the flange down to 5 11/16 in. diameter, assess the machining allowances first of course, then face across the back of the wheel, changing to direct drive as you come to the centre boss which is circular and slightly raised. Now centre, drill through to 39/64 in. diameter or, say, to ½ in. diameter and bore out, completing to size with a 5/8 in. reamer. If you have any trouble when drilling or reaming cast iron, use a drop or two of paraffin and you will get a superb finish; it cuts out any tool chatter.

Take an old drill of around 11/16 in. diameter and with shank to match your headstock mandrel and saw it off behind the flutes, then fit to your headstock and turn down to 5/8 in. diameter, a tight fit in the wheel boss. I use 2BA countersunk screws to hold wheels for turning against the faceplate, fitting 1/4 in. washers under the heads when the spokes are widely spaced as in this intance. First turn the tyre down to 9/16 in. overall thickness, then pull the tool out by 3/32 or 1/8 in. to deal with the crank boss; the exact figure is unimportant, it is the look of the wheel on completion that matters. Now turn the tread down to about 5¹³⁄₃₂ in. diameter and I recommend you do the same as me and have a ³⁄₃₂ in. radius ground on the corner of your turning tool, when you can deal with root radius and flange at the same pass; it really does make life easy. Bring all wheels to this stage, then take a final cut on the last one to bring the tread diameter close to 5³⁄₈ in. Leave this setting well alone and deal with all wheels to be exactly the same tread diameter; this is the important feature rather than its exact size. Rechuck again to file on the flange radius, then set the tool over to produce the 30 deg. chamfer; tidy up the spokes with files as necessary.

No crankpin drilling jig have I detailed for POM-POM and looking back the last example appeared for DERBY 2P in LLAS No. 25, so let me run through its manufacture. Take a 1¾ in. length of, say, 1 in x ⁵⁄₁₆ in. BMS bar, mark on a centre line and grip in the machine vice on the vertical slide. At ⅜ in. from one end, centre deeply, drill and ream through at ⁵⁄₁₆ in. diameter, then move on .875 in. on the cross slide micrometer collar and repeat. Try a piece of ⅝ in. diameter silver steel bar in the axle holes, it should be a nice and acceptable fit, so chuck in the 3 jaw, face and reduce over a ⁵⁄₁₆ in. length to ⁵⁄₁₆ in. diameter, a tight fit in the drill jig when no other fixing will be required. Scribe a centre line on each of the wheel bosses for the crankpin, offer up the jig, clamp firmly in place to drill and ream through; lay the wheels aside for the moment.

Crankpins

Crankpins can either be from mild or silver steel to builders choice and I must add a warning that my dimensions are taken from the back of the wheel, so check them to place before turning them up to drawing. 0BA is not the most popular size these days and may be varied to ⁷⁄₃₂ or ¼ x 40T as you like; secure in place either with Loctite 601 or Permabond A118.

Crank Axle

There are a number of ways of making crank axles, some of which I have described in LLAS thus far. For one as heavily loaded as POM-POM's will be, I much prefer brazing for the strength it provides, simplicity of construction too.

Find a nice piece of ¾ in. diameter BMS bar, one that has no rust evidence, chuck in the 3 jaw, face and turn down to ⅝ in. diameter, either a clearance fit of .002/.004 in. for securing with Permabond A118, or an interference one for a press fit as you decide, then I cannot be blamed, said he, for any wheel that comes loose! The wheel seat is of course ²¹⁄₃₂ in. long to match the wheel and any variation on this must be taken into account in arriving at the overall length, to which the bar must now be parted off and the second wheel seat turned to give the 4¹¹⁄₁₆ in. dimension over shoulders. The crank pins are plain ¹³⁄₁₆ in. lengths from the ¾ in. bar.

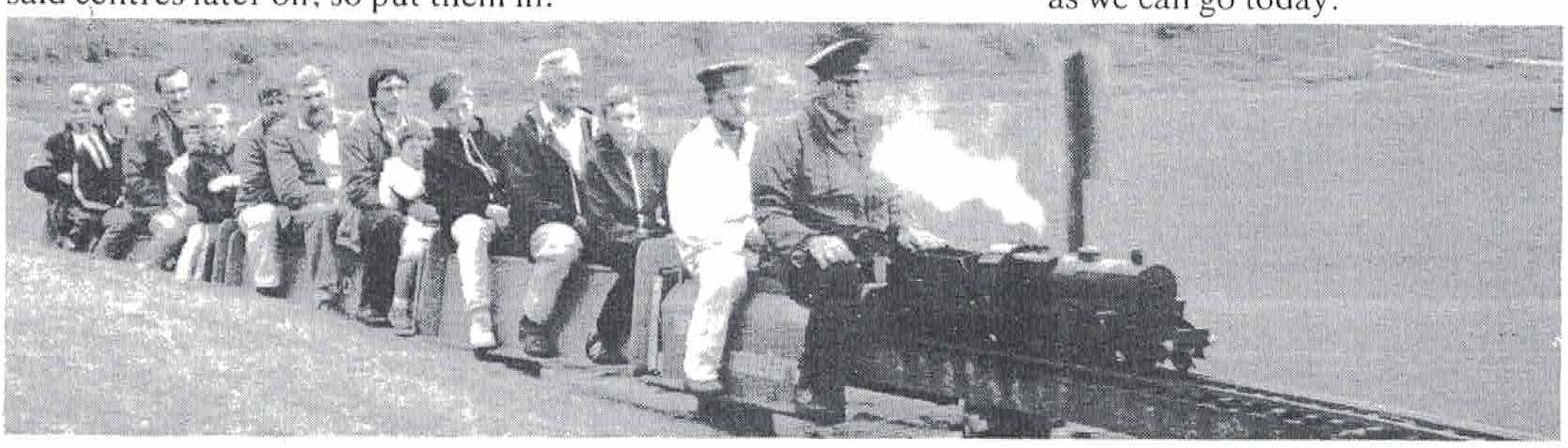
Crank webs are most satisfying parts to produce and as these come very close to the boiler stay, we shall have to be careful in arriving at the correct dimensions to avoid a 'foul'. Saw and square off four 2¹¹⁄₁₆ in. lengths from 1½ in. x ¼ in. BMS flat to be identical, which means milling them as a quartet. Looking at the crank web detail. I see I have omitted to instruct that the driving axle ends require to be centred, if only for looks, though in fact we shall be making good use of said centres later on, so put them in.

Back to the crank webs, to mark the centres on one piece, then to chuck the quartet in the 4 jaw, only do the job in pairs if you have any difficulty in chucking the four at one time, marking the pairs carefully for indentification if done that way. Chuck with one of the centres running true, centre drill deeply and drill through to about ⅝ in. diameter then change over to a boring tool. Open out until the webs are a tight fit over the axle, then move on and deal similarly with the other hole for the crankpins. Although not a recipe for sloppy workmanship, the very opposite is required here, if all the piece parts refuse to stay in their places when erected, you simply knurl the axle and crankpins in the alloted places, when nobody but you will know!

Having achieved a good fit, we must retain it whilst we radius the ends of the webs, using the mandrel and end mill technique described many times in LLAS, though once more will do no harm as there is potential for disaster here! Take a short length of ¾ in. diameter brass bar, it should be a nice fit in the holes in the webs, but ease it slightly if necessary, then mill two flats so that you can grip this mandrel very firmly in the machine vice, itself bolted to the vertical slide; take up any slack. With odd leg calipers, scribe on the shape of the webs at their ends, saw and file close to line as we do not want to have to mill off more than a whisker of material here. Slip a web over the mandrel, fit a large end mill in the 3 jaw, somewhere around ¾ in. diameter is the ideal, and grip to web very firmly with a 'Mole' wrench. Bring the workpiece carefully up to the end mill and pull round against the rotation of said end mill, never the other way, to tidy it up; by the time you have completed all eight ends you will be very proficient at this task, I promise!

Assemble on a surface plate, set the cranks at 90 deg. with your engineers square, **and please don't forget the eccentric sheaves,** or your face will be redder than the steel as we braze it up! Easyflo No. 2 is very satisfactory here, so mix some flux to a stiff paste and apply around all the joints, to seal them properly against oxidation, making sure the steel is nice and clean first. Sit on the brazing hearth, bring to the boil quickly with the No. 2943 burner or your equivalent, and apply the Easyflo quickly to all the joints, a job where two pairs of hands will be useful! The back gear eccentric sheaves are very close to the action and I am tempted to tell you to lightly grease them, but grease has a nasty habit of getting in the wrong places and we do need to get those inner crank webs very firmly attached, so you will have to be very careful. You can at least feed the spelter in from the insides of the webs and watch for when it has fully penetrated, then take the heat away. Allow to cool right out then clean up, then I like to test the strength of the finished job as well as I can ahead of fitting to the engine. First cut the redundant pieces of axle away between the webs, filing flush, then grip each web in turn in the bench vice, soft clams please, and do your best to separate the piece parts. Remember that each piston can apply a load not far short of 200 lb., so don't be faint hearted about your tests; nothing must move!

The axleboxes being specified solid, rather than split pattern, quartering the wheels must await the next session, even though we now have all the wheels and axles. So this is as far as we can go today.



Larry Loughborough ran his E. S. COX into an extremely creditable fourth place at the 1988 IMLEC hosted by the Leeds Society of Model and Experimental Engineers at their Eggborough Club track. Photograph by Dick Stockings