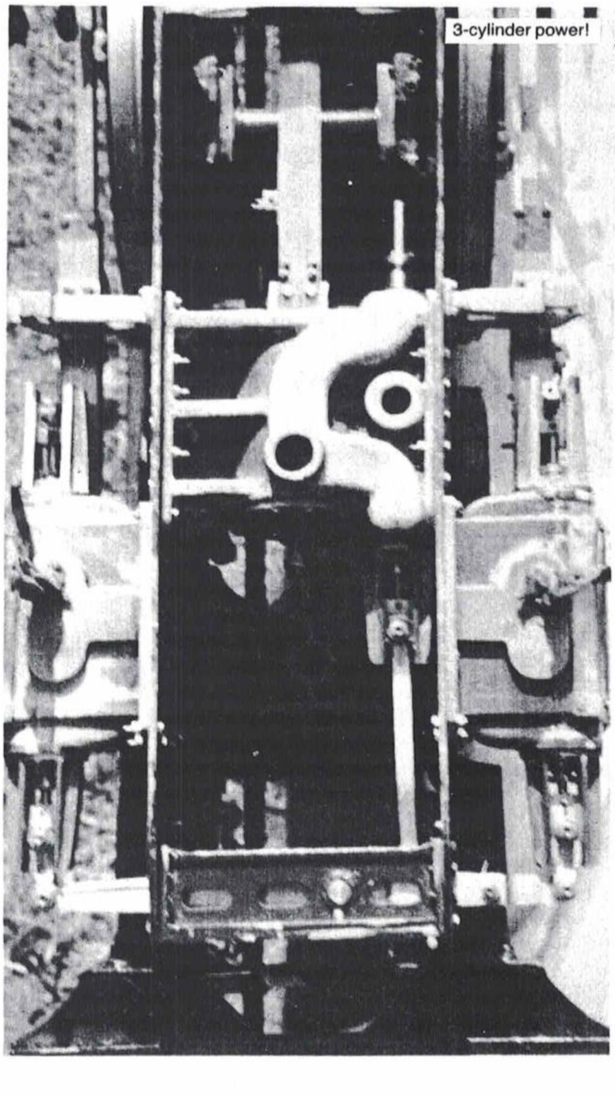
Doncaster — a 5in. gauge Gresley A1/A3 'Pacific'

by: DON YOUNG

Part 13 — Grate, Ashpan, Valances and Running Boards
My first statement this time that although every item is fully dimensioned, many of them will have to be checked to place, immediately brought to mind the sentence in Tim Coles A BEGINNERS GUIDE TO MODEL STEAM LOCOMOTIVES about drawing errors, ones that remained uncorrected. Now such things as steam turbines and radar reflectors have been built directly from my drawing board in industry before I ever tackled a miniature steam locomotive, and as a professional draughtsman of some 30 years standing, I would be very upset if that sentence applied to me. I do make mistakes, but would hope that the friendliness shown to me does extend to pointing out the error of my ways, to ensure those who follow have a smooth ride. Whether I am tempting fate by mentioning this in Part 13 of the series only time will tell, but I can say that every mistake which has been brought to my attention, and which I have been able to verify, has been corrected on the nearly 300 tracings for which I am responsible; I would not have it any other way.

Ashpan and Damper
Ron Kibbey, LLAS Member and former Chief Draughtsman at Rolls Royce, has done me the great honour of building two of my designs, RAIL MOTOR No. 1 and HUNSLET, superb machines that have featured in Myford advertisements, from which he has told me that my drawings are lacking in sub-assemblies, and of course Ron is right. As most things do, this stems from each of our earlier experiences, for fitting an engine into an airframe needs a shoe horn; not so when fitting marine turbines into engine rooms. The ashpan for DONCASTER though is a 'squeeze' job and after laying the boiler drawing on top of the mainframes, slightly altering both as a result, I came to the conclusion that it would be preferable to follow Ron's advice with the ashpan and then draw it as a pure detail in my normal way. I have also reduced my scope in the way of script by covering the making of a cardboard replica in the first instance by note on the drawing. Once this has been made, erect the boiler and sit it level on top of the star stay, then judge the fit of said ashpan before changing same from cardboard to stainless steel. The most interesting feature of this ashpan, apart from it fitting so snugly to both foundation ring and frames, is the lip extending beyond the damper door, this as you can see to carry ash clear of the brake gear pins. The firebox is going to move back by slightly less than 3/32 in. once the boiler has settled down after raising steam, so check the effect of this on the ashpan before attaching same to the foundation ring, using about a dozen 6BA stainless steel or bronze bolts, fitting them along the sides, but clear of the drop grate bearing. Full size there were a series of pegs welded to the foundation ring, over which the ashpan was fitted, usually with some difficulty! There were slots in the pegs to accept flat cotters and this was the means of ashpan retention, something for the purist to get his teeth stuck into.
From experience with wide firebox engines, in particular my LUCKY 7 design, air holes in the back of the ashpan are essential for good combustion, and because of the close proximity of the rear stay, this should be relieved to suit. Again full size, this was a flexible stay supporting the back of the firebox, but our ashpan is going to provide all the support we require at the back end of the boiler.
From now on, we are going to have to erect the boiler countless times, only to remove it as we fit the drop grate and damper with all its associated gear, in fact a simple form of lifting tackle will be a boon as this boiler is no lightweight. I didn't say a great deal about the actual construction of the ashpan, possibly because it is a real pig!, but if you are able to fold up the trough and sides in one piece then the rest is easy, the real problem being that 1/4 in. radius to match the frames at the front which tapers away to nothing at the side section of foundation ring. Fitting the back of the pan is relatively easy, but when we come to the front closing plate, then we have to fit a pair of hinges for the damper door to swing on. For the lugs, chuck a length of 1/4 in. x 1/8 in. steel flat truly in the 4 jaw and turn on a 3/32 in. diameter spigot over a 3/32 in. length; repeat at the other end of the piece and saw into individual lugs before clamping together and drilling through at No. 30. File the end radius as shown then mark off and drill the ashpan before rivetting the lugs to place. A neatly welded ashpan will be both decorative and functional, otherwise braze the joints to include the lugs.
Next cut the damper door to place to fit the opening snugly, make up the hinges, clamp together and braze, there being a


3-cylinder power!

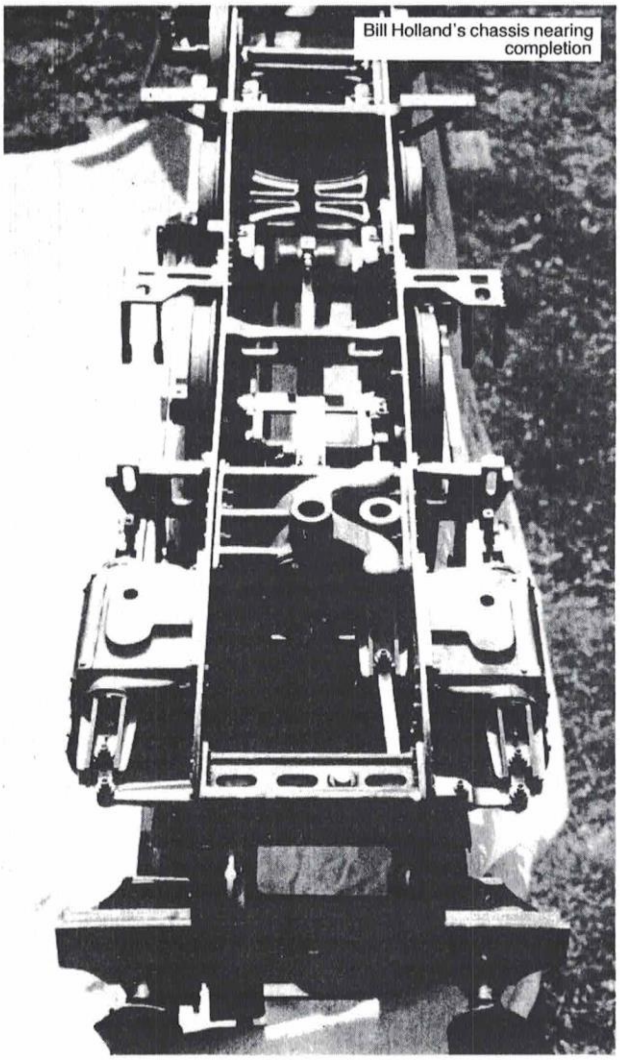
third lug to connect to the pull rod. Use soft iron or brass snap head rivets as pins, cross drilling at No. 56 for 3/64 in. diameter split pins.

We now have to go back to the drag box to set up the operating gear for the damper, starting with the bell crank. Mark the arms out on a sheet of 3/32 in. thick steel and first drill a Letter 'D' hole at the fulcrum. Turn up the pivot from 1/4 in. steel rod, press into the steel sheet and braze together, then drill the pair of No. 41 holes and profile the arms to drawing.

The bell crank trunnion can either be machined from 1/2 in. x 1/2 in. x 1/8 in. steel angle, or bent up from 1/4 in. x 3/32 in. strip, there is little to choose between the two, drilling the holes as specified. You can now see the area the damper gear has to work in and it can make the final decision whether to attach the bell crank to the right or left hand mainframe a little easier, the lug on the damper door of course coinciding; drill the chosen frame and mount the bell crank.

The damper lever is best cut from 3/32 in. thick steel sheet as was the bell crank; drill a No. 43 hole and press in the 3/32 in. pin to braze to place, but leave the 1/16 in. notches for a moment, until the control block has been erected. For the latter, chuck a length of 1/4 in. square steel bar truly in the 4 jaw, face, centre and drill No. 12 to 7/16 in. depth before parting off at 5/8 in. overall. Next square off a 1 5/8 in. length of 1/4 in. x 1/16 in. steel strip, mark off and drill the pair of No. 34 holes.

Towards the other end, mark off the 5/16 in. x 3/32 in. slot, drill



Bill Holland's chassis nearing completion

three No. 43 holes and file out to suit the damper lever, chamfering the outer end of the slot to suit the notches you will now cut in the lever. On reflection, I would use 3/16 in. brass rod for the plunger, so chuck in the 3 jaw, face, centre and drill No. 30 to 1/4 in. depth. Part off at 3/8 in. overall, reverse in the chuck and radius the end as shown, then erect with an 1/8 in. o.d. x 24 s.w.g. compression spring, one about 5/8 in. free length. Fit the damper lever and erect to both bell crank and drag box; check the operation before drilling the drag box No. 43 and tapping 6BA for hexagon head screws.

To complete the assembly we need the damper pull rod, from 3/16 in. x 3/32 in. steel strip and fashioned to place, for it has to clear the tee bar and rear stays, plus the trailing axle, a really tight squeeze! Once satisfied, braze a pin to the rear end and drill for another at the front, then erect. What you have to remember in service is that as the boiler expands backwards, so the damper door will tend to open, vice versa on cooling.

Fixed and Drop Grate

After all the struggles with the ashpan, the fixed portion of the grate at least is easy. I gave a lot of attention to the design of the grate, when the patternmaker suggested I make the slots along the grate in the normal way, when pattern costs would reduce by well over 80%. Such was very tempting, for apart from the pattern cost, the casting would have been much cheaper too. It all sounds good, until in service you try to rake those back bars in the extremities of the firebox; it cannot be done unless the grate is as drawn. Anyone who has fired a Gresley 'Pacific' and I must admit that such was a little beyond my capability, knows one has to build the fire up at the back corners for success; cloth over the knuckles to prevent them from burning and a wristy action to shoot the coal sideways, it was quite a feat when firing through the flap. A lot of coal will be burnt in these back corners on DONCASTER, so the bars must be easy to rake through, hence the air slots being crossways.

After that, fitting the grate is a piece of cake, just cleaning up the opening to accept the drop grate section and then filing the corner lugs so the grate sits flat on the ashpan, with the top of the grate at least level with the top of the foundation ring in the boiler, never below same. Now mark off and drill the No. 30 holes through the bearers for the drop grate pins, drill the drop grate to suit, then make up spacers from 1/4 in. rod to align the drop grate centrally in its hole. Again I would use 1/8 in. soft iron snap head rivets as pins, peening the shanks over so they won't come adrift, but do be careful not to fracture the grate sections in the process, as one grate per engine is sufficient costwise! In conclusion, the drop grate section should be just that, and very freely, for we don't want to have to poke about for it inside the firebox if the fire has to be dropped in a hurry.

The older members among us will remember the LBSC doctrine of simply pulling a pin out to drop both grate and ashpan and it took me many years to move away from this to a fixed ashpan, one with a removeable section of grate to come out through the firehole. This in service has proved just as effective as pulling a pin, for well over 90% of the fire decants into the ashpan, where it rapidly loses its ferocity and can be quickly dropped or raked out. Drivers of DONCASTER will have to be a little more skilful than this, but it is still amazing how quickly the fire can be dropped, quick enough to avoid boiler damage in emergency.

If decanting the fire is not difficult, fitting the drop grate operating gear full size certainly was!, though my experience of same should ease the way in miniature. The drop grate support shaft is first, the shaft itself being an 8 in. length of 3/16 in. rod. Cut the supports from 4mm steel sheet, thin them down to suit the runners if you have to use 3/16 in. thick material, finish to drawing, clamp together to drill the No. 13 hole, then press onto the shaft to be in alignment and weld for preference.

It is just possible to make the bearings from 3/8 in. x 1/4 in. BMS bar, otherwise use 1/2 in. x 1/4 in. section. Square off two lengths at 1 1/8 in. overall, clamp together and drill the bearing hole at No. 12. Try the fit over the shaft and if at all tight, open out to No. 11. Now profile the rest of the bar before marking off and drilling the No. 34 fixing holes. We arrive at the tricky bit, which is to achieve correct alignment of the shaft, for which we require the grate to be in place, but not the ashpan. Remove the ashpan, wedge the grate in place inside the firebox, then bring the ashpan up again to check the grate is properly positioned. Fit the bearings over the support shaft, offer the whole up to the foundation ring and check operation of the drop grate before drilling and tapping the foundation ring to no more than 3/16 in. depth; secure with 6BA bronze screws. Now bring up the ashpan and scallop in way of the shaft.

We move next to the fancy operating gear hung off the boiler, starting again with the crank, another bell one. Cut the arms from 1.6mm steel sheet, drilling the fulcrum hole at No. 13, then turn up the pivot from 5/16 in. rod and press the arms onto same before brazing. The bracket is not the easiest to make, but at least it is open ended at the back, so the sides can be made individually. I would bend one side up as a pattern and then try to make its partner to match, though I usually need a couple of attempts to succeed! Clamp together, drill the pair of No. 34 holes and secure with 6BA bolts, then fit a 1/4 in. thick packer to drill the No. 11 hole through for the crank. Snape the ends of the side members roughly as shown, fit the thrustplate and braze up, then drill the No. 30 hole. I would leave the slotting of same until all is erected and you can see what is required, so next turn up the screw from 1/4 in. steel rod, it being screwed 5BA both for the operating and 'driving' nuts. The circular one is from 7/32 in. bronze rod, drilled and tapped 5BA, when you can erect. Screw on the 5BA nut at the top and cross drill No. 53 for a 1/16 in. pin, but don't press same in yet. Now you can assess the movement required where the screw passes through the thrustplate, attend to same, then pin the driving nut and add an 8BA one at the bottom end of the screw, securing with a mild grade of Loctite or Permabond.

We have made several arms like that required at the end of the support shaft, so complete and pin to the shaft roughly in the position shown. Also with the operating gear in the position shown, attached to the boiler of course in way of the foundation ring with 6BA bronze screws, measure the length of the pull rod and make up from 7/32 in. x 1/8 in. steel strip. Use further 1/8 in. snap head iron rivets as pins,when you can check the operation of the drop grate. Remember that you will use this gear everytime you steam your DONCASTER, so it is not one of those optional extras, but vital to the well being of your engine.

Platework

At this stage of construction the jobs start to merge, for instance we need to lag and clead the boiler barrel so that the splashers can be finished to place, but at the firebox we need valance and running board against which to match said lagging and cleading, so let me start with the simple bits in the middle at the front end.

Front End

The centre front running board is a piece 4 1/8 in. x 1 31/32 in. from 1.6mm steel sheet; relieve in way of the vacuum standpipe then mark off and drill the 17 holes at No. 44, countersinking them. Offer up to the engine, spot through, drill and tap 8BA and if you are able to obtain a supply of 8BA raised countersunk head screws, then these look absolutely authentic when fitted and the screwdriver slots have been filled with plastic metal or Isopon.

The smokebox running board sits on top of the 2:1 gear frame and indeed is screwed to same. Full size there was a lip provided on the smokebox saddle for this running board to sit on; we can screw that length of 5/32 in. square bar to the saddle to represent same, the running board itself not being attached to same. Now, on the front face of the 2:1 gear frame, you will have provided either an oval or rectangular slot, this for access to lubricate the levers. If you have chosen an oval slot, then for the earliest period, say until at least 1930, this is all that is required.

After 1930ish a simple form of hinged cover was provided, made as follows: Cut a piece 13/16 in. x 17/32 in. from 1.2mm steel sheet, then chuck a length of 5/32 in. rod in the 3 jaw; face, centre and drill No. 47 to at least 5/8 in. depth before parting off a 17/32 in. slice. Chamfer the end of the plate to suit this hinge and braze together, then turn up the wee knob and rivet in place; complete the profile to drawing. For the hinge blocks, chuck a length of 5/32 in. square bar truly in the 4 jaw, face and turn down to 3/32 in. diameter over an 1/8 in. length, screwing 7BA. At 5/64 in. from the end of this spigot, cross drill No. 47 for the hinge pin, then part off, radius the outer end and reduce the thickness to 1/8 in.; repeat for a second hinge block. If you are lucky enough to locate as I have a 5/64 in. diameter x 1 in. long snap head brass rivet, then you have your hinge pin, otherwise make one up using the same method as for the smokebox door.

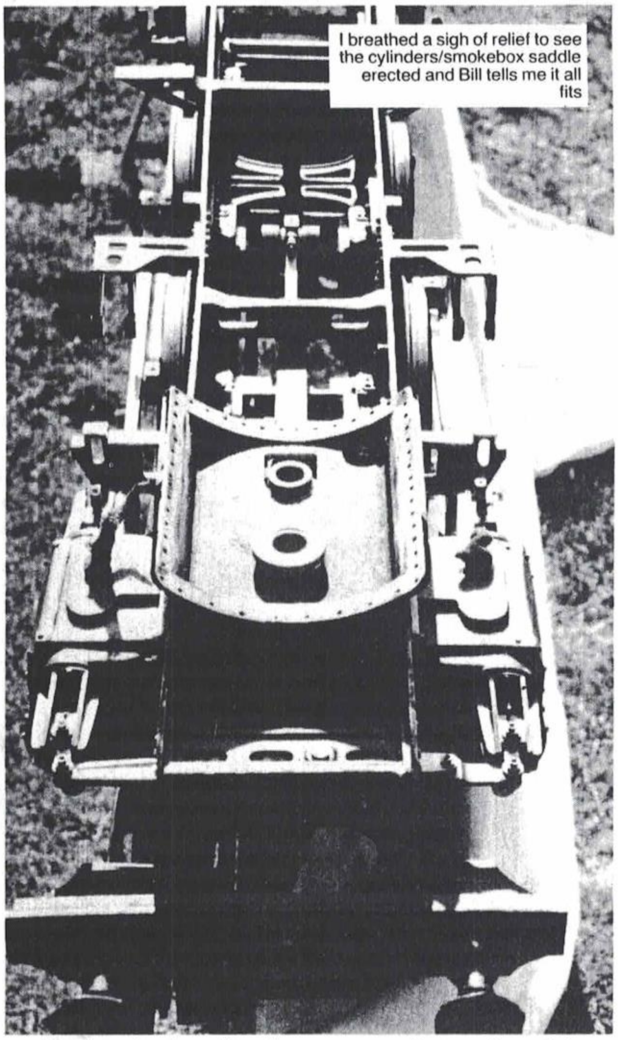
When the cover is closed, it has to fully cover the oval slot in the 2:1 gear frame, so locate to place and then drill said frame for the hinge blocks, tapping them 7BA. The catch is the awkward bit and I would make it 'Z' shaped and attach to the 2:1 gear frame with a 10BA bolt. To operate, you have to lift the door on its hinge pin, over the catch, and then open it — simple.

Circa 1947 a real 'Fort Knox' arrangement was arrived at, this to ensure both that the levers could be properly lubricated, and also that they were properly protected from smokebox ash and char. The door is 2 1/8 in. long x 21/32 in. wide x 1.2mm thick from steel or brass. It is then double-skinned by a 0.9/1.0mm thick sheet which folds outwards and downwards to protect the bottom slide. To complete the door, we require a handle and bracket. Bend up the former from 1/16 in. wire, then turn up the collars 3/64 in. thick from 3/32 in. rod. Drill the door No. 53, press in the handle and braze up. The bracket at the other end of the door is 1/4 in. x 3/16 in. angle from 3/16 in. x 1/16 in. strip and can be rivetted to the door. In the other face, drill a No. 40 hole, then clamp the door to the 2:1 gear frame and drill No. 48 into the LH mainframe, tapping 7BA for a 3/32 in. steel peg as shown.

Next take two 4 1/8 in. lengths of 5/32 in. square steel bar and reduce to 5/32 in. x 1/8 in. section, at the same time milling the 5/64 in. rebate to accept the door along its full length, remembering that each rebate is different, and to suit the door. To complete the runners, cut 1/8 in. square lugs from 1.2 or 1.6mm material, locate and braze to drawing, drill through each lug, offer up to the 2:1 gear frame, spot through, drill and tap 10BA for hexagon head bolts. This sliding door is of course the most awkward of the three possibilities, though the protection it provides the 2:1 gear is much greater, to make the whole exercise very worthwhile.

Valance

When I reached description of the valance last evening at the rough note stage, I decided to call it a day, for just as in making the valances, one has to be alert, the same applies in arriving at a proper description. Let us start at the front end, by first squaring off a 1 1/32 in. length of the 1/4 in. x 1/4 in. x 1/16 in. brass angle that we shall be using in gay profusion, clamping same to the front buffer beam. Next take about a foot length of the same material, leave a 7/16 in. flat at the end, then form the 1 1/16 in. radius by pulling round a piece of 2 in. diameter tube or bar. If you are lucky then this will pull round perfectly square, though it is likely to twist. Once twist has occurred, there is very little you can do but cut away the



I breathed a sigh of relief to see the cylinders/smokebox saddle erected and Bill tells me it all fits

outside face in the offending area, get the top face right to accept the running board, then cut a piece from 1.6mm brass sheet to match and silver solder in place. In this instance, we have another matching piece to cut out to form the toe of the valance. Always try to have any matching pieces stand slightly proud of the valance angle after silver soldering, so that you can file it flush, otherwise the end result will look horrible and be difficult to fill for painting. Saw off to arrive at the $1\frac{1}{32}$ in. dimension; if you do this at 45 deg., then it will be easy to match the next piece.

The next piece in fact extends right to the drag box, that is if you can manage it, so take a four foot length of the $\frac{1}{4}$ in. brass angle, snape at one end to match the front piece just made, and start forming from this end. All radii are fairly generous along the full length so twisting should not be a problem, but saw away and fill in if you are unlucky. Arriving at the drag beam, if you saw a 'V' notch in the top face of the angle, you will be able to form the tight radius and only have to silver solder what has become a close fitting joint. Saw off to length and attach to the drag beam end. It is not quite as easy as I have described it, but there are check interfaces on the way along, the first at the outside motion plate, then the expansion link bracket and finally the outrigger attached to the boiler stay, though you will likely have to match the outrigger to the valance instead of the other way round. Once the valance is attached at these three points, after silver soldering to the front section of course, then it will be sufficiently rigid to allow us to use as a template for the running boards.

Side Running Boards

For the running boards, we need lots of $2\frac{15}{32}$ in. x 1.2 or 1.6mm steel strip, so get some sheared from sheet and cleaned up to dimension. Take a 6 in. length for the side running boards at the front, leave $\frac{15}{16}$ in. flat, then bend over a length of bar or tube to match the valance, trimming off the excess. You can of course use bending rolls to advantage here, a most useful tool, and about the only one I would stop building locomotives to make — if I had the time! Anyhow, from the specified holes you will see that it requires another length of $\frac{1}{4}$ in. x $\frac{1}{4}$ in. x $\frac{1}{16}$ brass angle attached to the mainframes to match the valance and to fit snugly to the running board; do this to place. Fit both sides and we can add another finishing touch in the shape of the lamp irons.

Lamp Irons

The three lamp irons sited across the front of the engine are so distinctive as to warrant your consideration to machine them from solid, as they taper in just about every direction. As the section of bar will be only $\frac{5}{8}$ in. x $\frac{3}{16}$ in. the idea is completely practical; otherwise braze two pieces of $\frac{3}{16}$ in. x $\frac{3}{32}$ in. strip together and fashion to drawing, securing with 8BA raised countersunk screws in the positions indicated.

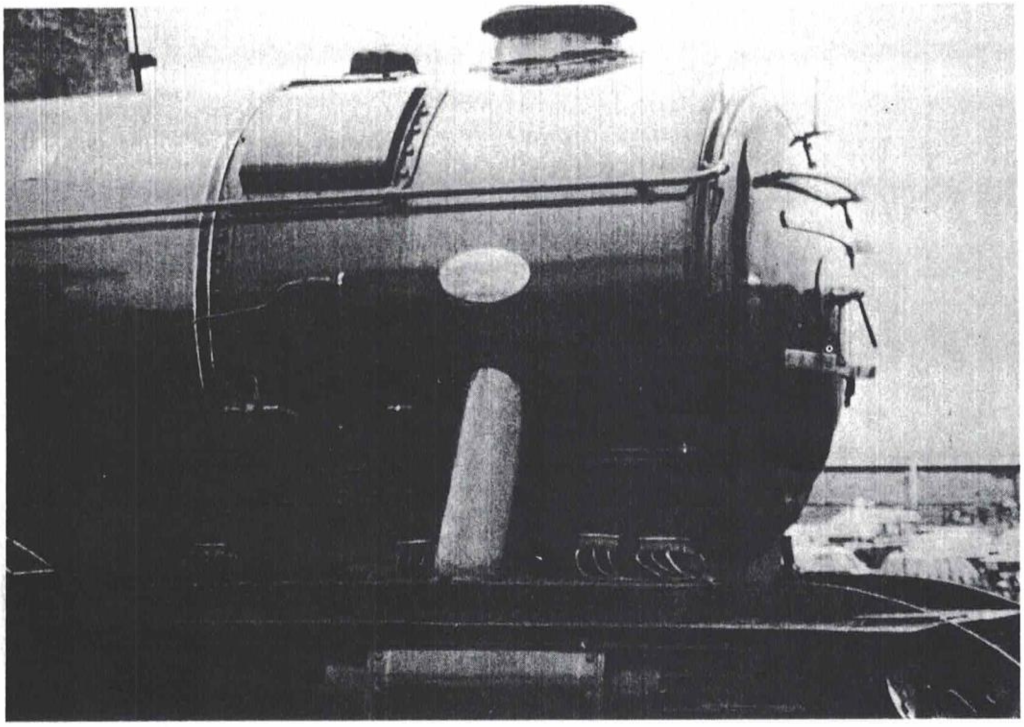
We now come to the large section of side running board extending from the front of the smokebox to behind the driving axle. Use a 27 in. length of the $2\frac{15}{32}$ in. wide strip initially, bending up to suit the valance and starting from the front end, when you can begin to mark out, again from the front end, dealing with each cut-out singly and to place. The cut-out that will positively locate the whole running board is that for the outside motion plate, so take particular care with this one, then it will become a register. The flap at the front end will be as useful in miniature as it was full size for lubricating the valve crosshead and 2:1 gear, so make it a good fit and make up wee hinges to suit. I know that some of you have difficulty in making up small hinges, you tell me so!, in which case use the smallest hinge available from a DIY shop and trim to place, making sure that you peen over the ends of the hinge pin. Mark off and drill the 83 holes at No. 44 and countersink, then spot through, drill and tap the valance 8BA, but before fixing we have to fit more $\frac{1}{4}$ in. angle to secure the splashers, rivetting to said running board and with No. 44 countersunk holes in the vertical face.

The upper side running board uses $2\frac{1}{8}$ in. wide strip and we initially require a $9\frac{1}{4}$ in. length, the rear edge being chamfered to match the main side running board below. Before doing this though, take a length of $\frac{1}{2}$ in. x $\frac{3}{16}$in. BMS bar and reduce the width to about $\frac{15}{32}$ in., the actual dimension depending on whether the running boards are 1.2 or 1.6mm thick. Shape the rear end of the bar to match the main side running board, cut another piece to go across at the front end, scarf the joint and silver solder. Now fit the top running board, clamp firmly together and drill right through at No. 50. Tap the main running board 8BA, then open out the top section and spacer to No. 44, countersinking the upper face as usual. Incidentally, this thick spacer was the only way I could think to make the part look authentic, for it is plate and angle construction full size. Apart from the flap in the upper section, which wants a cut-away in the main one below for access to the motion, there are holes to provide for the sandbox and slots for the lubricator, plus another large hole for the main steam pipe, when the whole can be erected.

Splashers

The last item for this session are the splashers and as usual I have left the most difficult part until last!

To my mind, the only way to form the beading around the edge at the front of the splashers is by turning, so bolt a $7\frac{7}{8}$ in. circle of 3mm steel sheet, or maybe brass is best here, to the faceplate and turn down to $7\frac{3}{4}$ in. diameter. Now form the beading either $\frac{11}{64}$ in. or $\frac{3}{16}$ in. wide; it is one of those



The smokebox of FLYING SCOTSMAN captured for us by Roger Early

in-between dimensions when scaled down from full size and your eye will be the best judge of what looks right. Cut out segments from the circle to make the front face of the splashers.

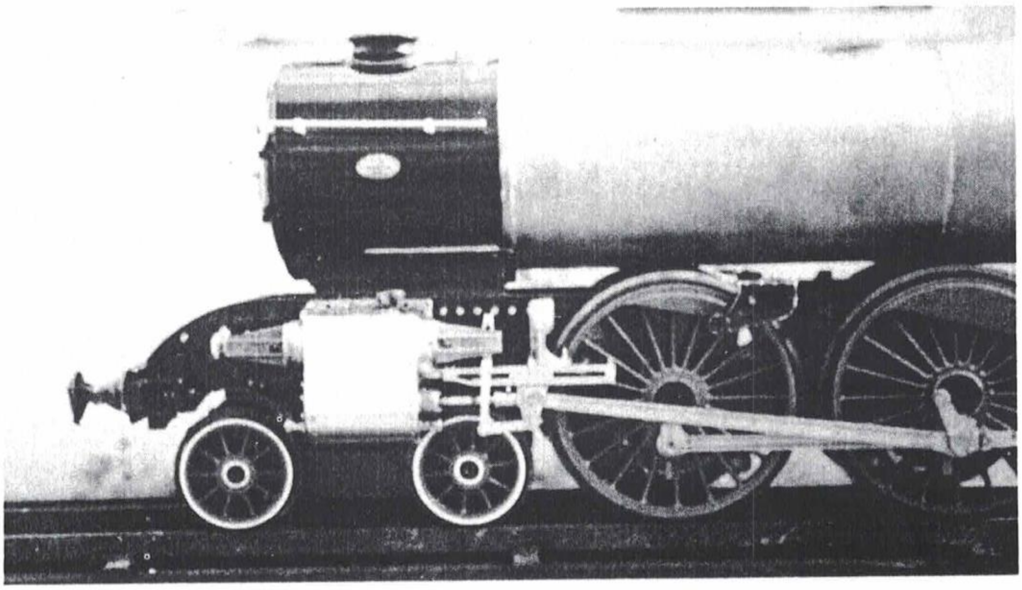
For the inside face, bend up 5 in. lengths of 1½ in. x 1.6mm steel strip to provide the flange as shown, then clamp to the front pieces and match the profile. The front pieces attach to the angle on the side running board, so spot through, drill and tap a couple of holes. The inside pieces sit snugly inside the mainframes and attach to 1 in. lengths of the ¼ in. brass angle, so locate same to match the outside pieces. Now cut strips roughly ⅞ in. wide to fit between the side pieces, this to close in the splasher, extending into bolting faces for the ends; clamp together, remove and silver solder the joints.

The boiler of course grows towards the trailing coupled axle, in fact this area is the tightest on the whole engine. Whilst you must snape the top of this pair of splashers to clear the boiler, it must be an absolute minimum or the wheel flanges will foul, in fact if the worse comes to the worse, then you should omit the closing plate in the splasher at this point, for the cleading will be in close contact and no gap will show.

Cab Floor Sheet

Actually I was wrong in labelling the splashers as the last item this session, for the simple cab floor sheet will bring us to a close. This requires very little description on my part, save to say that if I had looked at this detail last session, then I would have seen that I had investigated the siting of the hydrostatic lubricator oil tank when drawing up this part and had arrived at 1¼ in. diameter to suit the space available. If you intend rivetting this sheet in place, then delay same until the cab has been made and checked to place, but attach for the moment to the drag beam to make it nice and secure.

It is a pity that we could not finish the running boards this session, but there was not enough space on the drawing for same — next time though.



The front end of Bill Holland's Gresley 'Pacific' looks very much the part — roll on the day of her first steaming!

Doncaster — a 5in. gauge Gresley A1/A3 'Pacific'

by: **DON YOUNG**

Part 14 — Cab Platework and Fittings

A Dimensional Error

I did wonder if I was courting disaster by mentioning the possibility of dimensional errors in Part 13 of the series, and so it has proved.

Bill Holland was making up his reverser prior to final setting of his valves, managed the awkward stand OK, but when he came to the straightforward nut, he thought I had not allowed sufficient length at the top to be able to fit the handle. There it rested until Bill came to assembly, when he found the sleeve was very close to the stand, the penny dropped, and it is the sleeve that is incorrectly dimensioned, the $\frac{15}{32}$ in. dimension from the fulcrum should extend right to the bottom of the flange and not to the top of it. Sorry about that Bill, especially after providing all those superb pictures, but I hope at least we are in time to prevent other builders falling into this particular trap.

Just to show the other side of the coin, Bob Howard-Alpe advised me he was unable to correctly assemble his middle cylinder/smokebox saddle, whereas I already had Bill Holland's evidence in 3D, plus the drawings checked out OK. This one resolved into the $\frac{7}{8}$ in. dimension up from the centre of the steamchest to the top of the cylinder bolting flange not being adhered to, which led to more than one red face!, but at least the mystery was solved and another tip can be passed on. I do get queries of this nature quite regularly and can usually solve them on the spot, sometimes to the embarrassment of the querier, which should not be, for it is comforting to be able to check these things out to my own satisfaction, and point builders in the right direction. Typing that last sentence was actually interrupted by such a query; a couple of minutes spent chatting and another MOUNTAINEER builder was happy with his rolling chassis; me too!

Rear Side Running Boards

Start this time with a 16 in. length of $2\frac{19}{32}$ in. wide x 1.2 or 1.6mm steel strip, square one end and mark off the centre of the rear coupled wheel. The splasher cut-out is $\frac{15}{16}$ in. as before, mark on the $2\frac{3}{8}$ in. dimension ahead of the centre line, then I recommend you saw away right to the rear end of the strip, thus reducing the section to be bent to suit the valance; do just that. Offer up again and this time mark off for the firebox; saw out roughly and then file to place to get a decent fit. Take a 6 in. length of $\frac{1}{4}$ in. brass angle and bend to suit the running board, sawing off to length and securing with a dozen $\frac{1}{16}$ in. copper rivets as before. Drill all the specified holes, then offer up with the splasher in place and trim the latter as found necessary to gain a fit. Spot through, drill and tap for the 8BA screws, which want to be plain countersunk ones in way of the cab.

The step has a section as shown and is very much make to place. The step itself is $\frac{5}{8}$ in. wide from 1.2mm steel and length to be flush with the running board on the outside and the cleading on the inside. The base is $\frac{1}{2}$ in. wide, bent to suit the running board profile, then fit the end pair of gussets, braze up the assembly, spot through from the running board, drill and tap the step 8BA.

The Cab

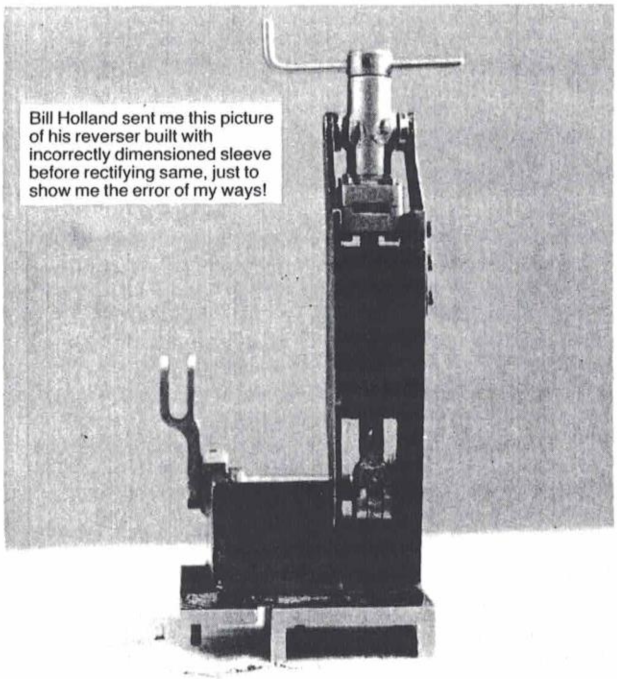
All the remaining work this session will be done inside the cab, though as with the last part of the GEORGE series, at this stage I am a little doubtful if I can complete in the space allotted. The cab structure can be a 'one piece' affair, just like full size, which were attached to the engine solely by bolts through the angles on the lower cab sides. When removed, they stood around quite happily in the Crimpsall; to me they seemed to resemble a small church.

The very first Gresley 'Pacifics' built to the generous GNR loading gauge had fairly ample windows in the spectacle plate, ones that only suffered from glare at night, the solution of which was the wedge fronted cabs of later classes. However, when the cab was reduced to the composite loading gauge of the LNER as a whole, the front look-out was severely restricted and drivers had to resort to opening the sliding window in the cab side and peering out ahead. It was some years before protectors were fitted to improve safety both for the driver and his train, but still the A1/A3's were not the easiest engines to drive safely, especially with drifting exhaust as valve vents were improved, the back pressure in the cylinders reduced. I well remember in the early 1950's travelling home from Kings X with Driver Gill, head swathed in bandages after being struck by a lump of coal falling from an engine going in the opposite direction; the injury killed him shortly after. Betty Gill was wife Barbara's best friend and brother Roy was a fellow apprentice at The Plant, so that tragedy in losing their father was felt very badly.

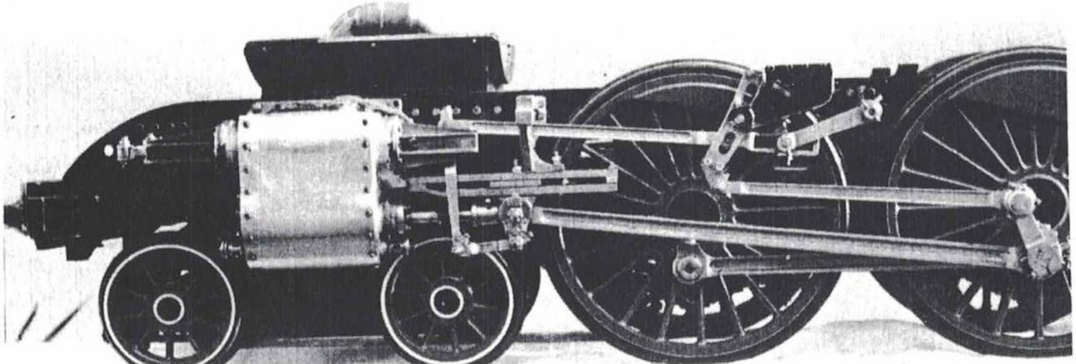
Having mentioned cab windows and protectors, a check shows neither has been detailed on Sheet 14, though help is at hand for the former in that virtually identical items are detailed and described for E. S. COX, concluding Part II in LLAS No 23, the spectacles too, and as this also includes Part 6 of the DONCASTER series, builders will have access to same.

Cab Structure

Take a piece of stiff card, mark off and trim to form the spectacle plate, then transfer the final result to 1.6mm steel sheet. Deal with the actual spectacles as previously described, though it would be as well to rivet the $\frac{1}{4}$ in. brass angle to the spectacle plate sides first, both for cutting to suit and to avoid damaging the 'glass'; erect to the boiler and running boards.



Bill Holland sent me this picture of his reverser built with incorrectly dimensioned sleeve before rectifying same, just to show me the error of my ways!



Bill's chassis, preparatory to checking under steam, when it performed as sweetly as it looks

For the cab sides, mark off on a sheet of 1.6mm steel, size 7¾ in. x 7$\frac{5}{16}$ in. to drawing. There are two features of particular note here, the first being that the lower part of the rear cab side bends inwards, so allowance must be made for this when marking out. The other feature is the cut-out above the lower cab side which initially was approximately level with the cab windows and was entirely practical, though aesthetically it was a mis-match with the tender. Starting around 1936, the cut-out was reduced to the alternative dimension shown in my notes, and to a degree where it could well have been dispensed with altogether, as happened on the Peppercorn 'Pacifics'. None of this will worry builders, for all you have to do is produce the cab side ir the era in which you are constructing your engine, as unfortunately you will not be able to stand on the footplate and experience the thrill.

Saw out the cab sides, file to line, bend the rear portion to drawing and then the top to match the spectacle plate; mark off and drill the specified holes. The beading along the rear edge is $\frac{3}{16}$ in. half round section and is sufficiently robust that it can be rivetted in position; remember that it is fitted to both sides. Fitting the beading around the cab window openings, and this time it is on the outside only, is rather tricky and the joint wants to be roughly in the centre at the bottom. Bend the $\frac{3}{32}$ in. half round section to place, then tin the face, offer up to the cab side and use an electric soldering iron pressed to the beading to obtain a proper joint. Rivet lengths of ¼ in. brass angle to the bottom edge, offer up to both running boards and spectacle plate, rivetting to the angles on the latter and using 8BA round head screws to secure to the running boards.

The ⅜ in. hole in the cab side requires a wash out plug pocket, something I had made on occasion full size. Although as a result of this I have suggested making from copper this with a view to fabrication, on reflection I now prefer machining from solid, when brass will be perfectly satisfactory. The flange sits on the outside, when you can either sweat or rivet to place as you wish.

Take a piece 12 in. x 7⅝ in. for the cab roof and roll to 6$\frac{3}{16}$ in. radius to suit the spectacle plate, sawing off to the correct 9⅛ in. rolled dimension, then radius the back corners to 'early or late' size as specified. The rear cut-out is optional, as you are only going to fill it again, and I doubt if any builder will produce his own lifting gear to fit the rear beam as full size. If you are going to omit said plate, scribe deeply to produce the 'joint', then drill and tap for 10BA bolts to complete the realism. For absolute authenticiity, cut the opening, make up and rivet a bolting frame to the underside of the roof, then make the closing plate, drill, erect, spot through to drill and tap the bolting frame at 10BA.

The cut-out for the ventilator is edged with ¼ in. brass angle and I would make in one piece, filling the corners with odd ends of 1.6mm brass and silver soldering together. Rivet the frame to the cab roof, but first consider the ventilator roof and its fittings.

You may be able to get the ventilator roof out of the surplus of the main roof, otherwise roll up, mark off, drill and break out the two slots, then deal with the $\frac{1}{16}$ in. diameter holes as specified. The ventilators themselves have also to be radiussed to suit, when we can mill the track. The centre piece is a 2⅞ in. finished length from 8mm x 2.5mm brass or steel strip. Grip in the machine vice, on the vertical slide, and use the side teeth of an end mill to produce the .05 in. rebate to $\frac{3}{32}$ in. width; reverse and complete, checking against the actual ventilator to be a sliding fit. Offer up to the ventilator roof, drill through, countersink as shown and secure with $\frac{1}{16}$ in. copper rivets. The outer tracks are from 6mm x 2.5mm strip with just a single rebate; clamp these in place, check the ventilators slide freely, then drill through and rivet in turn. A pair of knobs are required to complete the ventilators, so turn them up from brass rod and rivet to the underside of the ventilator, whilst fitted in place of course. Now you can either rivet, for preference, or braze the complete ventilator to its surround and erect to the roof. Handrail stanchions we have dealt with earlier, which leaves the protectors.

Protectors

In a moment we will come to the firehole door and one of its details is the flap hinge block; we need four similar items in which to mount our protectors. With care they can be made from ⅛ in. square brass bar, so square off into ⅜ in. lengths, clamp together in pairs and drill the No. 51 hole. Now you can start shaping, either by milling or I would simply file to profile. Offer up to the cab side, with a length of $\frac{1}{16}$ in. rod as alignment, to drill and tap 10BA. Again the glass is best made from perspex and wants to be between $\frac{3}{64}$ in. and $\frac{1}{16}$ in. thick; cut a piece a full 2 in. long and about ¼ in. wide. The end blocks are from ⅛ in. square brass bar, so chuck truly in the 4 jaw and turn down to $\frac{1}{16}$ in. diameter over a $\frac{5}{32}$ in. length, then part off to leave $\frac{3}{32}$ in. of original bar. Rechuck and clean up, then slot this end of the bar to accept the glass. To locate the protector positively against wind pressure, there is a little peg on the bottom glass holder which drops into a slot in the hinge block; there is a second slot which holds the protector fully forward and parallel to the cab side. This means that just like the first 2:1 gear door, you lift the protector and then turn it, so there has to be a clearance at the top hinge for this; cut the glass to a length to achieve this; then glue to its holders.

Completing the Cab Structure

The cab roof is far from finished and first it needs some angle attached as guttering, $\frac{5}{32}$ in. x $\frac{5}{32}$ in. x $\frac{1}{32}$ in. angle is the correct section, though commercial $\frac{3}{16}$ in. brass angle as available from Reeves will look the part without reduction to $\frac{5}{32}$ in. and save time.

The cab sides are joined at the back by another length of ¼ in. brass angle, rolled to match the top of the spectacle plate. Before attaching though, assess if you can easily remove the screws holding the cab sides down to the running boards and if OK, then silver solder the angle in place and rivet the cab roof to both angle and cab sides. If the screws are not easily accessible and they are less likely to be in miniature than they were full size, then I recommend you screw the cab roof in place, using countersunk screws with heads finally filled with plastic metal or the like.

For the body, chuck a length of 3/8 in. square bronze bar off centre in the 4 jaw so that it will just clean up to 5/16 in. diameter; do this over a full 3/4 in. length and screw the end 1/8 in. at 40T. Centre and drill No. 51 to 1 in. depth, then follow up at 1/8 in. diameter to 21/32 in. depth, 'D' bitting 3/16 in. diameter to 7/16 depth, then adding a 7/32 in. recess to 3/64 in. depth. Part off at 1 in. overall, mill the two side flanks to match the round portion of the body, then mark off and cross drill No. 51 for the fulcrum pin for the lever, 3/32 in. down from the top and as close to the edge of the body as you dare. Make up the lever to drawing and slot the body to place to accept same, when we are almost ready for the internals. First though screw the body into the turret, you may use a thin locknut if you prefer, to position the outlet union to give the best pipe run; turn up the connection, silver solder it to the body and drill into the bore.

Back to the internals, where we first have to seat an 1/8 in. stainless steel ball, then take a 5/32 in. o.d. x 24 s.w.g. compression spring and cut it so that when you place your finger over the end of the body, the ball just sits on its seat. Turn up the spring stop from 7/32 in. brass rod, drilling centrally at No. 30, press into the body and peen over to secure. We now need a push rod so that when the lever is in the position shown, there is a clearance of about .010 in. of the push rod from the ball, this to allow for expansion. When satisfied, rivet the lever to the body and we can move on.

Injector Steam and Check Valves

Save for a No. 55 hole to the brake valve on E. S. COX, the injector steam valves are identical, as are the feed check valves and as both are described fully in LLAS No. 22, page 28, I see little point in repeating the description as this Magazine also contains the Boiler description for DONCASTER, so all builders will have access to these earlier notes.

Vacuum Ejector/Brake Valve

This really is the piece-de-resistance of the whole engine, for if nothing else I just had to get this item both looking right and performing correctly, all of which kept me quiet for a few days I can tell you! To be able to make it correctly, no matter how many views I published, one needs to know how the whole thing functions before making a start on construction, that way it all comes clear in the mind.

The first creator of vacuum are the small cones, controlled by the small jet valve, and this is left permanently on whilst the engine is in steam, then you will always have a brake.

Looking at the top RH view (Steam), said steam enters the body at the 1/4 x 40T union and transfers to the front of the body through the 3/32 in. diameter passage into the steam valve chest. At the top of this chamber is a No. 51 hole going to the small jet, which can only be shut off at the small jet valve. Looking left and downwards at the rear cross section, the main jet valve is a 5/32 in. ball sitting on an 1/8 in. seat and operated by the push rod sat on the steam cam. When the brake handle is slightly backward of being vertically upright, the steam valve should be fully open, so the large cones are exhausting air from the train pipe, via the, ball, air value.

We now come to a point where the brake handle is being pulled towards you and downwards, first to shut off steam to the large cones and after a 'dwell', to begin to apply the brakes by admitting air into the train pipe, though it is a little more complex than that. Air must enter below the vacuum ball valve in the ejector body, so the hole of first importance to allow air to enter is the No. 51 (main air) one. It is a diagonal hole starting from the vacuum face and going downwards to emerge just below the ball valve as shown in the cross section: the plan view to the right shows the actual hole. The vacuum valve chamber is akin to the steam one, though this time the ball is spring loaded to prevent the ball lifting against the vacuum. Also in this instance the push rod does not require a gland, as air has to pass by it to apply the brakes. So all we need to complete this part of the circuit is a No. 51 passage from the valve chamber down to the main air passage.

Turning to the small jet, a No. 51 passage is drilled from the outside vacuum face right into the cone chamber. It also connects with a vertical passage, on top of which is the dummy air valve merely as a sophisticated plug; at the bottom is screwed in the release valve. With my system and using the pilot/small cones, when the brake is released, vacuum is pulled down through the release valve, and also by way of the isolator valve into the train pipe, so a full vacuum is gradually created, and more importantly maintained. When the brake is applied though, we don't want small cone vacuum interfering with the loss of vacuum in the main train pipe, otherwise the brakes would leak off. The isolator valve copes with this by closing off the small jet vacuum from the main air pipe, using a third cam and push rod. But vacuum is still being created by the small jet through that vertical passage, the release valve, and on to the tops of the vacuum brake cylinders, so brake effort will gradually increase, and this is no bad thing, so no limit valve is fitted. For a smart brake release, or to ease a train down along incline, you simply use the release valve. My Vacuum Ejector/Brake Valve therefore has every feature of the full size item, is authentic in appearance; now all we have to do is make it!

For the body we need a lump of brass, size 1 1/4 in. x 1 in. x 3/4 in. if you are using nice square commercial brass, though you may well have to start from the 1 in. square section as available from Reeves. Use the top face and sides as datum, together with the front face, and from these mark off for the cam operating spindle, drilling through at No. 43 and reaming 3/32 in. diameter; it is important that the spindle is not a sloppy fit in this hole for correct cam action. I suggest you hold the block in the machine vice, on the vertical slide, when after drilling you can change to a 3/8 in. end mill and mill the recess at the vacuum side to drawing. Turn the block through 180 deg. and mill the steam recess with the same end mill. The piece left in the middle is 9/32 in. thick and this requires a 1/4 in. radius, one which is difficult to mill around a 3/32 in. fulcrum, so filing buttons are the answer. Chuck a length of 1/2 in. steel rod, face, centre, drill No. 41 to 1/2 in. depth and part off two 1/8 in. slice. File to fit the recesses, then heat and caseharden; fit to the block with a 7BA bolt and file down to the buttons. Back to the machine vice to mill the back of the body, and its undersides, both to match the radius and be to the dimensions as stated.

Cone bores next, the small jet starting 1/8 in. down from the top face of the body and angled downwards at 8 deg., which for our purpose can be 5/32 in. over the length of the body, or 9/32 in. down from the top face. Scribe a line along one side of the body, it had better be the steam side, clamp in the machine vice with the line along the lathe axis, which means using an engineers square off the vertical slide table. Use a 1/4 in. end mill to produce the flat to accept the small jet valve, then centre, drill through at No. 31 and follow up with an 1/8 in. reamer. At the outer end, 'D' bit 5/32 in. diameter to 9/32 in. depth and tap 3/16 x 40T to about 1/8 in. depth. The main jet is 11/32 in. down from and parallel to the top face, so mark off and set up in the machine vice and first use a 9/32 in. end mill to spot face for the cap. Centre and drill through at No. 23, reaming 5/32 in. diameter, then 'D' bit 3/16 in. diameter to 11/32 in. depth and tap the outer 1/8 in. or so at 7/32 x 40T. The last passage, as against plain drilled holes, is to the train pipe, so mark off on the bottom face immediately under the main cone hole, to drill No. 23 and again ream at 5/32 in. diameter, removing any burrs at the junction.

We had better deal with the valve chambers next, which are 7/32 in. displaced from each side of the centre line and in alignment with the cam spindle, so mark on the centres. For the vacuum chamber, centre and drill through at No. 43,

Regulator completion

At that point my rough script deteriorated into unreadable scrawl due to the shivers, was it cold!, and it is two weeks later that I pick up the pen again, so I can but hope the break does not show. I have left an awkward item on which to restart, the regulator shaft brackets. Take a piece 13/16 in. x 9/16 in. from 1/16 in. sheet, which may be brass, and bed this to the backhead in the appropriate area, the top edge of the piece being in line with the centre of the regulator shaft; mark off and drill the three No. 44 holes. We now need a piece roughly 7/8 in. x 11/16 in. from 5/16 in. thick bronze; bed to the baseplate, clamp together and mark off for the No. 22 hole. Grip in the machine vice to drill through, then change to a 1/2 in. end mill to mill the recess shown to 5/32 in. depth. Now mark off to drawing to mill the 3/32 in. recess, this to expose the two stops, the 'close' one 8 deg. back as shown, and the 'open' one at 35 deg, plus 5/64 in. Offer up to the baseplate again, mark off at the back of the trunnion and mill away at the bottom, then complete the shape to drawing. Offer up again, make the web as shown, then cut the baseplate to suit. Check that the regulator shaft fits sweetly, then clamp together and braze up. The regulator handle fits neatly to the shaft bracket, so make up the handle before finally fixing the bracket to the backhead. I recommend the handle starts life as a 2 1/4 in. length of 1/4 in. square steel bar, the stainless variety if you wish. Chuck off centre in the 4 jaw so that you can turn down the handle itself to arrive at those 5/32 in. diameter collars, then turn the centre portion down to the 2 deg. taper indicated.

Next mark off and drill the No. 35 hole to start the 7/64 in. square to accept the regulator shaft, in fact you can file this square at this stage if you wish, checking to place that the stops actually coincide with the fully open and closed regulator valve; very important this. Transfer to the machine vice to mill the outer face at the boss to leave the collar 1/32 in. proud, then reverse and mill the section down to 3/32 in. thickness, increasing to 5/32 in. at the boss. Carefully mark off and drill the No. 51 clamping bolt hole to be central, slit down to the square, then complete the profile, either by filing, or a mixture of milling and filing, to complete. Erect and you can sample the feel of driving your A1/A3 for the first time and though no steam as yet, it will not be long ahead now to the great day!

Firehole Door

Firing through the flap, the small opening in the door when the flap was pushed fully open on its ratchet, was an art full size and although I did master it, in miniature and firing from behind the tender, I found on my K1/1 that the door has to be opened to be able to fire effectively. This means that although I have shown the anti-glare shield fitted to DONCASTER as an A3, I have not detailed same, for opening the door to fire each time, said shield would be a confounded nuisance. Whilst able to fire left handed, my action rapidly weakened, and turning the right way round, I soon got mixed up with the shield, so it is not my very favourite engine part!

Let us progress with the firehole door, which I remember as having more generous radii than the 1/16 in. specified, whereas all the full size 'Pacific' drawings repeat my detail, so my memory must be in error. It could mean though that there were two patterns of door, as I don't think even now I have forgotten the B1 and K3 doors that I fired through 35 years ago and more; they were the centrepiece of my vision for up to eight hours at a time. For my K1/1 door which is only a couple of feet away under the table as I type, I made up an oak former and then beat copper over it; such is far better than using the alternative steel sheet. Trim it off to be 1/4 in. thick as specified, then mark off and drill out the opening. I would leave the holes until the piece parts are made, as for instance the flap must be a fit in the opening, but do fit the stop which is a 7/16 in. length from 1/8 in. x 1/16 in. steel strip, either rivetting or brazing to the door.

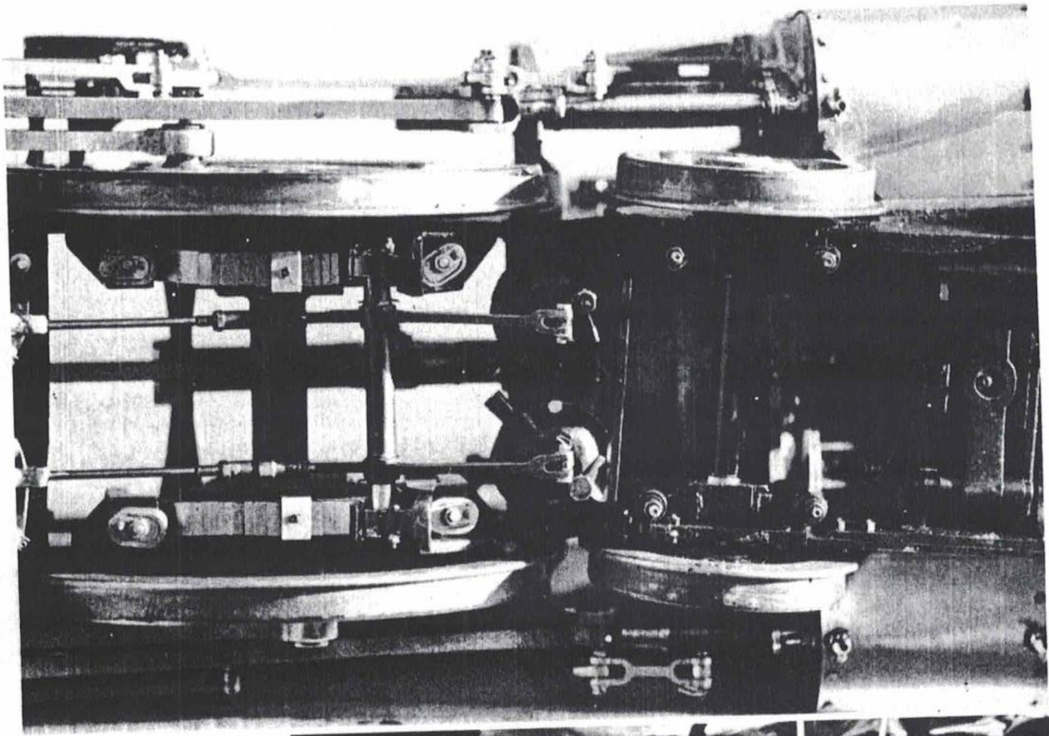
Mark off, saw out and file the flap plate to line, checking that the top is an easy fit inside the door opening, then chuck a length of 3/32 in. or preferably 2.5mm square bar and turn down to 1/16 in .diameter over an 1/8 in. length at one end. Sit on the flap plate, mark on the length of square bar to suit, saw off at a full 1/8 in. longer for the spigot, rechuck, face to length and turn the spigot as before. Clamp the hinge bar to the flap plate, drill in the five positions indicated at No. 57 and secure with 3/64 in. snap head rivets, flattening the heads a bit to be authentic.

The flap hinge blocks are from 1/8 in. square steel bar; first mark off and drill the No. 51 hole, then file on the profile. Mark off and drill the pair of No. 57 holes, countersinking for 3/64 in. rivets, then radius the ends. Offer flap and hinge blocks up to the door, clamp in place and check for freedom of movement before drilling through and rivetting in place.

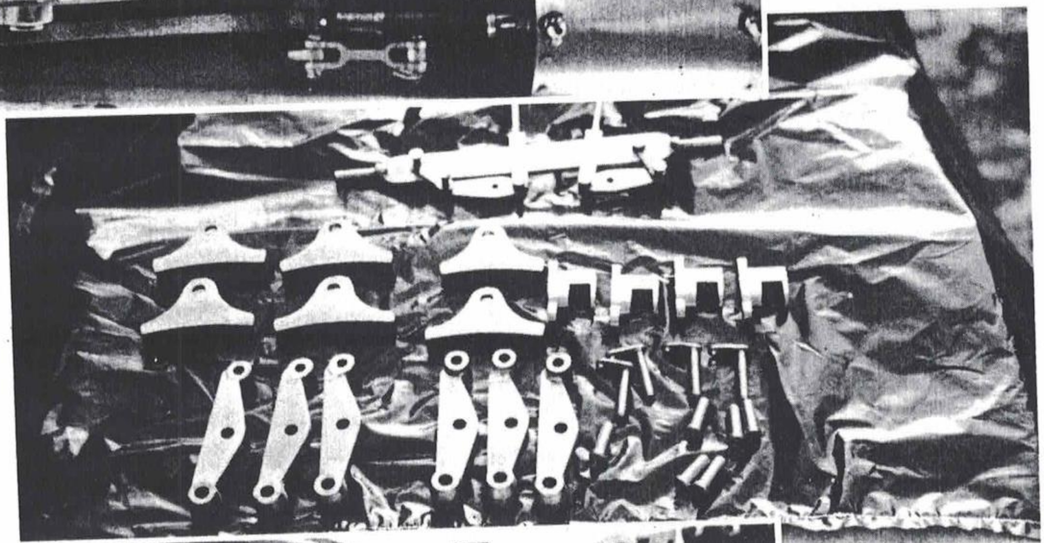
Ratchet hinge block next, so chuck a length of 5/32 in. square steel bar truly in the 4 jaw, face and turn down to 1/16 in. diameter over a 3/32 in. length. Remove to the machine vice to cross drill No. 51 as shown, saw off to length, cut the slot for the ratchet lever and then radius the end with a file. Drill the No. 51 hole in the door, fit the hinge block and peen over the spigot. The ratchet itself is best bent up from 3mm x 1mm steel strip, although it can be cut from sheet. Drill the No. 51 hole, fit to the block with a brass snap head rivet, then file a notch on the top of the flap at around 45 deg. Now concentrate on the ratchet, cutting notches so that when the flap is pushed in at the bottom, on release the ratchet engages positively. You then simply lift the ratchet with your shovel in service and the flap closes automatically.

Main Hinge and Block

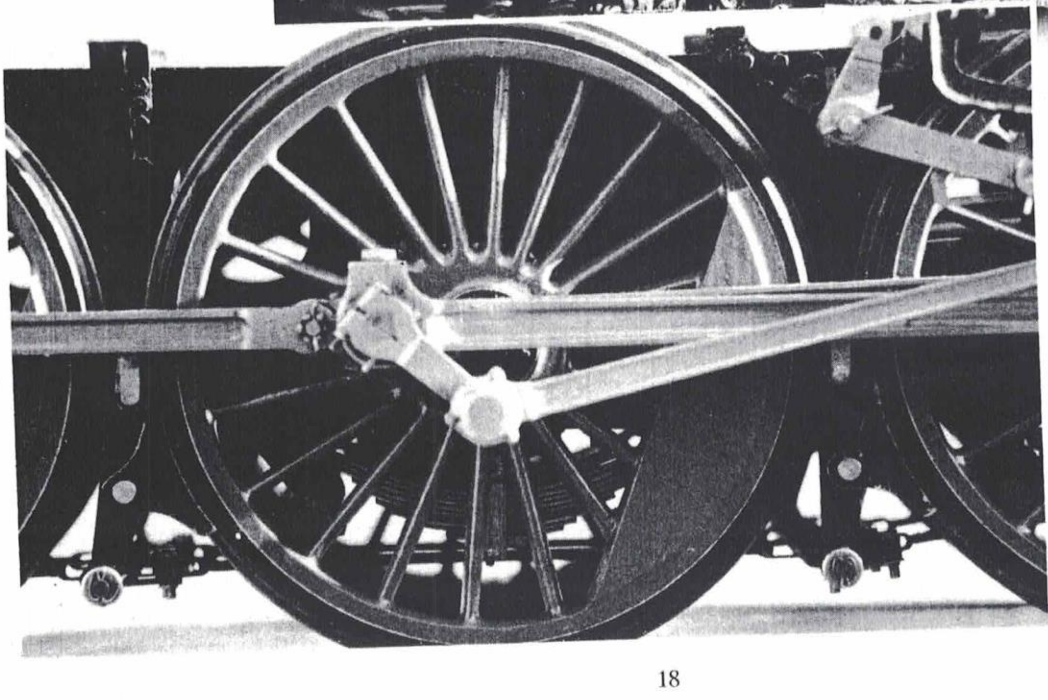
Although the base of the hinge block is shown 2.5mm thick, it would be wise to make this from 3mm material in the first instance, this to allow for some adjustment to place and increasing the 1/4 in. dimension to 9/32 in. to match. For the hinge bosses, chuck a length of 5/32 in. rod in the 3 jaw, face, centre and drill No. 47 to 1 in. depth, parting off a 7/8 in. slice. Now all you have to do is make the end webs, as a pair, to support the hinge bosses when you can clamp together and braze. Although you can saw away the redundant portion of hinge boss, final fitting should await the mating hinge, but do drill the trio of No. 41 holes.



The area behind the cylinders begins to fill up with the addition of the brake gear



A selection of the brake gear parts which Bill tells me assemble without any snags, so maybe I am learning at last!



It is thrilling to inspect a photograph such as this and thrill over the detail remembered from over 30 years back full size

For the hinge, chuck the 5/32 in. rod again, face, centre and drill No. 47 to 5/8 in. depth, parting off at 17/32 in. overall. Cut a piece 17/32 in. x 5/16 in. from 1.6mm material and chamfer the edge to suit the hinge boss; braze up. Clean up and check the 11/32 in. dimension, then mark off and drill the three No. 44 holes.

We need the hinge pin before we can swing the door, so chuck a length of 5/64 in. rod and tidy up the end to drawing, so it will easily align the No. 47 holes. Part off at 1 1/16 in. overall, then rechuck the 5/32 in. rod, face, centre and drill No. 48 to 1/8 in. depth, parting off a 1/16 in. slice. Press this onto the end of the pin, braze and then turn the head to drawing.

Assemble the hinge to the door, erect the hinge block with its pin and sit on the backhead, getting the door nice and central to the firehole, then adjust the base of the hinge block as found necessary before spotting through, drilling No. 48 and tapping 7BA. I would recommend phosphor bronze studs rather than screws or bolts to secure the hinge block, so chuck a length of 3/32 in. rod, face and screw 7BA for a full 5/32 in. length. Part off at 3/8 in. overall, chuck a 7BA screwed adaptor, fit the embryo stud, face off to length and screw again to leave a full 1/16 in. of plain rod. Fit two thin nuts to this end of the stud, tighten together and then use the spanner on the outer nut to screw hard into the backhead. When tight, transfer the spanner to the inner nut and continue tightening to release; repeat. Assemble the door once more and we must deal with its closure.

Latch and Knob

For the latch, start with a 1 3/4 in. length of 4mm x 1.2mm steel strip, bent at the top to drawing, then mark off the ends of the slots and drill No. 47. Use a swiss file to break the holes into a slot, then file the profile around them to arrive at the 7/32 in. width. If you have some 8BA hexagon bolts with about 1/16 in. of plain under the head, these will be fine for fixing the latch to the door, otherwise make a pair of these, or alternatively 8BA studs. Ease the slots in the latch to a nice sliding fit and assemble, though check the 1 1/2 in. overall dimension first and adjust if required.

The knob is simple turning from hexagon bronze rod; with the latch fully raised, site said knob about 1/64 in. below its lower end. Centre pop, drill and tap the backhead 6BA and screw in the knob. Now you have to bend the latch roughly as drawn until the latch drops into the recess in the knob when the door is fully closed; try throwing the door closed to check that the action is perfect every time, as you will be using the door very frequently at the track. I say the latter with the 'little and often' fireman in mind, for if the firebox were filled there is no knowing how far DONCASTER would travel on one firing.

Backhead Cleading and Tray

In 5 in. gauge the backhead cleading will handle perfectly well in one piece, not so of course full size, so we can omit the tapping strip and its attendant problems if we choose. Remove the firehole door in the first instance, take your piece of .7mm thick steel sheet and very carefully tap around the boiler bushes to faintly mark them on said sheet. Clamp the sheet to a block of hardwood under the drill and centrally in the cut-outs drill 1/4 in. diameter at the largest. Now it is simply a case of filing out to be a good fit over the bushes.

At the firehole ring, gently tap again to reveal the profile on the cleading sheet, once again cutting and filing to line, or rather 1/8 in. larger all round and taking in the hinge block. Now you have to tap around the opening to form an 1/8 in. deep flange; you can either make up a former for this or simply tap over in the bench vice. To complete, mark off and complete the outline as shown, including of course the cut-outs for the regulator shaft brackets.

Before we can erect the cleading we need the oil tray, it was good for keeping black tea warm too! The tray is from a piece 2 7/16 in. x 13/16 in. from 1mm thick steel sheet. Make up a hardwood or metal former, vee notch the two outer corners of the tray and with a wooden or soft faced mallet, flange up and trim to size. The lugs are from 1/8 in. or 3mm x 1.2mm steel, bent to place and either rivetted or brazed to the tray. Drill the lugs to drawing, offer up to the cleading, drill through and rivet to place.

I would suggest using 1/8 in. thick asbestos, the dust supressed stuff available from Reeves, to space the cleading from the backhead, when we can attend to the surround. The recommendation is that the surround be made in four pieces; from the top centre line down to the end of the curve, and the two straight pieces. It is also very worthwhile making up two hardwood formers, no handing to worry about here, over which to flange the surround with the usual gentle tool. I would be very tempted to use small self tapping screws to attach the surround to the backhead cleading, the slotted head type might just pass, though the Philips head type would definitely look incongruous. The alternative of course is to use 10BA screws and nuts.

Turret

Forty years back I assisted in the making of an all brass boiler for a 5 in. gauge locomotive, one that was still perfectly safe in a stationary capacity as late as 1975. Why then in 1987 will I not even specify brass for boiler fittings? There are two main reasons, the first being that the composition of brass rod available today is of higher zinc content than in 1947; then it was usually 70/30 and now much is 50/50 (Copper/Zinc). The other main change is that rainwater that we gathered back in 1947 was relatively pure; in 1987 it is 'acid' more than likely. For an item such as the turret, if a good bronze is not available, then copper is the alternative.

Start with a 1 1/4 in. length of the 1/2 in. square chosen material, mark off and drill right through at No. 11, taking note of the position of the hole in the bar. Tilt the bar over in the machine vice and mill the, front, face as shown, this so that the hand wheels on the fittings come clear of the cab roof. On the bottom face, drill a 1/4 in. hole into the main bore, then turn up the steam connection to suit.

Chuck the 1/2 in. square bar again, face, centre and then drill No. 11 to 1/2 in. depth, following up at 9/32 in. diameter to 1/8 in. depth, 'D' bitting and then tapping 5/16 x 40T; part off an 11/32 in. slice. Face, centre and drill this time No. 30 to 1/2 in. depth, tapping the outer end at 5/32 x 40T and parting off an 11/32 in. slice. Radius the edges of the centre piece only, as shown, chamfer all the ends of the bars at roughly 7 1/2 deg. to arrive at the finished item, then clamp together and braze up.

We now have to pack up the turret so that the front face is square to the chuck, then we can mill right across the end pieces, mark off, drill and tap the four holes as specified. Now it is simply a question of radiussing the end pieces to match the centre.

It is always a good idea to screw the steam connection hard into the boiler bush to so orientate the manifold that it tightens in its correct spot, then you can forget about fitting washers of dubious merit to correct things. If you find you have no alternative then a copper washer is the best, fibre next and aluminium a long way behind.

Whistle Valve

I am not very partial to whistle valves where you have to dive your hand into the cab, probably touching something very hot on the way, to grab a lever and push it down. I much prefer a whistle cord stretched to the back of the cab roof, a cord that you simply grab and pull; you can play a tune much better that way too! Seriously though, although you should be prepared to stop at any time on the track to avoid accidents, the whistle does have its use in the cause of safety. Also, as track lay-outs become more complicated and signalling centralised, there is a need for a whistle code to make sure you go the way you want to.

reaming 3/32 in. diameter, then follow up with a No. 23 drill and 'D' bit to 5/16 in. depth, tapping the outer 3/32 in. or so at 3/16 x 40T.

For the steam chamber, it is important to align the gland with the push rod; mark off at the bottom, centre, drill and ream through at 1/8 in. diameter, tapping the bottom 1/8 in. at 5/32 x 40T. I now suggest you chuck the body in the 4 jaw with an 1/8 in. reamer in the hole and set to run true, then you can drill No. 12 and 'D' bit 3/16 in. diameter to 1/4 in. depth, tapping at the top, 7/32 x 40T to 3/32 in. depth.

Now for the drilled passages and this time we can start with the steam ones. On the rear face, 9/64 in. down and in line with the steam valve chamber, mark off and drill through at No. 42. The steam inlet union I have shown merely sitting on the top face can of course be spigotted as for the train pipe one to positively locate it, though this is a decision I can safely leave to builders; turn up the union and connect No. 42 with the main passage. We need a number of plugs to fill redundant portions of drilled passages, for which brass rod is ideal; cut a piece 13/64 in. long from 3/32 in. rod and blank the end of the No. 42 passage.

At the front, we need a No. 51 hole to connect from the steam valve chamber to feed the small jet; drill from the outside, 1/8 in. down, and again plug the redundant hole on the outside. Move down 11/64 in. and drill another hole, this time No. 42, into the main cone chamber. This hole does not come fully into the chamber, so fit an odd end of 3/16 in. rod into same and clamp it firmly in place before drilling, then you will have another redundant hole to plug on the outside; both the latter are shown clearly on the rear cross section. That completes the plugging, so at this point they should all be sealed with silver solder, the steam connection too, when if you drop it hot into the pickle, the excess flux will break off and a few minutes will suffice before washing off and cleaning.

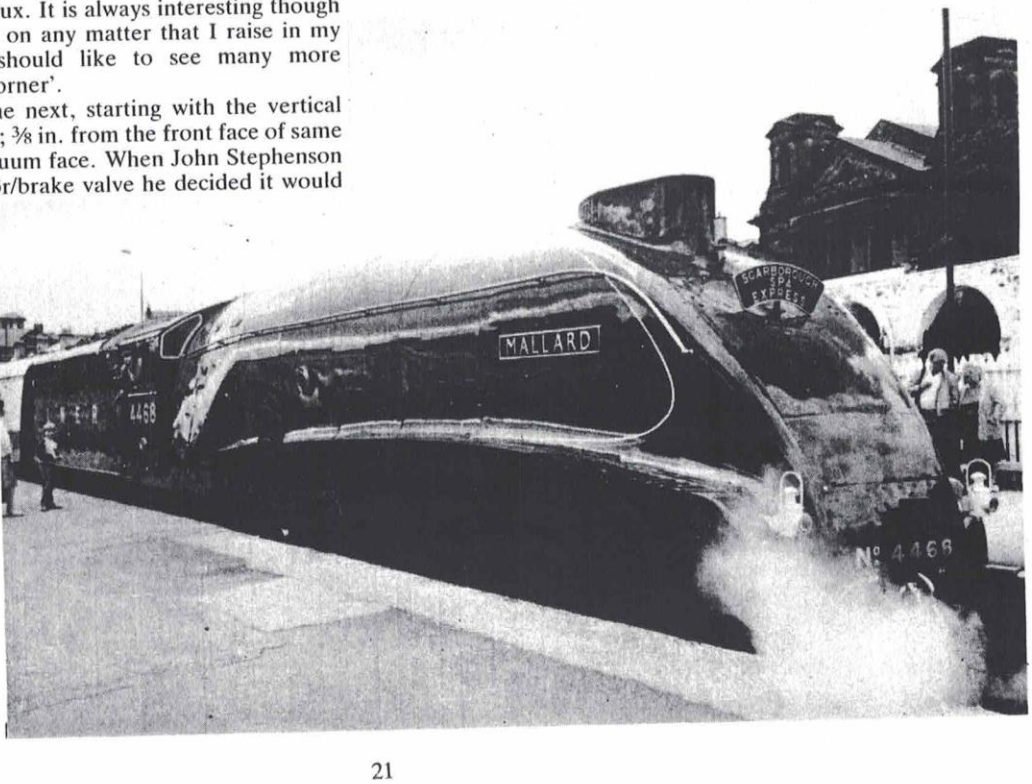
I had an interesting correspondence with Bill Treadway of Bristol, Conneticut about pickling; Bill reckons it should always be done cold, which I agree is much the safest way. Bill uses a pickle of strength that would get me into trouble if I were to specify same in LLAS, it is suitable for dissolving bodies, human as well as foreign ones!, whereas with the strength of pickle I must advocate, some heat is necessary to help get rid of the excess flux. It is always interesting though to have another viewpoint on any matter that I raise in my series, which is why I should like to see many more contributing to 'Builders Corner'.

The exhaust passages come next, starting with the vertical one right through the body; 3/8 in. from the front face of same and 5/32 in. in from the vacuum face. When John Stephenson in Hull first saw the ejector/brake valve he decided it would be suitable for the Club locomotive. Three months later he reckoned the valve would be fitted to one of his pair of A3's; John reckons there is a lot of work involved!, but he was able to highlight a couple of errors on my part, ones which have now been corrected, in fact two were resolved with but a single alteration. Originally I had drawn the train pipe connection identical to that for steam and of course there was no way in which to machine the air valve recess. The other point was that the release valve fouled the train pipe connection when it was being screwed in, but if the release valve is now fitted ahead of said connection, as is now possible, it can stay where I have drawn it and preserve the overall neatness. Mark off the vertical passage and drill right through at No. 51. Open out to No. 48 and 1/8 in. depth at the top to tap 7BA, then turn the body over, drill No. 22 to 3/16 in. depth and tap 3/16 x 40T. The dummy air valve is a bit of fancy turning, the 'pepperpot' will add the final touch, and there is a 3/32 in. long spigot screwed 7BA for attachment to the body.

Next hole is 3/16 in. down on the vacuum face and in line with the vertical passage, again No. 51 and continuing into the small cone bore. We now come to the most difficult hole of all, the main air one, and I have not made the start all that easy with the 7/32 in. dimension from the previously drilled one at 45 deg., but there is very little I can do about it. The hole has to be drilled at a compound angle, going forward by 5/32 in. on it travels and downwards by 13/32 in., though of course there is a little latitude as the hole in the train pipe connection can be drilled to suit your end result. For a 'one off' hole like this. I would set up an odd end of material in the first instance and have a dummy run; too much work has been done on the body to spoil it now! When all is well, transfer to the actual body and we only have one more passage to drill, that from the vacuum valve chamber down to the main air passage just dealt with. Centre pop just below the threads in the chamber and drill down; here you can correct a wee error with a 1/16 in. end mill. I had better hurry along with fitting out before space runs out.

Cones

Before manufacture we require two cone reamers from 5/32 in. silver steel rod, the first with a taper 3/8 in. long and the second 3/4 in. long; harden and temper.



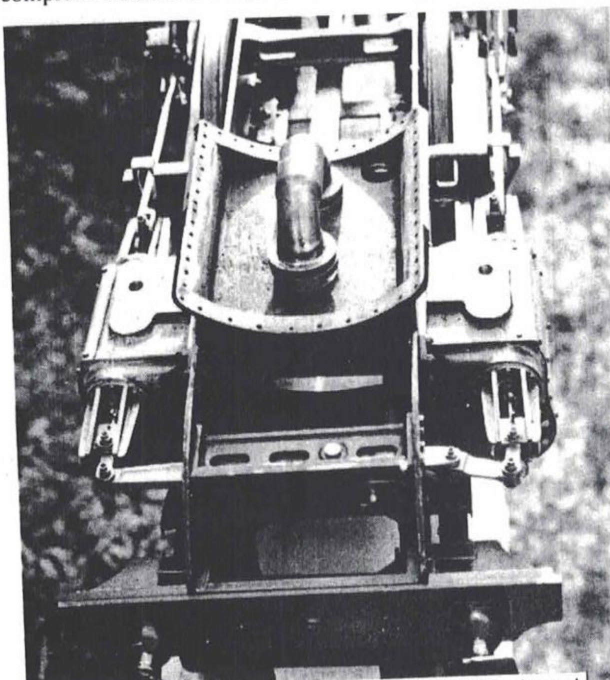
Bill played truant from his workshop long enough to capture MALLAND on film for us at York; doesn't she look grand

For the small cones, chuck a length of 5/32 in. brass rod, face and then turn down to a press fit in the body over a 7/16 in. length. A pin chuck is very useful from now on, so use same to lightly centre, then drill No. 62 in small increments to 7/16 in. depth. Chamfer the nose down to 5/64 in. diameter, then with the stubby reamer, open out the mouth until you have a knife edge. Part off at a full 25/64 in., reverse and face off to length, then use the 3/4 in. reamer to open the mouth out to .085 in. diameter. Press this cone into the body from the front end. For the steam cone, chuck the 5/32 in. rod again, face and then turn down to a press fit over a 19/64 in. length, then relieve the next 1/8 in. or so to be an easy fit in the cone chamber. Again chamfer the end, this time to 3/64 in. diameter, then centre and drill No. 80 very carefully to about 1/4 in. depth before using the stubby reamer to get a sharp edge. Part off to leave a full 1/16 in. thick head, reverse and face off to length, then centre and drill No. 50 to 3/16 in. depth. Erected, there will be a 1/32 in. gap between the cones, one which you should be able to check with 1/32 in. wire through the passage to the vacuum side of the body. The main cones each have heads, being turned from 3/16 in. rod to the dimensions shown in the same manner as the small ones. I described how to make wee caps for GEORGE in LLAS No. 30, so make up and fit one at the end of the main cone chamber, when we can attend to the small jet valve.

Small Jet Valve

For the small jet valve stem, chuck a length of 7/32 in. A/F hexagon bronze rod, brass will do at a pinch, face, turn down to 3/16 in. diameter over a 9/64 in. length and screw 40T. Centre and drill No. 48 to 3/8 in. depth and tap the outer 5/32 in. at 7BA; part off at 9/32 in. overall. Chuck a 3/16 x 40T screwed adaptor, fit the stem to same, then turn down with a round nose to 9/64 in. diameter and screw 4BA.

The valve is from 3/32 in. stainless steel rod, so chuck, face and turn down to 1/16 in. diameter over a 3/64 in. length, then reduce the next 5/16 in. to around 5/64 in. diameter, a nice fit in the No. 48 hole in the stem. Screw a full 1/8 in. or the original rod at 7BA, then part off at the 7/32 in. dimension, forming part of the valve itself in the process, then rechuck and complete. Assemble the pieces, make the gland nut and pack



Bill is assembling the exhaust system prior to fitting the blastpipe and nozzle

Just to change the scene, this MARIE ESTELLE was built by Bob Paule and Fred Ellis to promote my design in the USA, through Power Model Supply Co.

it when we have just the handle. I would mark off on a piece of 1.2mm brass sheet, the boss being 1/8 in. diameter and the spoke 3/16 in. long at 3/64 in. diameter. Drill the boss centrally at No. 53, then saw out and file to line before pressing on to the end of the spindle.

Main Steam Valve

Main steam valve next, for which we first need a 5/32 in. rustless ball and a cap with a wee indentation in same to give the ball sufficient lift. The push rod is a 21/64 in. length of 1/16 in. stainless steel rod which brings us neatly to the gland.

Many of the commercial valves I sold latterly used PTFE rod packing, the friction of which was extremely low, so this will be ideal for the gland. Chuck a length of 5/32 in. rod, face with a very sharp tool and screw 40T over a 3/16 in. length with the die slightly opened. Centre and drill No. 52, then part off an 1/8 in. slice leaving a wee pip on the end as shown. Although you can saw to make a screwdriver slot, I always use a file tang to screw in the gland, when little if any damage results. Now you can try the push rod again and ease the fit if necessary by putting the No. 52 drill through again. I think we should now attend to the vacuum side before adding the cams and their spindle.

Air and Isolator Valves

The vacuum/air valve is a plain 1/8 in. rustless ball, operated by a 17/64 in. long push rod, 3/32 in. diameter with two flats filed on to allow air to pass. The cap has a recess for a 3/32 in. o.d. x 26 s.w.g. spring of about 5/16 in. free length, though you will have to finally check this to place and in service.

The isolator valve body starts life as a 9/16 in. finished length from 5/16 in. x 5/32 in. brass bar. Mark off, centre, drill No. 53 and ream the 1/16 in. hole right through, tapping the end 1/16 at 8BA for a hexagon plug. Mill down to reveal the bolting flanges which are 1/16 in. thick, marking off and drilling the four No. 51 fixing holes. We now require a further pair of holes, drilled No. 60, to complete the circuit; remove any burrs in the main bore. The valve is a 3/8 in. length of 1/16 in. stainless steel rod, the return spring from 28 s.w.g. wire and working length checked to place, so that the valve follows its cam. Clamp the isolator body to the main body, spot through, drill and tap 10BA to 3/32 in. depth.

Before fitting the isolator valve, we have to make a cover to enclose the bottom of the air valve, the plate being from 1.6mm sheet, with a 11/64 in. x 1.2mm closing strip. I suggest you make this up and then mill the mating 1/16 in. recess in the main body to accept the cover, using a length of 3/32 in. rod to check alignment of the spindle, then drill, tap and secure with 10BA countersunk screws.

Operating Gear and Handle

We now come to the bits that control operation of both the main ejector and brake, starting with the spindle, a 61/64 in. finished length from 3/32 in. stainless steel rod, with the end 5/64 in. reduced to 1/16 in. diameter and screwed 10BA. Cams next, so chuck a length of 1/4 in. steel rod in the 3 jaw and reduce to 15/64 in. diameter over a 3/4 in. length. The .042 in. offset hole at No. 43 is critical, so I suggest you transfer to the 4 jaw and use a d.t.i. to check when the rod is running .084 in. eccentrically, then centre and drill No. 43 to the same 3/4 in. depth; part off three 5/32 in. slices.

Press one cam onto the plain end of the spindle and you can check the steam valve operation, only the ball will not reseat unless you apply air pressure to the chamber. Now press the brake valve cam onto the spindle, erected to the body of course, and it wants to be 180 deg. from the steam one, so there is a dwell between the steam valve closing and the air valve opening; you may have to slightly adjust the length of the push rods to achieve this. Fit the cover, and remember to drill an air hole in it, then press the isolator cam on in exactly the same orientation as the air valve one, only the latter is hidden, so you will have to mark the cover as a check.

Handle next, and this is a clever bit. Take a 1 3/4 in. length of 3/16 in. x 1.2mm brass strip, drill a No. 43 hole at one end and radius, then reduce the rest of the strip to 1/8 in. width and bend as shown, checking to the actual body that there is clearance as the handle comes within the body. Chuck a length of 5/32 in. brass rod, face, centre and drill No. 31 to 5/8 in. depth, parting off 1/16 in. slices. Press them onto the handle to the spacings as shown, then silver solder to complete. Now press the handle onto the end of the spindle, in line with the isolator valve cam, so the handle is up for ejector and down for brake.

Release Valve

Chuck a length of 5/16 in. square brass bar for the body in the 4 jaw, off centre so that it just cleans up to 7/32 in. diameter, face and turn on a 17/32 in. length. Centre and drill No. 43 to 17/32 in. depth and ream 3/32 in. diameter then follow up with a 5/32 in. 'D' bit to 3/8 in. depth and tap the outer 1/8 in. at 3/16 x 40T. Part off at 45/64 in. overall, mill down the two side flanks to match the body, then slot the end at 3/32 in. to match the lever you have made to drawing. Cross drill No. 51 for a 1/16 in. snap head brass rivet as the fulcrum pin. The push rod is a 3/16 in. length of 3/32 in. stainless steel rod, with two flats filed on it to allow air to pass.

The end connections are from 7/32 in. brass rod, fashioned to drawing and scalloped to suit the body; use a 3/32 in. rod to align the three pieces for silver soldering. The release valve lever must be to the rear to operate, so screw into the main body and orientate prior to brazing. Seat an 1/8 in. ball, turn up the cap with a No. 41 hole to accept the 3/32 in. o.d. x 28 s.w.g. spring, which wants to be about 3/8 in. free length.

Train Pipe Connector

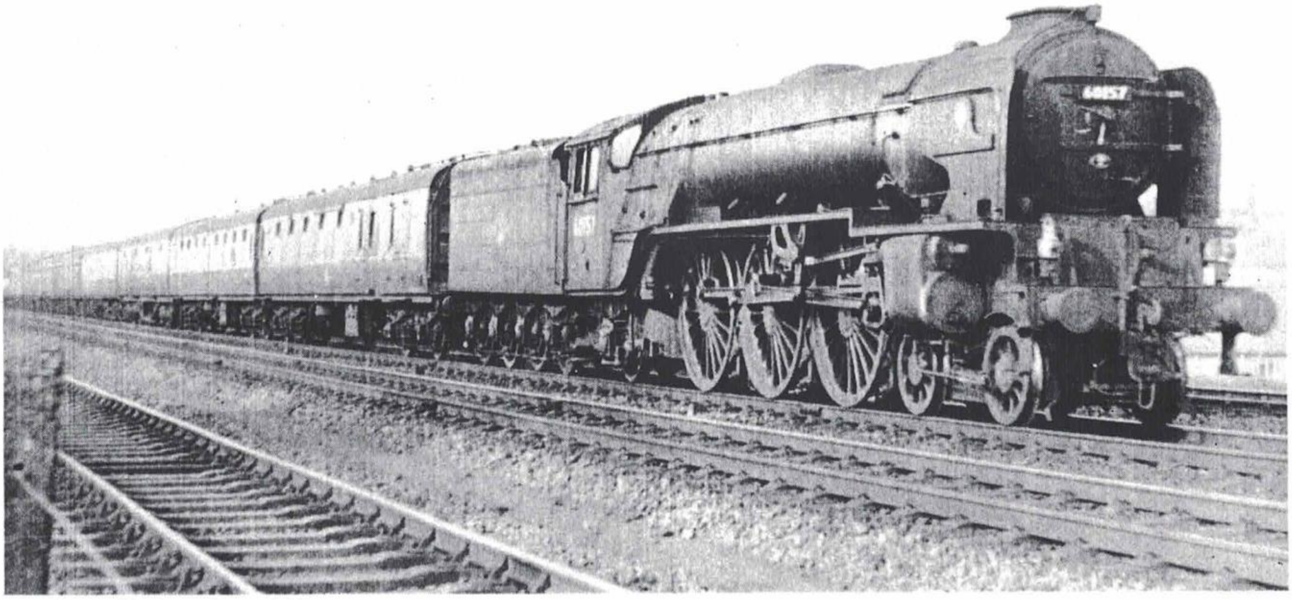
John Stephenson came all the way to Llanuwchllyn last September, fracturing a camshaft on the way, to show me the folly of my ways in not making the train pipe connection separately so that the ball valve seat could be machined. John favours securing the connection with Loctite and I was inclined to agree, but now I think I would prefer a pressed fit. So chuck the 1/4 in. brass rod, face, turn the spigot to your chosen fit over a 21/64 in. length; centre, drill No. 43 to 5/8 in. depth and ream at 3/32 in. diameter. Part off to leave 3/16 in. of original bar, rechuck, face and screw 40T over a 5/32 in. length; fit to the body once the release valve is in place.

Exhaust Tube

There are two conditions to be met with the tube; it must be thin enough not to interfere with small jet exhaust, and thick enough at the outer end to accept a 32T thread. My solution is a 1 1/16 in. finished length of 3/8 in. o.d. x 22 s.w.g. copper tube with a ferrule brazed in the outer end to accept the thread, though it could just as easily be machined from 3/8 in. brass rod. The flange is cut from 1.2mm brass sheet, though I recommend you clamp the sheet to a hardwood block first to drill the 3/8 in. hole, the No. 44 ones too, when you can saw and file to line. Braze to the exhaust tube, chuck and lightly face, and we can erect to the cab.

Although Sheet 15 is the last of the Drawing set, I reckon there will be a few bits and pieces remaining to make a Part 16, such things as pipework and A4 variant details.

Whilst Tom Greaves was helping me arrive at an authentic DONCASTER, he also suggested that I prepare the design for a Peppercorn A1 'Pacific', in particular 60156 GREAT CENTRAL, reinforcing his suggestion with photographs. I worked on GREAT CENTRAL and indeed went on trials with her, so the idea is attractive, though after DONCASTER it will be some time ahead before GREAT CENTRAL takes form on my drawing board.



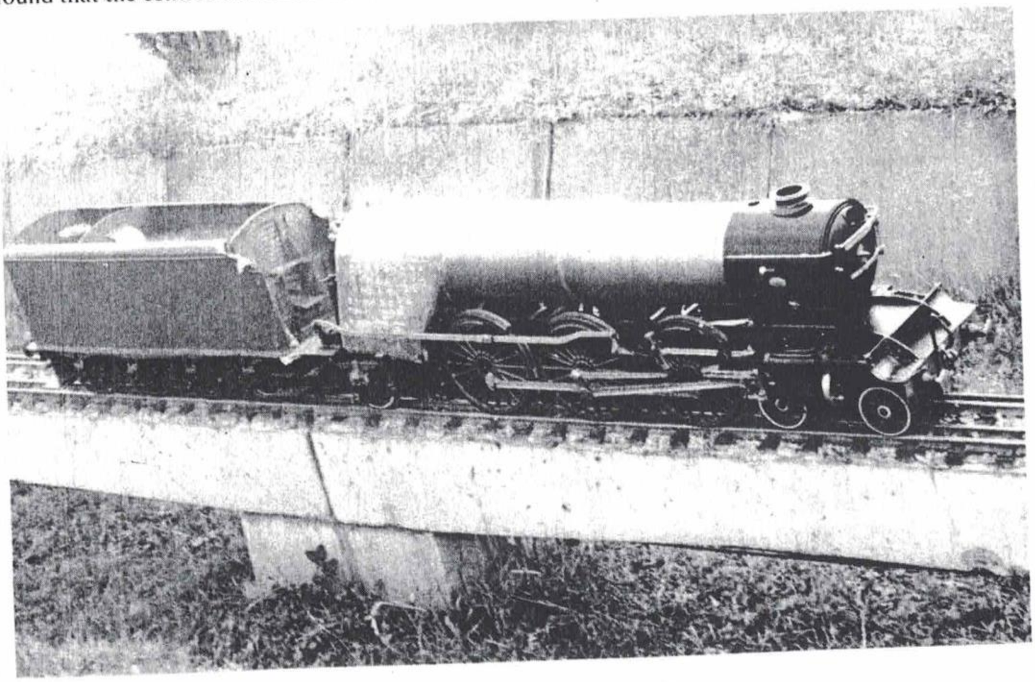
Doncaster — a 5in. gauge Gresley A1/A3 'Pacific'

by: DON YOUNG

Part 15 — Concluding details, later variants; GN Tender Body
Although all the A3's I came into contact with were very much admired, my own particular favourite was HUMORIST and this is the engine I originally intended to draw. When referred to Allan Garraway though, he very soon put me straight, saying HUMORIST was very much a 'one-off' engine for most of her life and that she was always attached to a GN style tender, and we don't like GN tenders do we Don?! In my other ear, Tom Greaves was telling me that the A3's were never better than in their final years when fitted with the Kylchap exhaust. As DONCASTER herself was for a short period fitted with a double chimney, minus deflectors and trailing a GN tender, then for the sake of completeness and to allow builders a full choice of engines, then these details are included.

Kylchap Draughting
On my own, I fitted the lipped pattern double chimney to HUMORIST in 1952 and reckoned it looked infinitely better than the stovepipe it replaced, though aerodynamically the lip was certainly inferior. For those building DONCASTER in her later years, our chimney casting will require a very minimum of machining, so first tidy up the top and bottom faces to be flat. On the sample casting I tried, I chucked in the 3 jaw at the bottom, the jaws just clearing the second 'pipe', when I bored right through to 1¼ in. diameter. The full size chimney has an upper taper of 4 deg., whereas Ell taught me that 2 deg. was better, though as this is a multi-stage exhaust, I doubt if much difference would be detectable between the two angles. Set the boring tool over to your chosen angle and open out to 2 in. depth to form the choke. On the first bore, I tried setting the tool over 5 deg. to bore the bottom at the same setting, but the chuck body got in the way, so I instead rechucked by the upper bore and dealt with the bottom, including that final radius. Dealing with the second bore and again chucking by the unmachined outside of the casting, I found that the centres came out at 1.621 in., which is as close to 1⅝ in. as we need worry about. All you have to do now is complete profiling with files and emery cloth; only the joint really requires the services of a file.
I should have said the chimney is almost complete, for there are lugs to be brazed on to accept the 4BA studding. Cut four pieces ⅜ in. square from 3/16 in. or 5mm brass sheet and drill them centrally at No. 27. Next chuck a length of ¼ in. brass rod, face, centre and drill No. 27 to ¾ in. depth before parting off two ¼ in. slices; repeat. Bring the exhaust box up to the base of the chimney, locate the lugs by means of the spacers and bolt through, easing the lugs if required. It would be as well to remove the exhaust box before silver soldering, so clamp over the lugs to hold them firmly in place.
You can now mark off and cut the smokebox shell to accept the chimney, allowing 3/32 in. all round for adjustment later on, except in way of the lugs; now we come to the clever bits.

Exhaust Box
I sure got caught out in assuming the exhaust box was made ahead of the chimney, but we can now quickly correct my error of assumption.
Instead of the circular flange on the saddle pipe, this time the base of the exhaust box is a 1¼ in. x 1 in. piece from 3mm brass or steel, and for the fabrication I would prefer brass in this instance. Find the centre of the base by the 'x' method, centre and chuck to run truly in the 4 jaw, then centre, drill and bore out to 13/16 in. diameter before tapping or screwing ⅞ x 26T. The backnut is from 1 in. A/F hexagon brass bar and wants to be ⅛ in. thick, again tapped ⅞ x 26T. Erect to the saddle and adjust for the baseplate to be correctly orientated.
The exhaust box top plate is shown as a separate detail. Mark off on a piece of 3mm plate, a piece you have checked is nice and flat, then I suggest you grip in the machine vice, on the vertical slide, to accurately drill the pair of exhaust holes and you can vary their centre to suit your chimney, when you can



I finally caught up with Bill Holland's CALL BOY at Bellany Green on the occasion of the 5th DYD Rally and found much to enthuse over.

deal with those outrigger ones for the alignment studs, but leave those for the nozzle fixings until the latter have been made. Before assembling the top plate permanently, use it as a jig for both the lugs on the Kylchap nozzles and skirt; you may also use it for the chimney in this state.

Assuming the last sentence has been carried out, we can now build up the exhaust box, cutting the pieces and fitting to place from 1.6mm sheet. Next turn up the entry flange from the middle cylinder exhaust, offer up and drill the side of the box to suit, or perhaps it would be easier to bore the plate out to size. That leaves the deflector to direct some exhaust from the outside cylinders towards the back of the box, such is vital to maintain an even draught. Make the deflector a couple to thous longer than an exact fit, so it can be clamped very firmly into position, then if the box is from brass as I have recommended; pickle, wash off, flux and braze up. Getting at the ends of the deflector is not easy and in doing so you are likely to get some of the spelter on the bottom threads, so after pickling and cleaning, tap out again before erecting. For aligning the chimney, take two 6 in. lengths of, say, ¾ in. diameter steel bar, chuck in-turn in the 3 jaw to face and turn down over a ¼ in. length to ½ in. diameter at one end, a good fit in the top plate of the exhaust box. Now align the chimney to the bars with calipers before fixing the chimney to the smokebox shell with 10BA bolts.

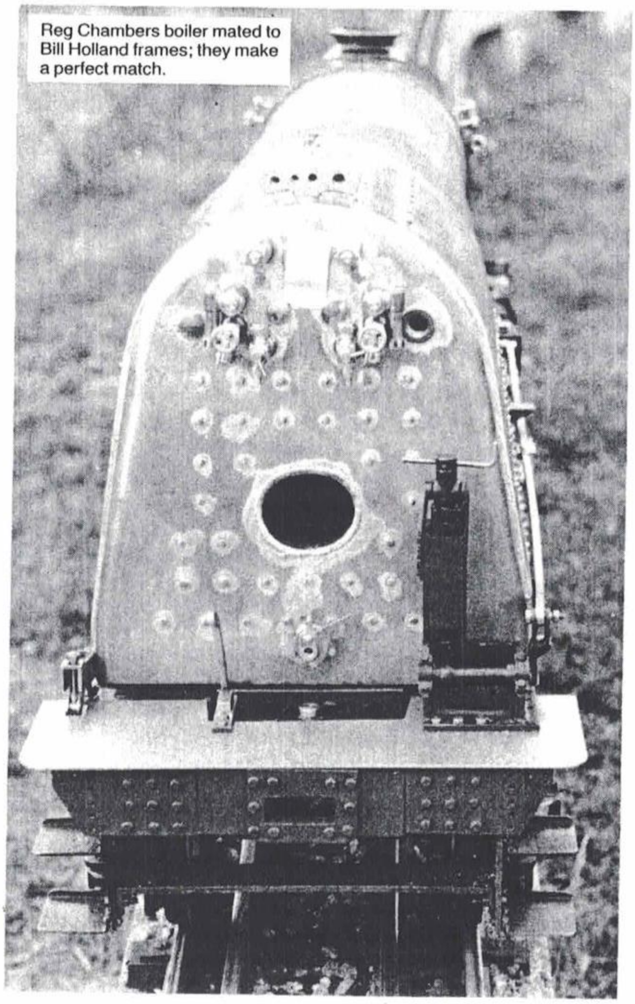
The skirt, or intermediate petticoat pipe, is made from 1⅛ in. o.d. x 20 s.w.g. copper tube, though I must admit that on my trial sample, I had zero success in belling the end. So I turned up a ring 1¾ in. o.d. x 1 in. bore and 3/16 in. thick from brass, silver soldered it to the tube and then turned to drawing; much better this than the tube jumping out of the chuck! I did not worry about the lugs as I was not trying to complete the Kylchap system, but do silver solder these on at the same time as the ring, as they do not get in the way when turning; thin tube must always be chucked by its bore.

The Kylchap nozzle is difficult to describe, even from my drawing detail, and if you get the opportunity to see MALLARD, SIR NIGEL GRESLEY, or any of the other A4's with smokebox door open, then a look inside will save you hours of head scratching. As an alternative, on Page 39 of MY FIRST 50 YEARS WITH STEAM shows the arrangement on COCK O' THE NORTH; all DONCASTER builders will find my book very useful said he with sales hat on!

Turn the skirting up from 1¼ in. diameter copper or stainless steel bar, to form the base for the nozzles as a first step. As there are four nozzles and they want to be closely identical, we must think in terms of a wee jig. Chuck a length of ⅞ in. diameter steel bar face and turn down over a full 1 in. length to 25/32 in. diameter, parting off a 15/16 in. slice. Use a 3/32 in. thick slitting saw to cut first into halves, then one of the pieces in quarters to provide our embryo jig, one which now needs the flat faces filed to a taper and the ⅛ / 3/16 in. dimension indicates there is some latitude here. Stainless steel to specification EN58J is soft and can be formed over the jig, otherwise use copper, and in either case you silver solder the seam. Match the four nozzles to the skirting, add the pair of lugs and silver solder the complete assembly.

All the parts made thus far can now be erected as a check, but before doing so permanently we require the pair of blast nozzle/blowers.

For the blast nozzle body, chuck a length of 1 in. square brass bar truly in the 4 jaw, to first face across and then centre to follow up at 5/16 in. diameter to 7/16 in. depth. Turn the outside down to 25/32 in. diameter over a 9/32 in. length, a good fit in the blower tube, then use a parting off tool to cut the steam belt ⅛ in. wide down to 9/16 in. diameter. To complete the outer profile, reduce the nozzle to 15/32 in. diameter at the top and roughly a 30 deg. angle. Part off at a full 11/32 in. overall, reverse and face to length. At this setting, set your wee boring

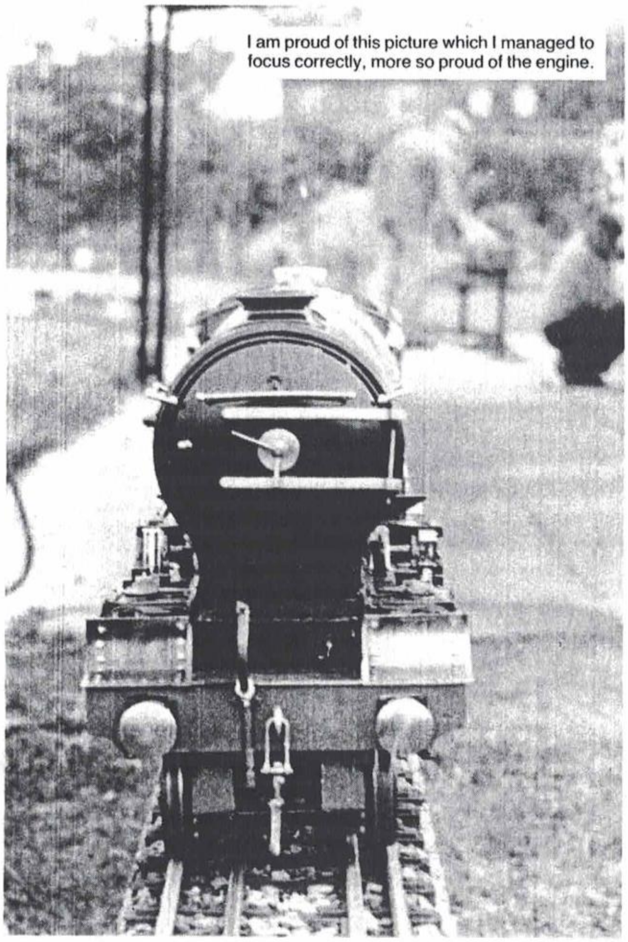


Reg Chambers boiler mated to Bill Holland frames; they make a perfect match.

tool over about 13 deg. and open out the blast nozzle until the diameter is 11/32 in. at the top; the ½ in. diameter at the base is only nominal. Part off a 3/16 in. length from ⅞ in. o.d. x 20 s.w.g. copper tube for the blower belt and turn up the union connection of a length to come clear of the Kylchap equipment, and we have to consider whether to fit those Goodfellow tips at the top of the blast nozzle.

These tips, as well as splitting the exhaust to match the Kylchap nozzles, also alters the angle of divergence of steam from the blast nozzle, so are doubly worth fitting, though mighty difficult to achieve. Chuck a length of ⅜ in. bronze rod in the 3 jaw, face and then set the tool over 13 deg. to match the nozzle bore. Turn to a tight fit for the rod to be flush with the tip of the blast nozzle, then part off a 3/32 in. slice. Mark off for the four tips and file them triangular, leaving a roughly 5/32 in. diameter centre boss; braze up the complete blast nozzle/blower assembly. Now drill out the redundant centre of the tips and carefully file to complete to drawing. It would have been better to have scribed on the bolting circle at the base at 1⅛ in. diameter when facing same, otherwise you will have to mark this out now, to drill in the corners at No. 44. Offer up to the exhaust box, you can use a short stub of ½ in. rod for alignment, to drill and tap 8BA; secure with hexagon head bolts.

We almost have our draughting arrangement, not quite though, for we now have to pipe from the middle cylinder into the exhaust box, using three 90 deg. copper bends, a length of ¾ in. o.d. copper tube, plus a pair of flanges to match, all being generally as described in Part 12 for the single chimney.



Superheater End Covers

Although very much an afterthought, or rather necessitated by fitting the larger superheater header, these end covers add rather than detract from the overall appearance of DONCASTER. As our superheater header does not extend through the smokebox shell, then our covers are merely ornamental and we may vary construction accordingly. When I originally drew parts for DONCASTER, it was always with the knowledge of how they were made full size and on reflection there are quite a few possible alternatives. With the end covers as instance, the central cover could in fact be from ¼ in. mild steel or even brass plate, annealed and radiused to match the smokebox shell, then with the 1.2mm flange silver soldered to place. It does add weight where it is not really required, so maybe mill out the centre of the plate to remove some of it, the beauty in using plate being that the radii can be included correctly. The Kylchap exhaust arrangement indicates the upper flange is 1¹¹⁄₁₆ in. distant from the top centre line, whereas the various GA's show the rear flange against the front boiler band, so clamp to place after drilling the 20 holes at No. 44, to spot-through, drill and tap the smokebox 8BA.

Banjo Dome

There were actually two patterns of banjo domes, the first being more in keeping with the description, having an almost circular dome portion, with a parallel 'handle'; I remember them mostly on the V2 class 2-6-2's. To my mind the streamlined pattern looks better on an A3, the casting only requires to be cleaned up to match the cleading, after which drill the No. 41 hole for attachment to the dome; it would be embarrassing should the dome cover fall off when running!

Later Safety Valve Body

Earlier engines were fitted with genuine Ross 'pop' safety valves, but obviously they were outside of the composite LNER gauge. Even with this knowledge, I still got the later valve higher than the original, the now 1³⁄₃₂ in. dimension used to read 1⁷⁄₃₂ in.! Turn the body to the stated dimensions and then fit the internals as described in Part 5, when all will be well. Incidentally, those tiny flanges above the base of the valve body were used for locking the valve after it had been set; this was by means of a wee pin, itself with a lead seal to prevent tampering.

Dummy Whistle

To complete the boiler top, the dummy whistle fits between the rear safety valve and the cab front. Chuck a length of ¼ in. brass rod and turn down to ¹⁄₁₆ in. diameter over a full ⁷⁄₁₆ in. length. Form the next ⅛ in. of rod into the lower bell, followed by the ³⁄₃₂ in. diameter spigot, then part off, reverse in the chuck, to drill and tap 10BA to ³⁄₃₂ in. depth. Chuck the rod again and radius the outer end for the top bell, with just a wee flat for a 10BA nut. Part off at ⁵⁄₁₆ in., reverse in the chuck to drill through at No. 55. Follow up with a No. 15 drill to ³⁄₁₆ in. depth and tap the remains of the No. 55 hole at 10BA. Chuck the lower portion again by the ³⁄₃₂ in. spigot and begin screwing the ¹⁄₁₆ in. rod at 10BA, screwing on the upper bell as you proceed, until the gap between the bells is ¹⁄₁₆ in. to drawing; complete with a 10BA brass nut at the top. Drill a No. 50 hole in the cleading, fit a 10BA screw from underneath and screw the whistle to same. It always struck me what a tinny whistle this was for such a large and impressive engine, though of course it was a totally different matter on the A4's with their lovely chime whistles. I will admit it brought tears to my eyes to hear the Doppler effect of the whistle as they passed me on Doncaster station; Platform 5 was my haunt.

Front Steps

If Gresley and his design team had a shortcoming it was in access to the front of the 'Pacifics' by the crews and of course the original A4 front end with the coupling hook recessed led to tragedy. The original A1 steps fouled the platform at some stations, there was an afterthought tubular affair, but in later years proper steps were fitted, though set well in as shown on No. 60048 illustrated in LLAS No. 19.

For the back of the steps, take a 2⅜ in. length of 1 in. x 1.6mm brass strip, mark off and cut to drawing before bending the top flap and trimming off any excess, remembering that the steps are handed. I recommend that the steps be fixed to the spring housing by a couple of 6BA screws, strong enough that they do not break off when the step fouls anything, as it will. Next make up the stay from ³⁄₁₆ in. x ¹⁄₁₆ in. strip, securing to the back of the steps with a couple of ¹⁄₁₆ in. snap head rivets, and to the spring housing with a single 6BA screw. I have already made reference to the vulnerability of these steps, and for this reason I would use 1.2mm steel for the actual steps, rather than the nearer to scale 1.0mm material. Fold them up to drawing and you can either rivet or silver solder to place; I would prefer the latter. Erection I have already covered, save to say the back of the steps comes flush with the cut-out on the bottom of the front buffer beam; that makes positive location very easy.

Fall Plate and Cab Floor

We cannot fit the fall plate until the cab floor has been laid and at every general refit at The Plant, a new wooden floor was fitted. The joiners were very obviously on piecework, for they arrived with a heap of planks, which in our case can be oak ones of ½ in. x ³⁄₁₆ in. section, laid a framework on the metal plate, which we can do laying our ½ in. x ³⁄₁₆ in. section timber on edge, with crossmembers right across the cab front

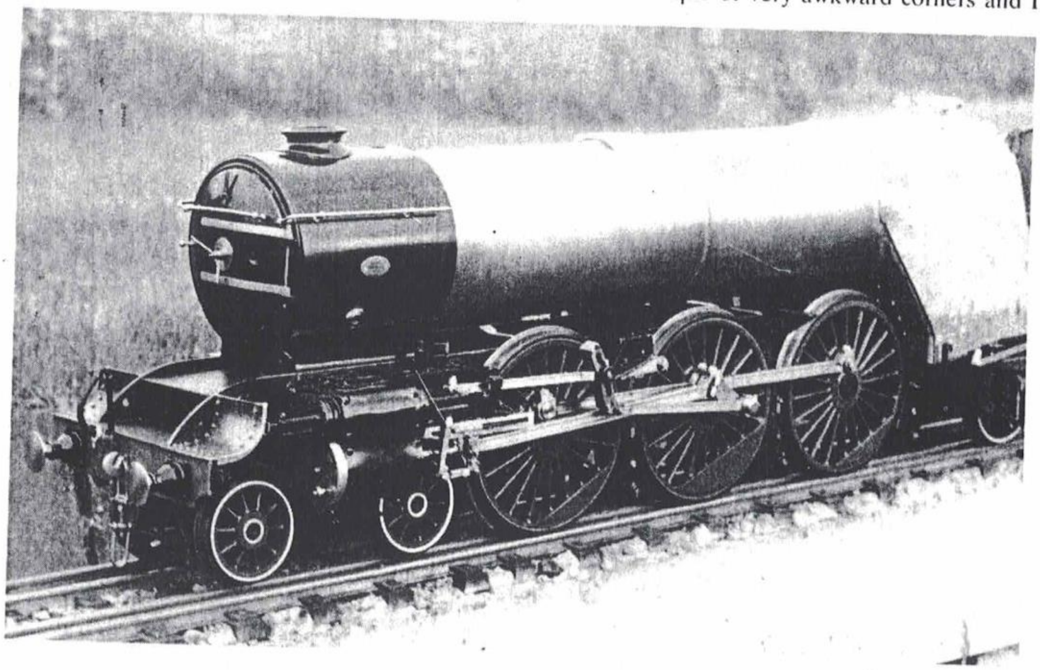
and back, and fore and aft runners in about four positions. The floor planks are also laid fore and aft and I suggest you start at the centre and work outwards, trimming the last plank to suit the cab side. There was a box on the drivers side which covered in the base of the reverser, but was mainly for the driver to place his feet on when seated in his bucket seat. Many a driver, uncle Frank included, needed a large lump of coal on top of the box for their feet to be comfortable. There were no drawings that I knew of for the wooden items, they were just made on the spot, but if memory serves me right there was a wee 45 deg. snape at the back inside corner of the drivers box; I have stood here and fired right, sorry wrong, handed . . . The fireman's foot box is slightly shorter and does not need a snape in the back corner; both boxes are 7/8 in. high with an extra 3/16 in. for the top planks. To complete the wooden cab floor, from the backhead to the rear edge of the foot boxes, an extra layer of planks are fitted, this time across the cab. I have driven engines without wooden floors and also with varnished ones, neither of which seemed right, for the answer to me is plain wood, which will very rapidly change colour in service!
For the flap, take a 7⅜ in. finished length from 1½ in. x 1.2mm steel strip, to first mark off and snape the corners as shown. I was going to say the bit about taking the engine to the track to check the fall plate, but if the engine will run round the curves, then the fall plate will be perfectly OK. Grip in the bench vice, using soft clamps, to form the 4 in. radius as close as you are able, then make up and fit the wee hinges, rivetting to the fall plate. Offer up to the wooden floor and you can either recess the hinges into the vertical, back crossmember, or into the top planks; cut the recess with a sharp chisel, then drill from the hinges through the planks and I suggest you use raised head countersunk screws if available, counterboring the plank to accept a 'captive' nut. I should have mentioned at the outset that planks full size were simply nailed in place, the floor was full of them!, and we can do likewise with panel pins rather than think in terms of glueing in place.

Name and Works Plates

Reeves provide a fairly comprehensive name and works plate service for the A3's, including all those wee instruction/information plates, like that for the scoop I have failed to detail! Ashdown Models I know also cover a few of the Gresley 'Pacifics', so there should be no problems in this direction. Until recently, Reeves plates were provided with a painted background, which is perfectly OK for most applications, but their new and unpainted nameplates will be more useful to us as we have to add at least the bolting skirt, if not thicken the actual nameplate. So first assess the thickness of the nameplate and if it looks too thin, then sweat on a back plate to bring it to ⅛ in. overall. Now cut a strip roughly 5 in. long and 5/16 in. x 1.6mm sections, bending to suit the base of the actual nameplate and cutting as shown; drill the five No. 44 fixing holes. There are little gussets at the ends, which can be omitted if they are too tricky for you, when you can soft solder together. Erect to the driving splasher, spot through, and for preference tap the splasher rather than drill a clear hole.
For most of their lives, the A1/A3's had their works plate attached to the smokebox in the position I have shown on No. 2547 in LLAS No. 16, secured in place with a couple of 10BA countersunk screws; brass ones. When the smoke deflectors were fitted, the works plate was moved to the cab side and in the position indicated for MALLARD as in LLAS No. 19. Adding the works plate adds the final touch to the engine, now all I have to do is cover the variant tender.

GN Tender Body

All the way through the series, I have been rather scathing of the GN version tender, and yet when it comes to the crunch, it was fitted to most of the more famous engines at some stage during their long lives, and of course was permanently attached to HUMORIST. Thus to be fair to builders, despite what my notes say on the drawing detail, I must cover the description properly and not scimp it as I had thought earlier. The only difference with the chassis is that the handbrake is located on the LH brake arm and the body is identical to the flush sided one internally up to the tank top, though externally it is marked different. The sides are nearly identical, save for the very tight radius at the top at the front end, but this time the rear corners are rounded, at 7/16 in., so it will be as well to form half of the back plate from each side, with a butt joint to complete; the common height is 5¾ in. at the back, but the side sheets this time are 6 9/16 in. high. The flared portion, conveniently attached to the outside face of the rear plate, has a couple of very awkward corners and I



Had not Bill spent time in hospital of late, I reckon I would have been handling CALL BOY on the track; my footplate pass is booked though!

suggest these corners be made separately and sweated into place later on. The tank top at the rear end is almost identical to that on the flush sided tender, save in the matter of the ring for lifting purposes; a young lad could easily fall over that and do himself a lot of damage! There are a pair of identical rings inside the coal space, so make all four at this stage; you will have to bend the rings up from 2.5 or 3mm wire and braze the joint after fitting to the lifting lug.

Before going any further we require the front bulkhead, or rather there are a pair of them which start as pieces of 1.6mm brass or steel sheet, size $8\frac{3}{8}$ in. x $5\frac{3}{4}$ in. The locker doors on the GN tender are bigger than those on the later type, being 3 in. high, so cut them out and then transfer to the front bulkhead, to cut this $\frac{1}{16}$ in. less all round and to include the hasp. Moving to the centre of the bulkhead, there is the horribly uneven cut-out for the coal door, the upper portion of which requires some negotiating! The coal door cannot be opened until coal is below that level on the coal plate and of course it opens inwards. Further to the left, we now have to make the cut-out for the handbrake, it starts at the centre line and extends for $2\frac{1}{2}$ in., when you can roll up the filling piece, with base of course. The other front bulkhead to the rear is much simpler and really forms the back of the lockers, so make a cut-out to match the coal opening at the front and add walls to close the lockers in.

The tank top comes right forward to the front of the pair of front bulkheads, but is cut away at the handbrake, when we must attend to that sloping top bulkhead. Take a piece $8\frac{3}{8}$ in. x $4\frac{1}{8}$ in. from 1.6mm brass sheet, mark on the fold line at $1\frac{5}{16}$ in. as shown and bend to the 65 deg. angle. Erect to the tank top, cut away at the handbrake, then radius the top and add $\frac{3}{16}$ in. half round beading on the front edge only.

Only the coal rails left, all from the $\frac{3}{16}$ in. half round beading and held in place by the $\frac{3}{16}$ in. x 1.2mm supports; secure them with $\frac{1}{16}$ in. countersunk copper rivets in the first instance. Between the front and rear coal bulkheads, the coal rails are plated in between their supports, so cut the pieces to place, when I suggest you soft solder all the upper joints at the same time that you deal with the inside of the tank.

Just the finishing touches, like the lamp irons at the rear of the tank, then the little step at the front RH side as shown, and pieces of guttering over the locker doors. I find when I have the pleasure of driving an A3 that I have virtually to climb on the tender to reach the controls, so I can imagine what will happen to those coal rails at the back of the tender, but then I had the same experience with LBSC's MINX!

Footnote

Although there will be a little more on DONCASTER to cover such things as piping, this is the end of what for me has been a major series, and like when the drawings were completed, I feel a little deflated. The most frequent question I am asked is 'What is your own favourite engine Don?'. I have to answer truthfully that each in turn as it is designed and detailed becomes a favourite; it must do for me to put my heart and soul into the project, in fact I am finding out the last few months that I just cannot pick up a project and put it on paper, the adrenalin is missing. I must agree though that the A3's were a favourite engine from acquaintance over 40 years now, almost to the day when LLAS No. 32 is published, and I had been hoping to save her up until last. That DONCASTER has proved to be the most popular of my designs published in LLAS proves I was wrong to delay her introduction, but like when I completed my 02 No. 14 FISHBOURNE, it does leave a wee vacuum. The next most numerous engines I have worked on are the V2's, but Les Warnett tells me he is working on that particular engine, in which I wish him well. It is not the end for me though and next issue I will be introducing a new engine, one that is totally different from DONCASTER.

I make no apology that this picture has also been used in our Catalogue and MY FIRST 50 YEARS WITH STEAM, for Tom Greaves has chosen the right camera angle to show off the greyhound qualities of DONCASTER herself. Although my part in the design is almost at an end, many builders are just setting off on their great adventure, and where better to start than from Kings X and with the YORKSHIRE PULLMAN; even if she is fitted with the 'wrong' tender!