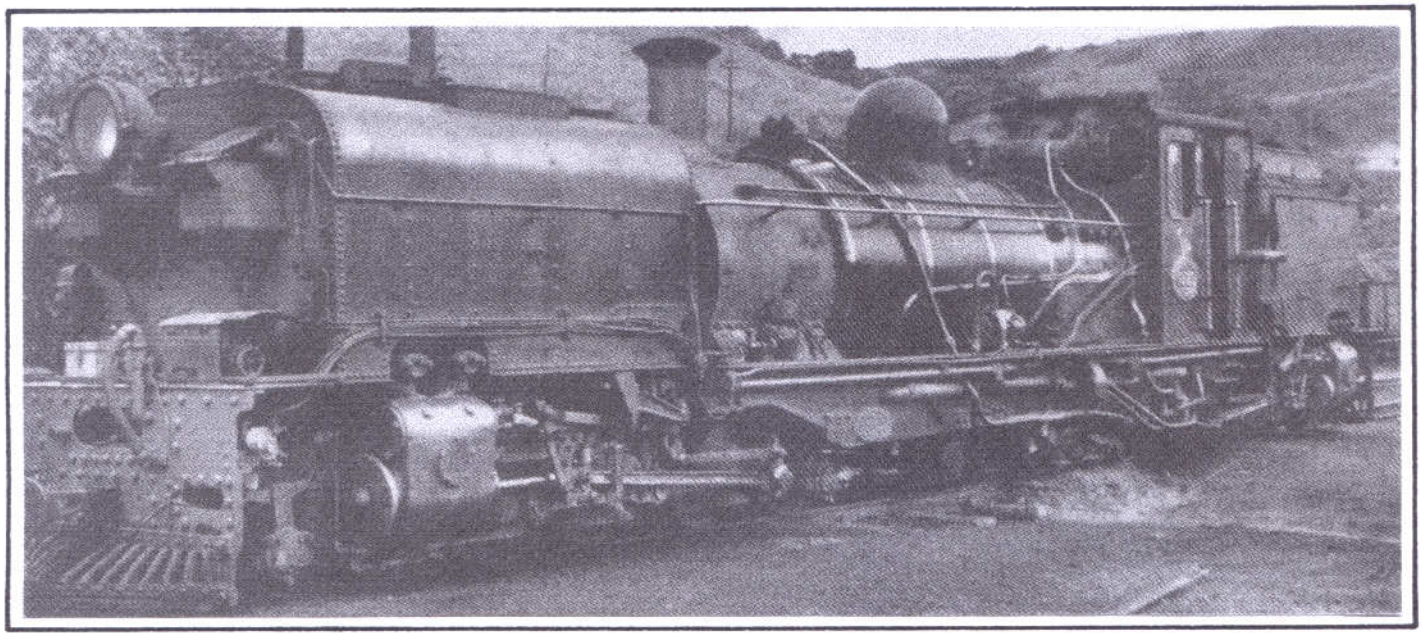
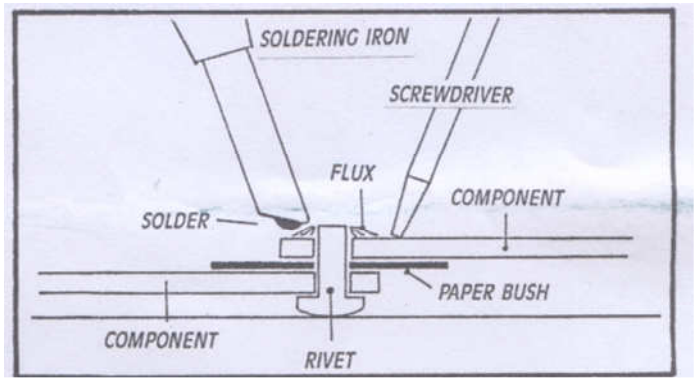
NGG 16 GARRATT



CONSTRUCTION HINTS AND TIPS

- Unless stated, all half-etched fold lines bend with the line inside the fold.
- Folding can usually be carried out either with fingers, flat-nosed pliers or tweezers, except when the component being folded is too narrow to grip. For example, bending the small folded flange along the bottom of the firebox sides. This is best formed after pre-scoring the fold line a few times, then gripping the component between bending bars (mine are nothing more sophisticated than two steel rules held in a vice or Workmate) push the fold over with a smooth wood or metal block.
- Where it has not proved possible to half etch the surface of the component leaving rivet or beading detail standing proud, tiny halfetched holes appear on the inside of certain components. These are guides for your rivetting tool, and rivet or bolt detail is easily embossed using firm downward pressure with the component lying on a sheet of ordinary writing paper supported on a firm surface. A kitchen worktop offcut is ideal, but not your best antique dining table top! If the component 'curls' whilst being embossed, here's a good tip to straighten it out again. Once embossed, lie the component on a firm surface, rivets facing uppermost, then use the rubber insulated handles of a pair of pliers or snips to gently beat the part flat again. This works every time without ever harming the newly embossed rivet detail.
- Valvegear joints are pivotted using tiny steel rivets. Instead of crimping the rivets closed, which in my experience always proved a hit and miss affair, use the following soldering technique which produces a perfect moving joint every time.
    - It relies on the use of an ordinary paper bush, made from a tiny square of writing paper, which acts as a barrier, preventing solder from penetrating between the components being joined with a rivet, leaving the joint free to pivot.
    - The accompanying diagram shows the procedure involved. Poke a hole in the paper square with a pointed wire, just big enough for the tail of the rivet to pass through. This paper bush is then inserted between the components being joined, and the assembly steadied on the workbench using slight downward pressure from a small screwdriver or similar, which will hold everything in alignment. The application of a small drop of flux (Cams Green Label) to the protruding rivet tail, followed by the tiniest bead of 145° solder, brought to the job on the tip of a clean, hot soldering iron, will quickly secure the joint. Apply the iron only until the solder flows into the joint - usually no more than a second - then, once the joint has cooled, check that it pivots as intended before tearing the paper bush away.



    - Note how the paper prevents unwanted solder straying where it is not wanted and gumming up the joint unnecessarily. Wash off all traces of flux deposits which will rust steel rivets if not cleaned thoroughly. File any protruding rivet tail flush then lightly lubricate the joint. That's all there is to it. Easy, or what?
    - Just make sure every rivetted valvegear joint pivots freely before moving on to the next one. If the joints don't pivot uninterrupted off the model during construction, they sure won't get any better once the assembled valvegear is installed later, spend the time to get it right
- These kits are designed primarily for solder assembly, the recommended tools being a 25 watt iron and 188°, 140° and 70° lowmelt solders. 240° resin cored electrical solder is sometimes useful. 188° solder conveniently comes in stripform or as `solder paint' which is a suspension of fine solder granules and flux which is easily applied to the joint as a paste. The application of a

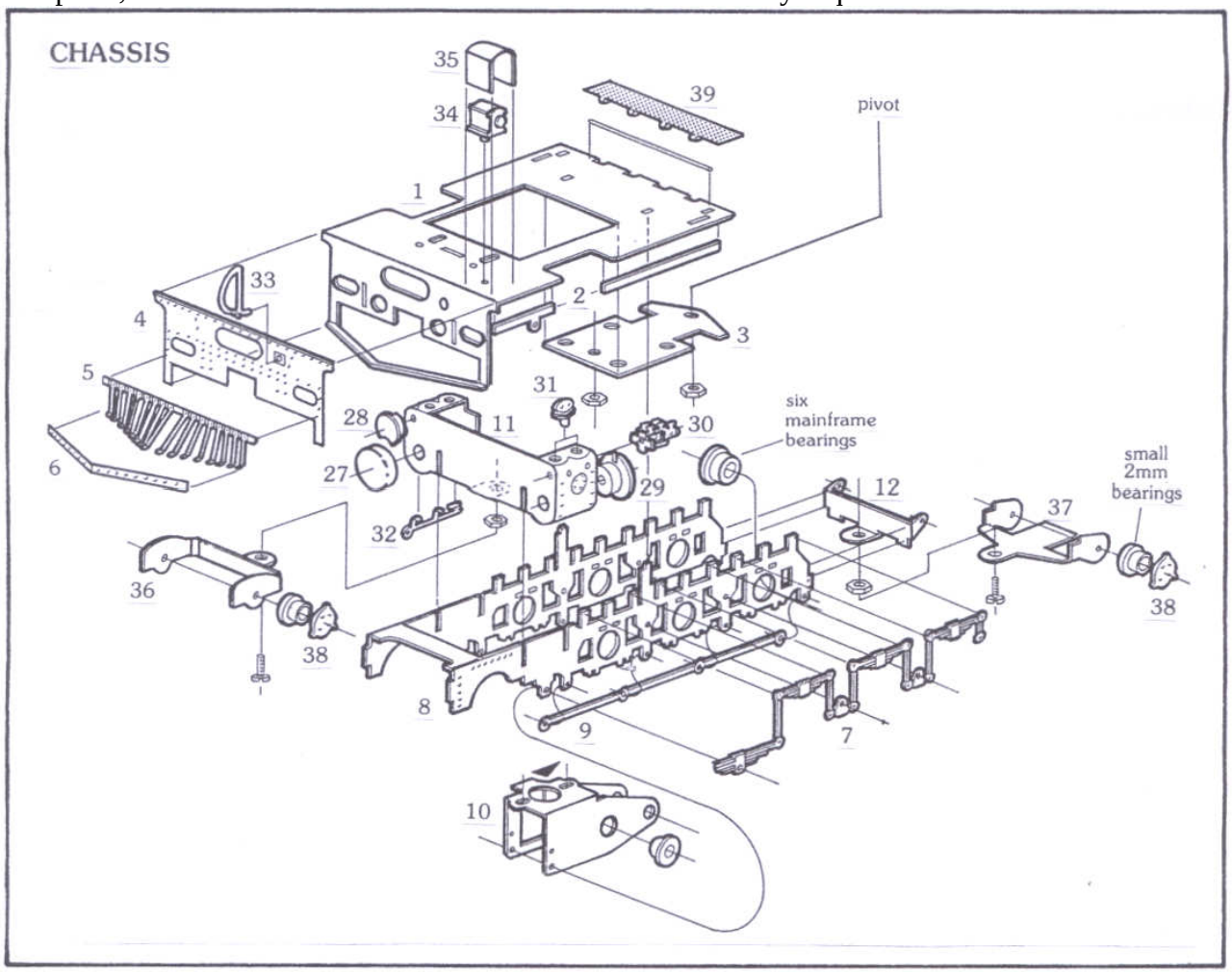
clean, hot iron will produce a neat, strong joint which can be easily cleaned up by scrubbing the joint with a self-propelling fibre-glass eraser after a thorough rinse to remove flux deposits. These eraser brushes make a splendid job of restoring a shiny finish to any metal components, though they do have a tendency to deposit their spent bristles into your unprotected fingertips - ouch!
    - The solders flow superbly combined with the use of Carr's Green Label flux which is a dilute phosphoric acid solution and should be washed off the model after every session. Carr's regularly advertise in RAILWAY MODELLER magazine.
- Other essential tools required to complete models such as this include:
    - Scriber
    - Selection of Swiss files
    - Jeweller's screwdrivers
    - Taper broaches - used for reaming etched holes to exact size. A set of six are available from Éxpo Tools, sizes 03mm-3mm.
    - Craft knife
    - Tweezers
    - Various fine pliers and side cutters
    - Pin vice and a selection of necessary drills
    - Minidrill with abrasive pads and cutting discs.
    - Wheelpress. Used to install wheels squarely onto axles.

1 BASIC CHASSIS ASSEMBLY

THE front and rear power units of the NGG16 are identical up to running plate level. In fact, the only difference between both running plates is the four small cut-outs on the inboard edge of the front running plate which provide clearance for the hinge flaps of the fall plate which spans the gap twixt front power unit and the main loco running plate.

Once you have identified the front (1) and rear running plates, construction of the power units can commence.

I shall describe construction of only the front unit, remembering that with the above noted exception, both units are identical and follow the same assembly sequence.



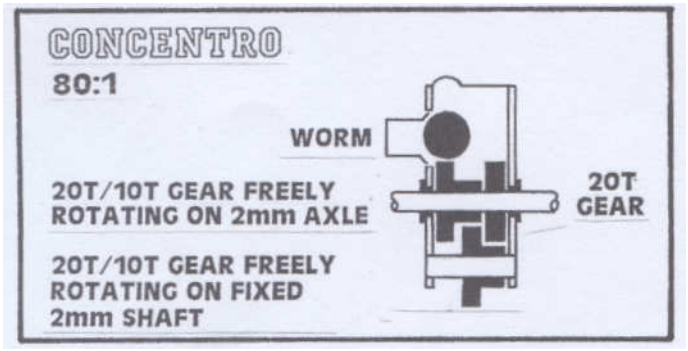
1. Taking the front running plate (1), fold the bufferbeam to 90°. At this stage, do not fold the cow-catcher frame or coupler mounting plate.
2. Add the valances (2) to the half etched grooves on the underside of the running plate, noting the position of the small lugs which later accept the drain cock operating rods.
3. Locate the pivot plate (3) to the underside of the running plate, using a 12BA nut and screw to temporarily secure the plate while soldering it in place.
4. Fix the 12BA captive nuts below the two holes in the pivot plate. This is best achieved by tightening the nuts and screws up fully then flowing a small amount of flux around the nuts where they contact the plate, ensuring no flux contacts the protruding screw threads. Using a clean, hot soldering iron, apply a tiny amount of solder to the joint. This will flow neatly around the nuts, and once cooled, the screws can easily be removed leaving the captive nuts secured to the pivot plate.
5. Attach the bufferbeam overlay (4),
6. then fit the cow-catcher (5) to the bufferbeam. Carefully fold the individual bars to their approximate angle before bending up the lower V-frame to 90° where it should mate with the bars.
7. To complete the cow-catcher, form the rivetted bar (6) to shape and fix it to the leading edge of the V-frame.
8. Fix the left and right spring/equalising beam overlays (7) to the chassis mainframes (8), pinning them in place with tiny lengths of 0.7mm brass wire. The wire pins can then be filed flush on the inside of the mainframes and left to protrude 0.2mm on the outside of the equalising beam overlays.
9. Similarly add the brake pull rods (9) to the inside of the dummy brake hangers. Again pinning them in place with 0.7mm wire. File the pins flush on the inside of the frames, leaving them protruding 0.2mm from the hangers on the outside. Strictly speaking these pull rods are inboard of the driving wheels on the real thing, but as the gearboxes take up all the room between the wheel backs on this model, there is no room to install them prototypically. If you prefer, omit them completely. It's your choice.
10. Fit the six mainframe bearings, installing them so their flanges are fully home against the inside of the frames. File any excess bearing material so that only 0.5mm is left protruding outside the frames. A sanding or cut-off disc in a minidrill makes short work of this task, a file only being used for the final few tidying strokes. Once completed, remove any swarf and check that an axle passes freely through all bearing holes.
11. Fold the chassis to 90°, and again check the axles pass unhindered through their bearings.

2 GEARBOX ASSEMBLY

THE gearboxes contained in this kit are adaptations of the 'CONCENTRO' units available from 'PORTER'S CAP PRODUCTIONS', a recent venture launched by myself and Chris Gibbon of High Level Models. The Porter's Cap Productions' range of gearboxes are primarily designed to offer standard gauge modellers unsurpassed quality drive units capable of incredible slow speed performance. The initial range of gearboxes have been received with great enthusiasm by their purchasers, hence it was only a matter of time before the units were made available with minor modification for 9mm narrow gauge applications.

The units supplied for the NGG16 use exactly the same components as the standard 'CONCENTRO' gearbox from Porter's Cap Productions, but the reduction in width of the unit in order to fit between the wheel back-to-back measurment of 009 results in minor modification being necessary to decrease the overall width of the final 20 tooth gear.

As supplied, the 20T gear is too wide thanks to its moulded bosses. These must be completely removed by the modeller, a task which is easily performed by paring them off with a scalpel and giving the gear a final rub on fine (1200 grit) wet and dry paper. A rinse under the tap and a quick clean up with an old toothbrush will leave the thinned down 20T gear ready for installation.



1. Turning to the gearbox frame (10), enlarge the etched holes as necessary using a taper broach (not a drill) to accept the small 2mm bore bearings and the 2mm steel layshaft.
2. Once the holes are correctly enlarged, rub the gearbox on fine wet & dry paper to remove any burrs.
3. Install the bearings so their flanges seat snug against the outside of the frame and file the excess flush with the inner face of the gearbox.
4. Fold the unit squarely to shape and check that a 2mm axle passes cleanly through the bearings without any trace of binding.
5. Reinforce the gearbox folds with a neat solder fillet, then wash the gearbox frame in soapy water to remove all traces of flux residue.
6. Check that the layshaft is a snug fit through its holes, then trim it to exact width, ensuring its ends are flush with the outside of the gearbox frame.
7. Before adding the gearbox internals, ensure your work area is free from debris and filings.
8. Install one of the 20T/1 OT gears loosely on the axle, together with the interference fit 20T gear, ensuring the gearbox is centrally mounted on the axle once the gears are in place. The remaining 20T/1 OT idler gear loosely installs onto the layshaft as per the diagram. I prefer to fix the layshaft in place using 70° low melt solder after first flooding the gearbox internals with cold water. A quick in and out with a clean hot iron and plenty flux makes for a neat and easy joint without fear of damaging any of the moulded components. You may just as easily secure the layshaft to the gearbox frame using the tiniest amount of Superglue if you prefer this method.

The beauty of these gearboxes lies in their user friendliness and compact design - especially so in the case of the 'CONCENTRO' used here which contains an impressive 80:1 ratio in what must be the cleverest use of space yet devised. Oh, by the way, an identical 108:1 unit is available using a 27T first stage gear and compatible worm, but that ratio would have been too high for the Garratts I feel.

9. Before fitting the Mashima 1220 motor, the trailing motor shaft (nearest the brush gear) must be removed. Unless you have a high quality pair of snips capable of neatly cutting through the hardened steel shaft, a carborundum slitting disc in a minidrill is the best way to remove the excess material. *WARNING! Don't* allow *the heat generated by the* cutting disc to damage the moulded *brush housing on the motor* - take it a little at a time.

10. Fit the worm to the motor shaft. This is best achieved using a vice. The worm should be positioned on the motor shaft so it aligns with the 20T worm gear and the cut-out in the gearbox sideframe. Temporarily offer up the motor to the gearbox until the worm is correctly positioned. It's probably a good idea to screw the motor to the gearbox at this time in order to appreciate the fine running capabilities of the unit under test power. One of the fixing screw positions is a little tricky to get at, but this is easily overcome if you use your smallest jeweller's screwdriver With a tiny drop of Superglue on the end to pick up the motor fixing screw until it can be driven home. The oval fixing slots in the gearbox motor mounting plate allow infinite adjustment for correct worm/gear meshing. Note: The worm is slightly offset to the 20T wormgear. This does not have any detrimental effect. Similarly, the motor is offset to the gearbox.
11. When you have satisfied yourself with the drive unit's capabilities, install the driving wheels onto the axle, setting the back-to-back measurements carefully with a suitable gauge. Mine came from the N-Gauge Society, and is designed to accurately gauge wheelsets for 9mm gauge. Having installed the wheels onto the gearbox axle, it will be apparent that a tiny slot filed into one side of the motor's casing will be beneficial in order to avoid the risk of a wheel flange causing an electrical short should it contact the metal motor case. Mark the position of the slot with a scriber or similar, then remove the motor entirely and create the necessary slot with a few file strokes. It's advantageous for the chassis to have free running wheelsets while the valvegear is being fitted, so store the motor safely to one side until the valvegear is fully installed and tested.

3 WHEEL AND FLYCRANK INSTALLATION

1. FIT the wheels to the remaining two driving axles, gauging them correctly, then carefully spring the chassis mainframes apart and insert the axles through their bearings.
2. Check from a frontal view that the chassis folds are 90° before temporarily clipping the folded-up cylinder assembly (11) to its slots in the chassis.
3. Similarly clip the running plate in place so that on a flat surface such as a glass plate, downward pressure using a finger onto the running plate will allow you to check that all is square and true before fitting the rear chassis crossmember (12).
4. Remove the running plate assembly and check the chassis for free running. All the wheelsets should revolve without any form of binding whatsoever before proceeding. From now on, every part of the valvegear must be inspected after it is assembled, eliminating any trace of binds as construction proceeds. A 0.7mm wire crossbrace slid through the holes in the chassis and the corresponding holes in the gearbox frame orientates the gearbox correctly in position.
5. Prepare six flycranks (13). This involves tapping the cast holes 14BA to accept the 14BA countersunk crankpin screws. Fib the-screw heads flush with the rear of the cast cranks once the screws are fixed in place.
6. Check the axle holes in the cranks for casting debris, and ensure the holes fit cleanly and squarely onto the axles.
7. The three left cranks can be fitted to the axles, ensuring the axle ends are flush with the outer faces of the cranks. No quartering is necessary at this stage; merely fit the cranks without worrying. I recommend soldering the flycranks in place using 145° detailing solder which flows very easily with plenty flux and obviates the need to linger with the iron - essential in view of the injection moulded plastic wheel centres. To further protect the moulded wheel centres, flow a brush load of water between the mainframe and the wheel in question whilst soldering on the cranks. Works every time.
8. Once the cranks are secured, wash off all traces of flux deposits in warm soapy water, then ensure the outer crank faces are flat and free from any excess solder traces.
9. Identify the left coupling rod (14) and carefully enlarge the crankpin holes with a 1.6mm drill used in a pin vice (it's all too easy to allow the drill to cut off-centre if used with a powered minidrill). Rub the coupling rod on fine wet and dry paper to remove any burrs before checking that the crankpin bushes are an easy fit in the holes. File each bush until it is only just thicker than the 0.020" nickel coupling rod.
10. Place a half etched brass washer (15) over each crankpin, then add the left side coupling rod over the pins. We are using the crankpin bushes inverted as retaining collars on the crankpins, so pop these in place in order to check that the coupling rod doesn't bind on the crankpins during rotation. If necessary very slightly enlarge any tight crankpin hole in the coupling rod if any trace of binding occurs. Once free running is achieved, fit the first and second crankpin bushes permanently using either 145° solder or a tiny drop of Superglue to attach the bushes to the crankpins. Snip off any excess protruding first and second crankpin and file flush with the outside of the bushes. The third bush is not yet fitted permanently, this being treated differently when the con rod and return crank are eventually installed on the third crankpin.
11. Fit the right side leading flycrank loosely to its axle, advancing it approximately 90° from its left side counterpart. For example, if the left flycranks have their crankpins in the six o'clock position, adjust the right side crank until its pin is at the three o'clock position. It doesn't matter if it isn't advanced exactly 90°, near enough will do just fine. Solder the right leading flycrank in place on its axle.
12. Loosely fit the two remaining right side flycranks, using the right side coupling rod - with its holes correspondingly enlarged to accept the crankpin bushes as per the left rod - to position them correctly. Rolling the chassis on a glass plate should automatically position the two unsecured cranks. Once this is determined, the coupling rod and bushes can be carefully removed and the cranks permanently fixed in place one at a time, checking after each is fitted.

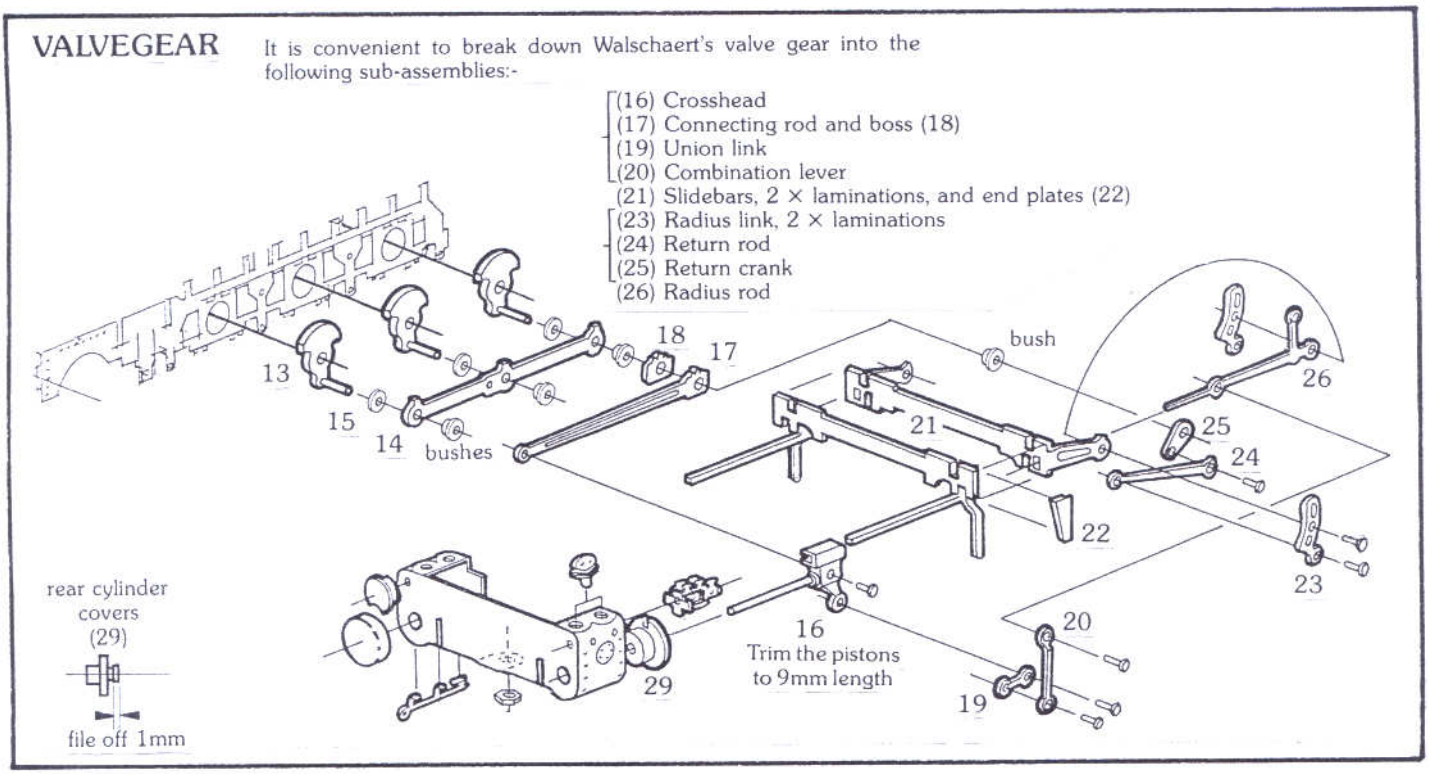
After washing off any flux residue and removing any excess solder, the coupling rod and bushes can be permanently fitted as per the left side. The quartering is completed.

13. To recap, of the six flycranks present per chassis, only two require careful adjustment to ensure perfect quartering, not half as difficult as it apparently seems when you tackle it in this fashion.

4 VALVE GEAR INSTALLATION

I SHALL outline assembly of the left side motion parts. Construction of the right side is a mirror image.

The notated exploded diagram fully describes the part names and clearly indicates which component overlays which. The various moving joints are performed using the tiny steel rivets supplied, and the motion is constructed in sub-assemblies off the model before being fitted to the chassis.



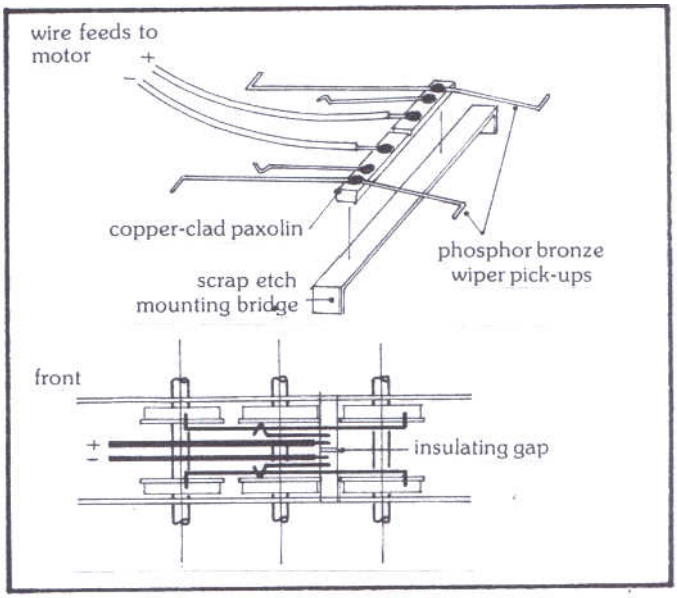
1. Taking the crosshead (16), ensure that the cast channel is a smooth sliding fit along the slidebar. You will probably find that filing the cusp off the slidebar results in a perfect sliding fit.
2. Before proceeding, it will be necessary to file off the oil box protruding from the top edge of the crosshead, leaving the top edge flush.
3. Trim the pistons to 9mm length from the flange.
4. Fit the con rod boss (18) to the inside, i.e. the un-fluted side, of the con rod (17), then drill out the hole to 1.6mm using a drill in a pin vice. Remove any burrs.
5. Attach the con rod to the crosshead, followed by the union link (19) and combination lever (20), noting the slight joggle you must form at the upper end of the combination lever. Put this assembly to one side.
6. Fold the slidebars forwards and radius link brackets rearwards to 90° on the front and rear laminations of the slidebar brackets (21). Strengthen the tiny slidebar folds with a neat solder fillet before joining the two laminations together and adding the end plates (22) to the outboard edges. Form the slight joggle in the vertical rod projecting down from the rear of each slidebar as per the diagram.
7. Take the two radius link laminations (23) and slot the smaller end of the return rod (24) between these, pinning the joint with a rivet.
8. The trailing end of the return rod is rivetted to the return crank (25).
9. The radius link pivots from the radius link bracket, noting that the radius rod (26), which must be fed forwards through the slot in the slidebar bracket, has its trailing end sandwiched between the two radius link laminations, the assembly being pinned with a rivet.

10. This rivet is secured to the inner radius link lamination, leaving the whole radius link free to pivot unhindered from its bracket.
11. You can now offer up the previously assembled crosshead/con rod/ union link/combination lever sub-assembly, and pin the top of the combination lever to the leading hole in the radius rod with a rivet. This virtually completes construction of the left side motion components. Repeat the process for the right side.
12. Taking the cylinder assembly, add the various details. These initially consist of the front cylinder covers (27) and valve chest covers (28).
13. However, before fitting the rear cylinder covers, file the cast outer flange off the piston gland reducing its length by l mm to provide clearance for the crosshead at its furthest point forwards during its stroke.
14. Once modified, fit the rear cylinder covers (29), aligning the cut-outs for the slidebars with the ones on the cylinder etch.
15. Fold up the valve guides (30) and add these directly over their holes.
16. Check that the dummy valve rod extending forwards from the leading end of the radius rod passes cleanly through the valve holes.
17. Add the cylinder top castings (31) to their locating holes.
18. Fit the drain cocks (32) beneath the cylinders.
19. Add the captive nut to the underside of the front bogie mounting tag on the cylinder assembly.
20. Slot the completed cylinders in place in the chassis.
21. The completed valve gear assembly can now be offered up to the chassis, slotting the pistons, slidebars and valve rods loosely into their respective holes. The slidebar bracket sits astride the chassis, nestling into cut-outs in the raised vertical frame extensions which help locate the running plate in position later.
22. At this stage, I recommend you lightly tack solder the slidebar bracket to the chassis extensions in order to check that everything works as intended.
23. Then fit the trailing end of the con rod, along with the necessary retaining bushes, to the rear crankpin.
24. This is followed by securing the return crank to the rear crankpin - noting its advancement relative to the flycrank in order to impart the necessary rocking motion to the radius link - snipping away and filing flush any excess crankpin material.
25. Carefully check the motion to ensure clearances are adequate. Your rolling chassis should be exactly that - free rolling on a flat, smooth surface with no binds detectable. Light lubrication of all moving joints and bearing surfaces is highly beneficial.

5 ELECTRICAL PICK-UP

ONCE you are satisfied the chassis runs freely, it's time to consider the electrical pick-up arrangements. My preferred method involves the fabrication of wiper pick-ups from the phosphor bronze wire supplied and mounting these on small pads of copper-clad paxolin from which wire feeds to the motor can be soldered.

Pick-ups are an area of personal preference, and are best left to individuals to sort out. However, for what it's worth, I'll describe my method which by no means is the definitive method, rather it can be aptly described as the 'it works for me' method of pick-up fabrication. I think a diagram probably explains my method better than anything.



1. The scrap etch mounting bridge fits neatly between the second and third leaf springs on the chassis.
2. A copper-clad strip - don't forget to cut the essential insulating gap in the copper surface - is cut to length to span the bridge and the phosphor bronze wipers bent up to fit before being soldered to the copper-clad surface. TIP: Solder the outermost pick-ups first using 240° electrical solder. This will prevent them coming adrift when the shorter wipers for the centre driving wheels are soldered adjacent to them using 145° detailing solder. If, like me, you don't possess a temperature controlled soldering iron, simply unplug the iron for a while allowing it to cool down enough to still melt 145° solder but leave 240° untouched.
3. Similarly, add the motor feed wires with 70° low melt solder using exactly the same technique.
4. Fabrication of the phosphor bronze wipers to the copper-clad paxolin strip is best achieved off the model, repeatedly offering up the assembly to check for fit.
5. Once the pick-up strip is ready, the assembly can be thoroughly washed to remove flux residue before being superglued to the mounting bridge.
6. The motor can then be refitted to the gearbox, ensuring the worm/ gear mesh is correctly adjusted, and the feed wires soldered to the motor tags - careful and patient adjustment of the wiper pressure on the wheels will pay dividends and result in a smoothly operating mechanism. Clipping the running plate assembly to the chassis will allow you to temporarily stick some lead weight over the driving wheels which will improve traction and pick-up performance during running of the unit under test. It goes without saying that wheels and track should be scrupulously cleaned prior to any test running of your chassis.
7. Incidentally, I recommend electrical links twixt front and rear chassis units once the model is fully constructed. This allows each motor the benefit of electrical pick-up from all twelve driving wheels. 'Impressive performance' should be an understatement!
8. When you have adjusted your chassis for optimum performance, unclip the running plate and add the vacuum pipe (33), lubricator (34) and lubricator sand shield (35) to their respective positions.
9. The running plate assembly can then be mated permanently to the mainframes and the drain cock operating rods bent up from a single length of 0.45mm brass wire and clipped in place between the lugs on the running plate valances and the locating holes on the drain cocks.

10. The coupler mounting plate can now be bent up to 90°. This should be used to fit the couplings of your choice, but depending upon personal preferences, you may opt to omit the mount and devise one of your own. The coupler pocket may be further re-worked and adapted according to the individual whim of the builder.
11. Fold up the leading (36) and trailing bogie frames (37), reinforcing the folds with neat solder fillets.
12. Clip the wheelsets in place. Using the bearings supplied, add these to the outside of the bogie frames, directly over the axle centres.
13. Cap the bearings with etched lids (38) which represent the roller bearing axlebox covers nicely. Note that whilst few compromises have been necessary during the design of these NGG16 Garratt kits, I have found it obligatory to dispense with the front bogie leaf springs and to remount the rear bogie 1mm further back in to order to impart the adequate sideplay necessary for anything resembling reliable operation. You do prefer your models to go round corners, I presume?
14. Both bogies mount to their respective pivots via 12BA screws.
15. This completes the front power unit chassis which is identical to the rear unit apart from the addition of the hinged fall plate (39) which locates as per the diagram.
16. A piece of 045mm brass wire cut to the same width as the fall plate should be fixed to the top of the running plate, flush with its rear edge, and the half etched hinge flaps of the fall plate can be easily wrapped round this and tucked snug against the plate's bottom face. The fall plate eventually spans the gap between the front power unit and the loco's main running plate when the units are pivotted together.

6 POWER UNIT SUPERSTRUCTURES

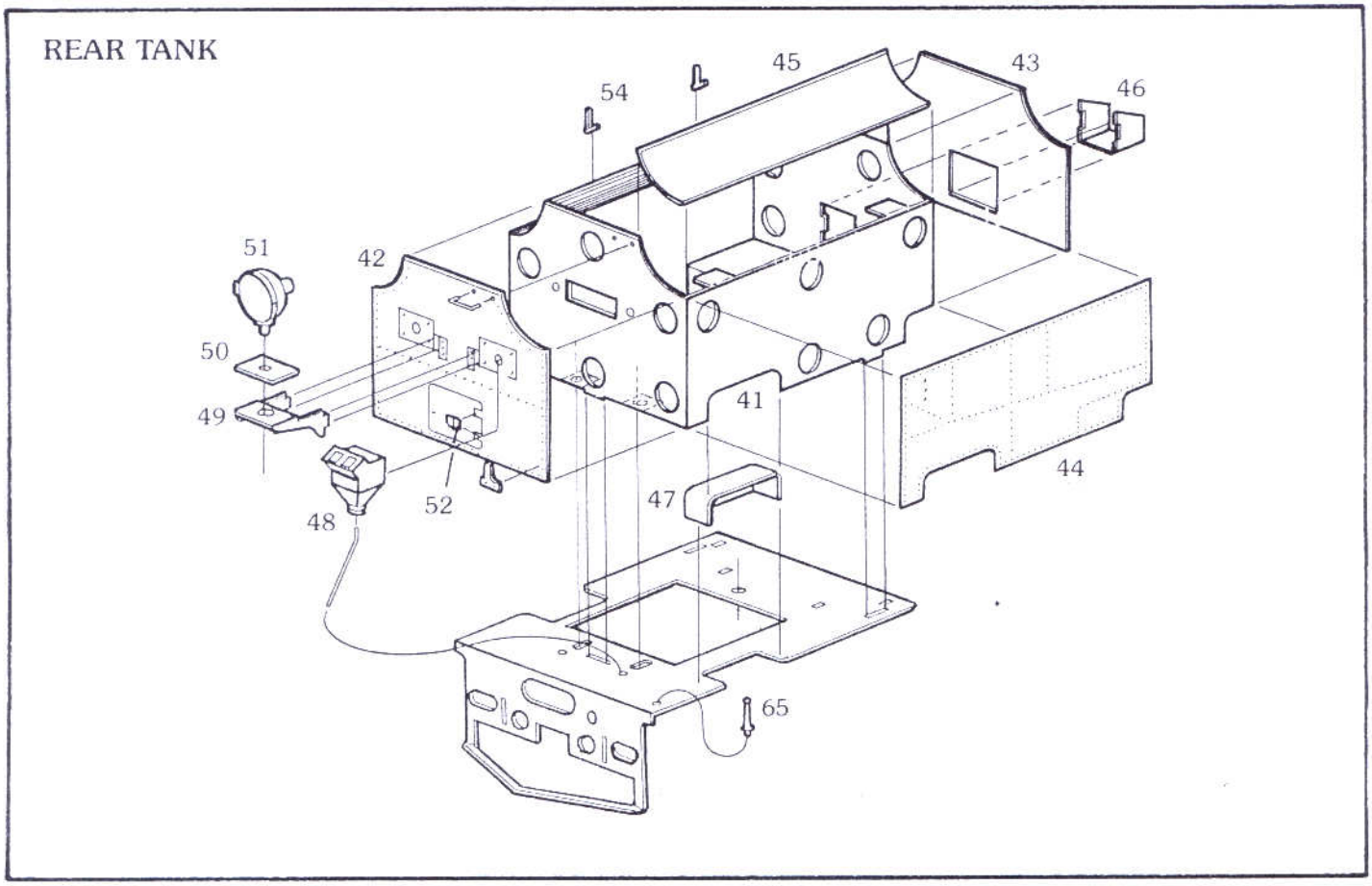
THE model depicts an NGG16 with a rivetted front tank wrapper and a coal bunker/water tank rear wrapper. The twin sanding and single large headlight arrangements are identical both ends. Handrail holes are pre-etched. Footstep positions are indicated on the elevation drawings, though these varied from one prototype to another. Similarly, lamp irons vary. Should you wish to model an NGG16 with a welded front tank, rub the wrapper on fine wet and dry paper to remove the etched on rivets. (How could you?)

If you desire to represent one of the dual sealed beam headlight fitted locomotives, suitable headlights are available from the likes of Detail Associates.

Both front (40) and rear (41) tank inner formers fold neatly to shape from single large etches, unobtrusive butt joints being present on the inboard face of both formers.

REAR TANK

1. THE rear tank overlay panels for the outboard (42) and inboard (43) ends, together with the side overlays (44), attach directly to the inner former and are easily fixed in place by soldering with 70° lowmelt or, if you prefer, superglueing from inside the tank former through the many circular holes provided. This ensures the rivetted outer tank overlays remain clean and free from stray adhesive. On the rear tank, fit the outboard end overlay first, followed by the sides, then the inboard end overlay.

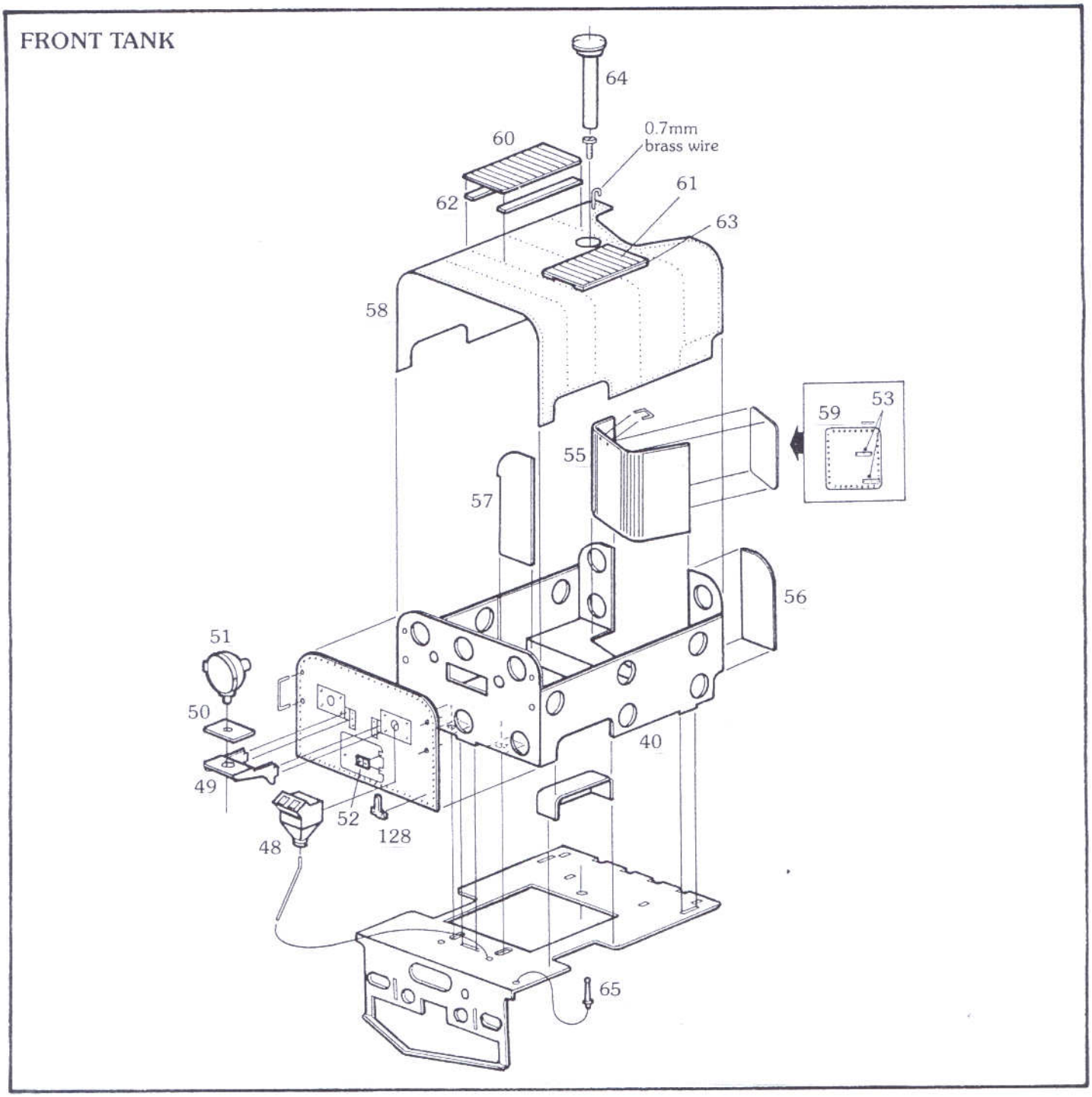


2. The concave upper panels (45) of the rear tank have half etched lines on their inside faces which allow them to be easily curved round a suitable cylindrical former. I used a piece of brass tube, round which the panels formed perfectly.
3. Fix the panels in place once formed to shape, then add lengths of 0.45mm brass wire along the top edge to represent the beading. This should match the half etched beading present on the end overlays.
4. Fold the coal chute (46) to shape and tab this to its position on the inboard end.

5. Box in the cylinder cut-outs on the lower edge of the tank sides using the two infill panels (47) which form to shape and locate inside the tank.
6. Fix two captive nuts above the holes on the fold-up tank locating tabs. These accept the two 12BA tank fixing screws which pass up through the running plate, securing the tank in place. A third 12BA screw fits down through the opposite single locating tab into the captive 12BA nut fixed to the underside of the running plate.
7. Four fold-down tabs are supplied inside the rear bunker which can be used to support a false plasticard panel on which your coal load can be placed. Don't forget to incorporate some kind of access hole in your coal load in order to get at the tank securing screw.
8. Outboard end detail, at least that which is common to both tanks, includes a pair of sandboxes (48) and their relevant pipes fabricated from 0.7mm brass wire, along with the headlight bracket (49), plinth (50) and headlight (51).
9. A pair of teeny hinges (52) fit into the recesses provided in the end access door.
10. As previously noted, footsteps (53) and lamp irons were variously sited on the tank ends. Refer to photographs of your chosen prototype for confirmation of the exact position of these details.
11. If desired, a pair of fire iron brackets (54) may be fitted to the left side concave tank panel.

7 FRONT TANK

1. HAVING folded the inner former to shape, it is necessary to form the inboard end panel (55) to shape so that it fits snugly in place, conforming to the shape of the curved floor panel. Impart the necessary curves in the panel by bending it round a suitable rod - 1 used a drill shank - so that the half etched lines on the inside face of the component allow the panel to form easily to exact shape. Test fit the panel in place repeatedly until you are happy it fits precisely, then fix it in position.
2. The two end overlays (56) fit in place at the inboard end of the tank.
3. Fix the two strengthening gussets (57) to their half etched grooves inside the tank former.



4. The outer rivetted overlay(58) will form easier if it is annealed prior to shaping. I anneal etched components on the domestic cooker - usually on the electric hob for about ten minutes on

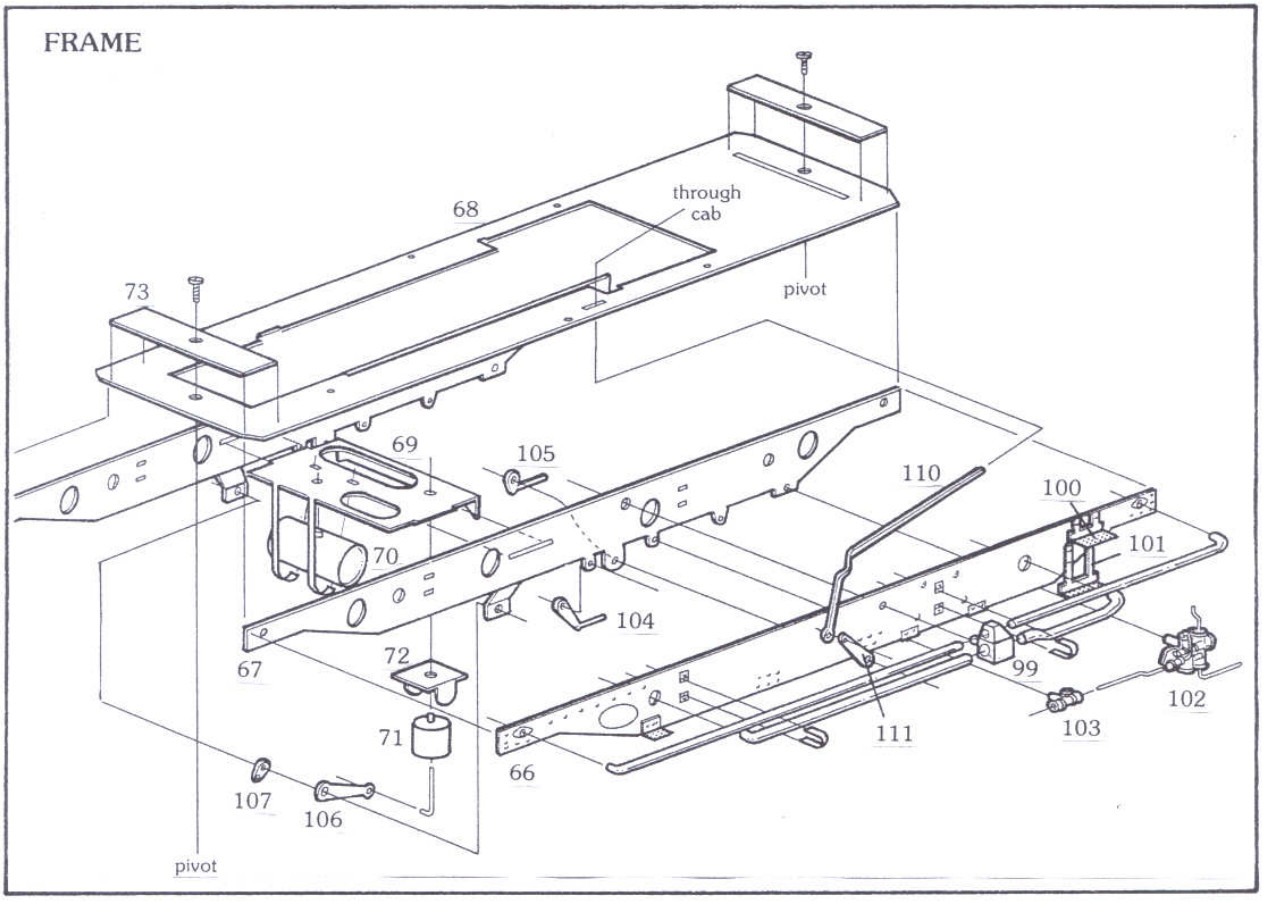
maximum. This softens the material so that it is easily curved without the associated 'springyness' present in otherwise virgin brass or nickel.

5. Once annealed, the wrapper can be tack soldered to the tank former with 70° lowmelt along one bottom edge, having ensured it is perfectly aligned.
6. Now, on a perfectly flat, clean surface - a glass plate is ideal - simply roll the wrapper to shape using the actual tank inner former to impart the necessary curves. On the test etch, this operation took less time to perform than it takes to read this description of the technique involved. With luck, your tank wrapper will have formed equally smartly, and it can be fixed to the inner former using 70° lowmelt or Superglue fed through the circular holes inside the tank. Ensure the wrapper and former are firmly in contact with one another before applying your choice of adhesive. I turned the tank on its side and used downward pressure on a smooth surface to hold the inner tank former firmly against the wrapper before applying 70° low melt solder through the circular access holes.
7. Once one side was secured, the other was similarly tackled. Seam joins where the tank wrapper met the front and rear tank panels were easily performed from inside the tank.
8. The recessed inboard end of the front tank is detailed with a rivetted door overlay (59) which incorporates a pair of footsteps (53). A wire handgrab fits above the panel.
9. Assemble the tank top footboards from the large (60) and small (61) planked panels and the long (62) and short (63) runners. These fit to the tank tops astride the filler cap (64) which incidentally doubles as the securing screw which fastens the tank to the running plate after you fix a 12BA screw into the recess moulded into the end of the long spigot projecting down from the cap. As per the rear tank, two captive 12BA nuts fit above the fold-up tank locating tabs, and these accept two 12BA screws passed up through the running plate.
10. Apart from a pair of 0.45mm wire handrails, sanding and headlight details mirror that of the rear tank. If required, drill a hole in the left side of each running plate, just behind the bufferbeam and immediately inboard of the valance to accept the cast handgrabs (65) which feature on some NGG16s.

This completes both power units, leaving only the boiler/cab unit to tackle. It's all downhill from here on in!

8 FRAME/BOILER/CAB ASSEMBLY

1. ADD the outer detail overlays (66) to the sideframes (67), again using the circular cut-outs on the inner frames through which to apply your choice of solder or Superglue.
2. Fix the sideframes into the half etched grooves on the underside of the main running plate (68), ensuring they are at 90°. Note that the sideframes are handed and the sideframe with the extra holes fore and aft to accept the water balance pipe fits to the left side.
3. Fit the crossmember (69), tabbing it into its slots between the mainframes.
4. Add the air tank (70) to its location, and once it is in place, pull the securing bands tightly round it, feeding them through the slots in the crossmember.
5. Solder them in place, snipping off the excess band material which should be stored safely for use shortly.
6. Add the brake cylinder (71) and its mounting bracket (72) to the crossmember.
7. Add the wire rod to the cylinder. Fix the pivot reinforcing plates (73) to the top of the main running plate, aligning the pivot holes.
8. Fold up the cab assembly(74), carefully butt joining the rear panel and adding the inner cab rear panel (75) to reinforce the joint.
9. Fabricate and fit the cab handrails either side of the door openings using the handrail knobs and 0.45mm brass wire.
10. File the knob spigots flush inside the cab.
11. Add the double (76) and single (77) side window frames inside their respective openings.
12. Fix the spectacle surrounds (78) outside their openings in the front and rear cab panels.
13. Door panels (79), should you opt to fit them, locate inside the door openings.
14. Fold up and fit the sun shades (80), aligning them with the top edge of the cab sides.
15. Fit the firebox (81) to the lower cab front, then add the four small (82) and one large (83) ashpan hatches to the side and front of the ashpan respectively. These can be fitted in the open or closed position.
16. Fix the smokebox tube (84) to the front of the boiler tube (85).
17. Lightly scribe a line the full length of the boiler/smokebox. This is the centre line on which to mark and drill the positions of the various boiler top fittings.



18. Fit the smokebox front panel (86), ensuring the small halfetched nick on the inside aligns with the scribed centreline on the smokebox. This ensures the handrail knob holes on the smokebox front panel are correctly orientated.
19. Lightly chamfer the top edges of the firebox sides, and fit the boiler in place, butting it squarely against the cab front.
20. Anneal the firebox wrapper (87) and roll it to shape until it is a snug fit over the rear boiler section, disguising the join twixt boiler and firebox.
21. Install the wrapper so the scribed boiler centreline is visible through the etched holes for the safety valves.
22. With the firebox wrapper securely fixed to the boiler, drill out the necessary holes for the chimney (88), top feed (89), dome (90), safety valves (91) and outer steam turret casing (92).
23. Fit these components to their respective holes.
24. Similarly mark and drill the positions of the exhaust steam ejector pipe on the right smokebox side, the blower pipe on the left smokebox side, and the whistle (93), which locates to the right of centre of the boiler centreline just ahead of the top feed.
25. Use 1 mm rod to represent the ejector pipe and 0.7mm wire to fabricate the blower pipe. Both pipes run from the smokebox, the ejector passing through the hole in the cab front, the blower running the length of the boiler before jinking up to meet the outer steam turret casing.
26. Mate the cab/boiler assembly with the main running plate using the tabs and slots provided.
27. Fix the smokebox saddle panels (94) in place, followed by the rivetted flanges (95).
28. The smokebox door (96) and handle (97) can now be added.
29. Fit the smokebox lubricators (98) to their openings in the smokebox saddle.
30. Mark and drill the handrail knob positions, but at this stage do not fit the handrails. In fact the handrails are best added after the model is completed so that fitting boiler band detail (I fabricate mine from Sellotape strips) is not impeded. Similarly, the fine conduit and pipework is best left till last.
31. Turning to the sideframe details, bend up the left and right steam pipes to the profile depicted in the elevation drawings. These are fabricated from 1.6mm dia. brass rod and the ends should

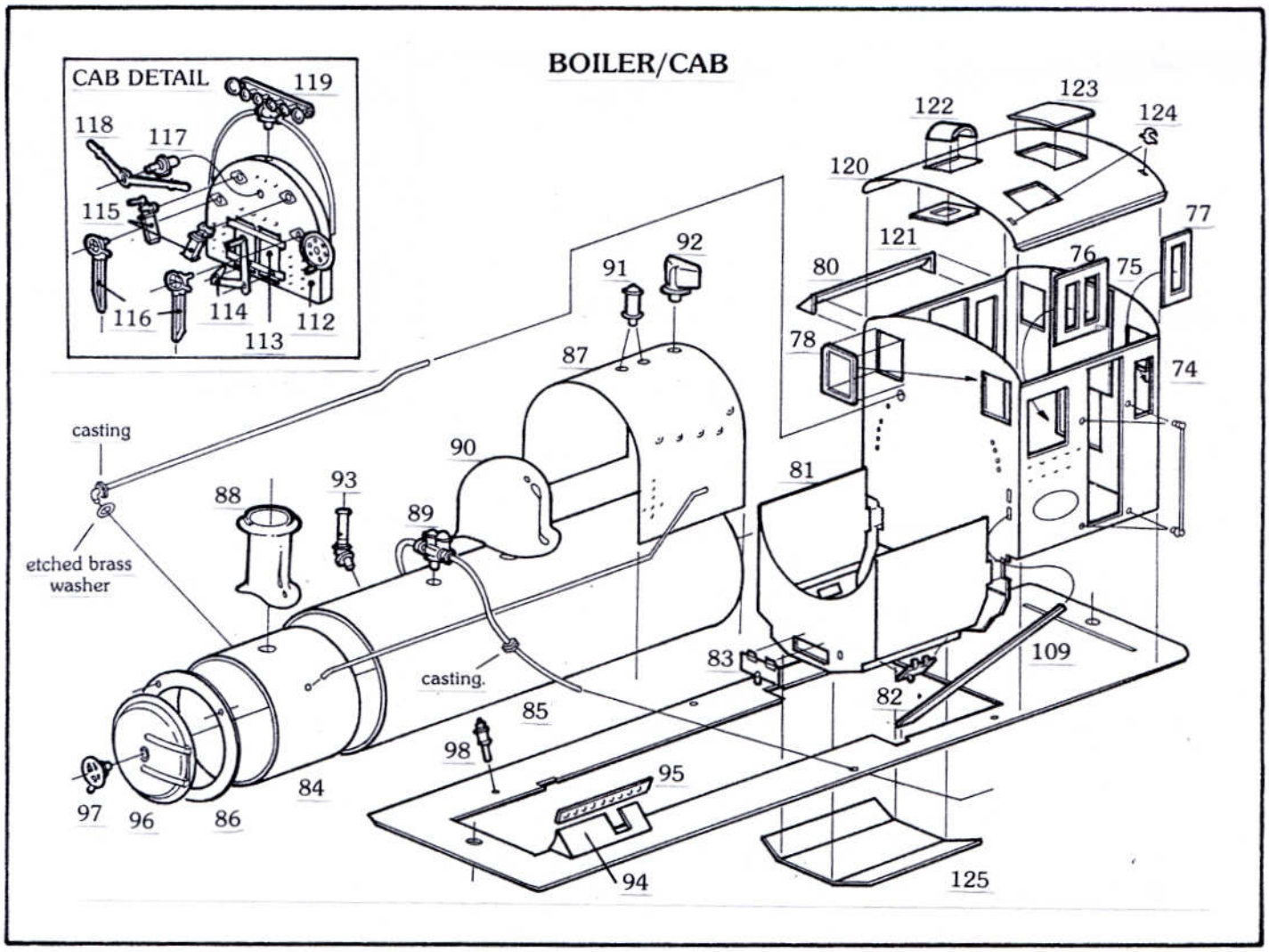
be snipped off 1 mm after passing through the holes in the sideframes. Note that the left side steam pipe, and the 1 mm dia. water balance pipe above it, both slot through a cast housing (99, what is that? Pre-heater perhaps?) which plugs into its locating hole in the left side frame.

32. The fastening bands are represented using the leftover material from the air tank bands and fit through the slots in the sideframes.
33. Footsteps locate beneath the cab door openings as indicated on the elevation drawing. Note they are handed, and the steps with shorter brackets (100) fit above the ones with long brackets (101).
34. The injectors (102) plug into their locating holes in the sideframes, along with the valves (103) which plug into their holes in the frames just outboard of the firebox.
35. Add the plumbing between the top feed, valves and injectors using 0.7mm brass wire. The pipes running from the injectors, up through the running plate to the cab front are bent up from 0.45mm brass wire.
36. Add the ashpan door lever (104), rocking grate lever (105), together with the large (106) and small (107) brake cams to their respective cross-shafts which are fabricated from 0.7mm wire, apart from the brake cross-shaft which is l mm rod.
37. You have a choice of mounting position for the turbo generator (108). The elevation drawing depicts it mounted on the boiler top, together with its associated steam input and exhaust pipes. Alternatively, many NGG16s mounted the genny on the left side of the main running plate as per the photograph.
38. Fit the ashpan operating rod (109) and rocking grate rod (110) to their respective positions on the left side, both levers enter the cab via small slots. The rocking grate lever passes through a slot in the running plate, connecting with the operating cam (111) which pins to the extended wire crossbrace protruding from the left sideframe.

9 CAB DETAIL

TIME to own up. The cab interior detail as supplied consists of generic fittings, which, while offering an extremely high level of detail, may or may not represent the NGG 16s actual cab layout. However, I'm sure modelers will be delighted with the result.

1. Drill out the holes in the backhead casting (112) to accept the various fittings.
2. Add the firebox door (113) and the operating lever (114), pinning these together using lengths of 0.45mm wire.
3. Add the water gauge glasses (115), injector valves (116), regulator valve (117) and regulator handle (118) to their respective positions. The steam turret (119) locates on top of the backhead with its piping spanning the circumference of the firebox backhead.
4. The completed backhead fits to the inside of the cab front panel. I suggest this is added after the model is fully painted.
5. Roll the cab roof (12) to shape after first annealing it. The sharper curves at the sides of the roof are easily formed by bending the roof round a 2mm dia. former (drill shank?). I did mine by holding the drill shank in a vice and gripping the roof panel between this and one of the vice jaws. The roof was then bent around the drill shank using a block of wood to bend the metal over it. Easy.



6. Once the roof is tweaked to final shape, add the ventilators (121) and covers (122). The half etched covers easily bend to shape with your fingers round a suitable drill shank.
7. Fit the hatch cover (123) over its opening.

8. The four tiny lifting eyes (124) tab into their slots. TIP: The lifting eyes are easier to handle if you leave the excess tab material attached to them until they are fitted. Once secured, the tabs must be filed flush on the underside of the roof.
9. I prefer my models to have removable roofs. To achieve this, I add small sections of square plasticard rod to the underside of the roof which positively locate it against the cab side and front panels. This lets me take off the roof in order to appreciate all the interior details
10. I have left mention of the ashpan baseplate (125) till amost last. If you desire a flickering fire effect in the ashpan, this can be installed using one of the commercially available units advertised in the model press. Once fitted, I suggest you temporarily fix the ashpan baseplate in place using double sided Sellotape, allowing its easy removal for access.
11. Builders plates (126) and shopping plates (127) are included. These fit to the cabsides and front of the sideframes respectively if desired.
12. Lamp irons (128) varied from loco to loco. Fit these as per your prototype.
13. Finally, mate the three separate loco sections using 12BA screws down through the main running plate and into the captive nuts secured beneath the power unit pivot plates.
14. You will find it beneficial to drill a small hole in the coal chute of the rear unit in order to allow screwdriver access to the rear 12BA pivot screw. With hindsight I should have provided the chute with a ready etched hole, but hey, nobody's perfect, right?

10 LIVERY

AS EVER, these models will no doubt end up appearing on a variety of freelance layouts in a number of unprototypical colour schemes. However, most modellers will perhaps prefer the S.A.R. (South African Railways) subdued livery of all-over black with graphite silver smokebox and the bufferbeams and flycranks highlighted in red. Boiler bands are polished brass. You may even take a fancy to the 'Red Devil' livery if you feel your model doesn't already stand out enough from the rest of your motive power stud.

At the time of writing, of the Welsh Highland Railway's imported examples, (initially Nos. 138, 140 and 143) one currently retains the S.A.R.'s. livery with the addition of WHR lettering displayed on the coal bunker sides, one has received green livery, and the third is rumoured to eventually be outshopped in 'Red Devil' livery.