

Victorian Railways X Class 2-8-2 Locomotive and tender kit

Ref.E226A&B and E227, Manufactured by DJH exclusively for Steam Era Models

Introduction

The first X class 'Heavy Mikado', number 27, entered traffic from Newport workshops in March 1929. The new locomotive was based on the existing C class 'Heavy Consolidation' and shared the same driving wheels, cylinders and motion gear, but was designed to be easily converted to standard gauge with a wide firebox placed behind the driving wheels and above the frames. Because of the greater weight of the X, as compared to the C, a booster engine was fitted to the trailing truck to increase tractive effort at low speeds, so that the X could haul similar loads to the C when operating on a gradient. A further ten locomotives, numbered 28 to 37, were constructed at Newport Workshops in the same year. All these engines were built with cast steel trailing trucks and boilers featuring a round or wagon top firebox, although X36 and X37 did not have boosters fitted. X37 was subsequently fitted with a booster, but X 36 remained the sole example not so equipped right through to withdrawal in 1960. All eleven locomotives were built with single stage air pumps, but were provided with cross-compound pumps between 1932 and 1936. The booster exhaust was initially routed to the smokebox, but problems were experienced with the exhaust from the booster interfering with the draft and the piping was altered so that the booster exhausted direct to atmosphere on top of the boiler behind the dome. Electric lighting was added and the boiler feed check valves were relocated from the sides of the boiler to points on top of the boiler in front of the dome during the 1930s. Further engines were constructed in later years, with X38 entering traffic in 1937, 39-45 in 1938, 46-48 in 1942, 49-51 in 1943 and 52-55 in 1947. These later engines were built with Belpaire firebox boilers and, from X 39 onwards, fabricated trailing trucks. Four of these locomotives received tenders from S class pacifics that were streamlined for the Spirit of Progress in 1937, the rest received tenders with welded tanks. X27-37 were later equipped with Belpaire boilers, with the last wagon top firebox boiler being replaced in the late 1940s. X 46 was the first of the fleet to be built new with automatic staff exchange equipment; the rest had this equipment fitted between 1942 and 1945. Various other modifications were carried out over the years, including a change in the drafting, which necessitated replacement of the shapely capped funnel with a plain funnel of larger diameter, but from 1940 the booster exhaust was rerouted back to the smokebox. Because of problems with drifting smoke obscuring the vision of the crew, smoke deflectors were fitted at the same time or shortly after the 'modified front end'. X32 was converted in July 1949 to burn brown coal dust. Blow down valves and the associated mufflers and piping were installed in the early 1950s, as well as the treatment tank on the tender top. As the X class fleet passed through workshops for overhaul, tenders and trailing trucks were swapped around, so that lower numbered engines could be seen with fabricated trailing trucks and/or welded tenders. By the mid to late 1950s, as the lattice cowcatchers got bent and misshaped in various accidents, they were often removed and replaced with a simpler design formed from steel plate. The table below sets out the condition of the ten locomotives for which number plates are provided when they were being photographed by railfans in the late 1950s.

Locomotive number	Trailing truck	Cowcatcher	Tender
28	Fabricated	Plate	Welded
29	Fabricated	Lattice	Riveted
33	Cast	Plate	Riveted
35	Cast	Plate	Riveted
36 (no booster)	Cast	Plate	Riveted
38	Cast	Plate	Riveted
39	Fabricated	Plate	Welded
46	Fabricated	Lattice	Welded
50	Fabricated	Plate	Riveted
51	Cast	Plate	Riveted

The X class were withdrawn from regular traffic throughout the late 1950s and into 1960, with X29 and X 36 being the last to go, on 7th November 1960. Fortunately one X class survived to be preserved at the ARHS museum at North Williamstown, although it is perhaps a shame that it was X 36, the only engine not equipped with a booster, which became the single representative of the class to escape the scrapper's torch.

Please read instructions carefully before commencing assembly.

Assembly methods

The two main construction methods are:

- i) Low-melt solder. Low-melt solder is an excellent medium to use with white metal kits. It is quick and provides a stronger joint than can be achieved with glue. Joint strength is achieved as soon as the solder solidifies, enabling the next step in construction to be undertaken without waiting for adhesive to set. It has the added advantage of allowing repairs to minor casting flaws, and because of the relatively low temperature, many parts can be held in the fingers while soldering. To join white metal to brass it is first necessary to 'tin' the brass with normal solder. The white metal casting can then be attached to the tinned brass with low-melt solder. Low-melt soldering requires the correct type of soldering iron (e.g. Dick Smith T2000). These irons have temperature control, as low-melt solder only requires around 150 degrees Celsius. Do not use the same iron for low-melt and normal solder as solder mixed in this way has poor strength. Suitable low-melt solder and flux is available from Carr's and from Brunel Hobbies. The Brunel low-melt solder has the advantage that it will adhere to brass without the need for pre-tinning with normal solder. ***Do not attempt to solder white metal castings with a standard soldering iron.***
- ii) Glue. Superglue and five minute Araldite are two types of adhesive suitable for use with this kit. Some modellers prefer to superglue major joins first and the fillet the joint with Araldite. Small detail parts are best attached with superglue. Solder must be used for electrical connections such as the wiring from the pick-ups to the motor.

Whichever method you choose, 'dry fit' all parts to ensure a good fit before attaching them permanently.

Tools Required or Recommended

Sharp knife, such as Stanley knife, knife with snap-off blades or a scalpel.

Fine pointed tweezers.

A set of needle files in assorted shapes.

A set of tapered broaches for enlarging small holes in sheet metal.

Wooden pegs and/or Blu-Tac, for holding parts during soldering.

Wire cutters.

Needle nose pliers.

Round nose pliers.

Small model makers vice with smooth jaws.

Pin vice with a range of collets for holding small drills.

A 150mm single cut mill file.

A set of small screwdrivers.

Jeweller's piercing saw.

Glass fibre burnishing tool.

Soldering iron for electrical connections.

Temperature controlled soldering iron if the model is to be assembled by solder.

Emery paper, in various grits from 240 to 600.

An etched or laser-cut jig for bending handrails to a U shape of various lengths in steps of 0.25mm.

A range of small twist drills from #80 or 0.35mm up to 5/64" or 2.0mm.

A 'Hold and Fold' device (4" or 100mm size) is also useful for bending some of the etched parts to shape.

CONSTRUCTION

It is important that all cast parts are free of "flash" – (excess metal along the part line.) and fit properly. Flash may be removed from the white metal castings by scraping gently with a sharp knife. Files are required for cleaning up the brass and nickel silver detail castings.

All locating holes for wire piping and fixing details should be drilled prior to assembly. It is often simplest to drill holes in etched parts while they are still part of the etch sheet. "Tinning" of etched parts (eg. where they are required to be attached to white metal castings) can also be done while the part is still attached to the main sheet.

Etched items can be removed from the sheet with a fine pair of side cutters, or by placing it on a scrap of hard timber (eg masonite) and cutting the tabs with a large Stanley knife. Take care not to distort the parts while cutting them free. Trim the remains of the tab off the part with needle files. All etched parts feature a "cusp edge". This cusp may require smoothing with needle files to allow parts to fit accurately. Etched parts which require folding incorporate half etched lines to locate the bend. As a general rule, the half etched line goes *inside* the fold. The only exception is when a part must be bent double, at 180°, when the half etched line is to the *outside* of the fold.

Always check the fit of the parts prior to fixing. Adjust as necessary before fixing them in place. In many cases it is possible to solder details from *behind* the surface to which they are fixed. When attaching white metal castings with low melt solder use plenty of flux. The flux acts as a heat transfer medium and helps the solder to penetrate the joint.

As with all classes of V.R. locomotives, individual X's varied in minor details over the years. Modellers are therefore advised to refer to photographs of the prototype if they wish the model to reflect a particular class member at a particular time.

During construction refer to the drawings at all times. Parts should be as drawn on the illustrations, so be careful that you have the right part.

Parts are identified on the drawings with a prefix:

- W** for White metal castings,
- L** for Lost wax brass or nickel silver castings
- E** for Etched parts.

The instructions sometimes refer to the right-hand (**R/H**) and left-hand (**L/H**) sides. This is taken as viewing the model from above and looking forward.

To minimise the risk of losing parts, do not remove them from the etched sheets or plastic packing until they are required. It is recommended that construction start with the tender, to develop your skills before tackling the locomotive.

SAFETY FIRST These models are not toys and are not suitable for young children.
White metal castings and solder contain **LEAD** and modellers are advised to wash their hands after working on construction.
When using superglue, solder or when spray-painting, ensure the work area is well ventilated.

TENDER

Refer to drawings 1 to 4

Underframe

Solder the turned brass bogie pivot bosses (E226) to the tender underframe (E72) and bend the front headstocks down at 90°. Bend the ends of the floor valance strips (E102 and 103) down at 90° and then bend the last little section back over at 180°. This last bend is an example where the half etched line is on the *outside* of the bend. Now solder these strips to the bottom face of the floor along each edge. Use the minimum of solder, so that the slots used to locate the side sill strips remain clear. Once the valance strips are soldered in place file the edge of the floor and valance strip to remove the cusp edge, so that the combined thickness is smooth and represents the 2" angle steel along the edge of the underframe. Drill 0.4mm holes at the four marks along the lower edge of each side sill strip (E63 and 64), form hooks from 0.4mm wire and solder one in each hole. Refer to the detail view on figure 1. Solder the side sill strips to the tender floor, ensuring that the strips are straight and stand at 90° to the floor. Enlarge the holes etched in the side sills until the rope hitches (L33) can be fitted in place, then solder from behind.

The rear headstock (E67) has half etched dots on the rear face. If you have a rivet press, you can press out these dots to form rivet detail on the front face. Otherwise it is best to leave the dots alone as using a pointy tool and hand pressure will cause distortion. Solder the rear headstock to the floor and side sills.

Turn the floor over, bend the U shaped brake lever supports etched into the floor at 90° and reinforce each bend with a small fillet of solder. Now solder the two centre sill strips (E65) to the floor, using the tabs and slots for location. Also solder the coupler support (E66) to the tender floor.

Screw the drawbar pin (P/N108441) into the threaded hole towards the front of the tender floor. Enlarge the hole in the reinforcement (E45) to 2mm diameter and solder the plate and the pin in place. Dress the top surface smooth with a file. Drill 0.7mm diameter holes in either end of the brake cylinder (W1) and then solder it to the underframe. Push the levers (E75 and 76) into the drilled holes and secure each lever etching to the cylinder with low-melt solder. Also secure the levers to the U shaped supports with solder.

Tank

A representation of the conduit has been etched on the rear of the tender wrapper (E59), but it is quite shallow. If this is acceptable, then proceed straight to forming the tank to shape. If you would like to overlay this representation with pieces of wire to represent the conduit then drill 0.35mm diameter holes at each of the positions that are half etched on the inside face of the rear. These pairs of holes will be used for fine wire clips to hold the conduit in position. Drill a 0.8mm hole at the point marked behind the junction of the vertical conduit to the backup light and the horizontal conduit.

Fold the bottom edges of the tender wrapper at 90° along the half etched lines and fold the small tags over 180°, to make them double thickness. Bend the tank into a U shape using the half etched lines in the back corners to guide and a 1/8" diameter rod standing upright as a former. Check the fit of the top deck (E71) to make sure the bends are correctly located and the correct radius. If you have a 12BA tap then tap the hole in each tag 12BA. If you don't, then enlarge the hole in each tag to 1.3mm, oil the thread on a 12BA screw, push it through from underneath and thread on a 12BA nut until it is tight. Carefully solder a nut to the top of each tag and remove the screw once the solder has cooled. It will now be possible to temporarily attach the tank wrapper to the underframe with four 12BA x 3/32" screws.

Bend the coal doors (E61) to shape and add small handles formed from 0.3mm wire. Check that the overall width of this part is the same as the bunker floor section of the top deck (E71), otherwise there will be problems later assembling the bunker. If necessary adjust the angle of the 'vee' bent into the coal doors. The lifting eyes on the top edge should be inclined at about 45°.

Form the tender front (E60) to shape and solder the steps (E98) in place. Also add the horizontal handrail at the top left and the small tap (L5) in place. These parts are shown on Fig 2. After soldering, use a file to ensure that the back of E60 is smooth. Solder the coal doors centrally behind the tender front and ensure that the holes provided in both parts for the hand-brake wheel (L35 on fig 2) are in alignment.

Form the bunker sides and rear (E74) to shape. Solder the bunker sides to the tender front so that the coal doors run between the sides of the bunker and act as a spacer. Position the front between the sides of the tank wrapper and on top of the underframe, located by the tags on the front and bunker sides engaging with the slots in the underframe. Solder at the corners of the tank, taking care not to solder the tank to the underframe.

Carefully file the cusp edges from the footplate supports (E62 and 70) and form E62 to shape. If the cusp edges are not removed first the shape of E62 will not be neat and square. Check the fit of all parts against the tender front and, when satisfied, solder the two inner supports (E70) to the front first, followed by E62. Fold the two steps (E96) to shape and solder one on either side of the support. Finally solder the footplate (E77) on top of the supports.

Bend the supports for the top deck (E42 and 46) to shape and secure them inside the tank wrapper with a couple of tacks of solder.

The holes for locating the water treatment box and the tool box are only half etched on the underside of the top deck (E71). For a 1950s period model, drill through the outer two of the three holes and enlarge them until the locating pegs on the water treatment box (W2) and the toolbox (W4) will fit. For a locomotive with wagon top boiler, only open up the centre hole and solder the toolbox in place. Solder the two lifting eyes (E73) into the slots etched in the top deck and form the bunker floor to shape. Check that the top deck can be slid into position.

When satisfied with the fit, undo the four 12BA screws and remove the tender tank from the underframe. Tin the edges of the sections of the top deck that will run either side of the bunker and slide the top deck into position. Now secure the top deck to the tank by soldering around the edges from underneath. The bunker floor can also be soldered to the bunker sides from underneath. The top deck can only be attached to the bunker sides and the tank wrapper by applying flux to the sections tinned earlier and then using the soldering iron from outside the tank wrapper and inside the bunker. Mind you, it will not be a problem if these last joints are left unsoldered. While the tank is separated from the underframe also solder the water treatment box (W2), the toolbox (W4) and the water hatch (W3), securing all with low-melt solder from underneath. Drill 0.35mm holes in the tank filler and add a handle formed from 0.3mm wire. Drill 0.7mm holes at the marks on the water treatment box and add the two pipes from 0.7mm wire. Form a handrail from 0.4mm wire and solder it in the back corner of the top deck, so that it projects above the back of the tank wrapper by about 1mm.

Solder the handbrake wheel to the tender front and add an operating spindle from 0.7mm wire. Form two handrails from 0.4mm wire and solder them on either side at the front corners. The bottom of each handrail locates in a notch etched into the footplate support (E62), so that the handrail won't interfere with the underframe.

Detailing the Underframe

While the underframe is still separate from the tank, solder the cast steps (L40) to the front corners of the underframe and the rear step (L22) to the left rear corner. Form the stirrup step (E97) to shape and enlarge the hole in the tag on the top right corner with a taper broach or 0.35mm drill. There is a small mark to the left of the rearmost hook on the R/H sidesill. Drill this place 0.35mm and solder a short piece of 0.3mm wire into the hole. Now put the step in place, with the tag on the left engaging a slot in the side sill, the tag on the right located by the 0.3mm wire pin and solder from behind. Trim the wire on the front, but leave a small amount proud to represent a fixing bolt.

Form the guard irons (E23 and 24) to shape and solder to the headstocks as well as the brake hose (L39). Use low-melt solder to attach the two buffers (W5) to the headstocks, soldering from behind.

Form an uncoupling handle from 0.3mm wire and thread the lifting arm (E90) into a position close to the centre. Lay the handle on top of the tags that extend from the rear edge of the floor and secure it by bending the tags back over double on

top of the handle. Slide the lifting arm into final position adjacent to the centre support and secure it to the handle with a touch of solder, taking care not to solder the handle to the support at the same time.

Detailing the Tank

Temporarily attach the tank to the underframe and solder the two brackets (L16) to the tank, taking care not to solder them to the underframe. Now remove the tank from the underframe, because all the other details should be soldered from inside the tank. Add the back-up light (L17) the marker lamps (L10 and 12) and the plugs (L15).

If you are going to add wire conduit then drill 0.4mm holes in a junction box (L38) so that it can be threaded onto a piece of 0.4mm wire. Bend the wire to shape, so that it runs from the top of the plug on the right, across the back of the tender and down to the bottom left corner. Secure the conduit by soldering the junction box into its locating hole and making U shaped clips from pieces of copper wire stripped from the pink multi-strand wire, which locate in the pairs of holes drilled earlier. Form little connecting loops from the same copper wire to run from each electrical plug to the underside of each marker lamp. Run a second 'L' shaped length of 0.4mm wire to represent the conduit from the top of the junction box up to the back-up headlight and secure with another U shaped clip of copper wire. Run a short length of 0.4mm wire from the top of the L/H electrical plug to the horizontal conduit.

Fettle the appropriate ladder (E68 or E69) to remove the cusp edges and make the rungs look as round as possible. For a welded tender, form two handrails to shape from 0.4mm wire and solder them in the holes in the rear corners of the tank. For a riveted tender there is only a rail on the right. Now solder the appropriate ladder in place, the E68 located by the tags and slots on the riveted tender and the E69 immediately to the right of the handrail on the left corner of the welded tank.

Finally, tin the back of a tail disc (E86 or 87), either open or closed at your choice and sweat it in place, below the conduit and just to the right of the vertical centreline.

After all the detailing is finished the tank can be re-attached to the underframe with four 12BA x 3/32" screws.

Bogies

Insert the bearings into the holes in the back of the bogie side-frames (W6). Make sure that the bearings are pushed all the way into the holes. If necessary make the holes a wee bit deeper by twirling a 2mm drill by hand. Secure each bearing with a touch of low-melt solder.

Attach the side-frames to the bogie stretchers (E21) using four 12 BA x 3/32" cheese-head screws.

Do not over tighten the screws or they will strip the thread in the side-frames. Slacken off the screws and install the 10.5mm spoked wheels with the pinpoint axles. Tighten the screws and check that the wheels turn freely.

Cut a spring (P/N108342) in half and put one piece over each of the shouldered M2 screws (P/N108144) before attaching the bogies to the underframe.

Finally a Kadee coupler, either No 5 or No 58, can be attached to the bracket provided at the rear of the underframe, using an M2 screw (P/N 108074). If you will be running the tender with other buffered stock or double heading, you may need to use a coupler with a longer shank to avoid problems with the buffers.

LOCOMOTIVE

Chassis

(refer to drawings 6, 7 & 8)

Half etched, push-out rivet detail is provided on the frame plates (E1 and 2). If you own a rivet press you may like to push these out, otherwise they are best ignored. Bend the joggles in the rear of the frame plates, taking care that the half etched line is to the ***inside*** of the various bends and each one is at 45°. Fold the spacers (E6) double and then assemble the frames with these etched spacers placed between the frame plates and the machined brass spacers (P/N108396), using the four M2 screws (P/N108386). Orientate the folded spacers so that the connecting tags are at the top and the bottom edge is flush with the frame edge. The machined spacers also need to have the cross-hole orientated vertically.

Slacken the screws on one side slightly and insert the spacers (E3, E4 and E5) as well as the air reservoir (W11) between the frames. Place the frames on a hard, flat surface such as a sheet of glass and tighten the screws. Make sure that the reservoir doesn't cause any distortion to the frames. If necessary slacken the screws, remove the reservoir and file one end slightly shorter and repeat the process. When all is good solder E3, 4 and 5 to the frame plates and use low-melt solder to fix the reservoir in place. It is also a good idea to reinforce the visible 45° bends in the rear of the frames with a fillet of solder.

Enlarge the holes in the centre of the half etched hexagon recesses in the rear headstock (E22) to 1.3mm. Put a 12BA x 3/32" screw in each hole and oil the thread before screwing on a 12BA nut. Carefully solder the nuts to the rear headstock and remove the screws. Locate the rear headstock on the tags at the ends of the frame plates and solder.

Use a similar technique to solder an M2 hex nut above the forward hole in the spacer E4. This nut will be used later to attach the booster engine, as shown in the detail view on fig7.

Bend the upper ash-pan sides (E51 & 52) to shape, locate the tags on the bottom edge in the slots provided along each edge of the spacer E5 and solder in place. Form the motor support (E10) to shape, locate the tags in the slots in E5 and solder from underneath. Form the lower ash-pan (E58) into a U shape, locate the tag in the forward slot of E5 and solder in place.

Solder the detail plates (E7 & 8) to the frames, taking care that the two holes in each are in exact alignment with the holes in the frames.

Use low-melt solder to fix the rear beam castings (W12) to the junction of the frames and rear headstock.

Driving Wheels and Gearbox

Turn the frames over and install the driving wheel-sets. Note that the arrangement of the bearings is slightly different for the first and fourth axles, as compared to second and third. The first and fourth axles have the horn-blocks arranged on the axles so that the outer flange is thicker and there will be minimal lateral movement on these axles. The second and third axles have the thinner flanges on the horn-blocks to the outside, allowing a small amount of lateral movement. Of course the driving gear is on the third axle as well. Check that each of the axles can spin freely when installed in the frames. If the first or fourth axles are a little tight, check for a very small amount of lateral movement. If there is none, check that each end of the axle is flush with the face of each wheel hub. If the axle is standing proud, gently press on the end of the axle with a flat instrument, so that it will be flush with the face of the wheel hub.

Bend the spring detail and brake supports along the edge of the keeper plate (E11) down at 90° and reinforce each bend with a small fillet of solder. The narrow supports for the first and third brake shoes are especially vulnerable and you will have the keeper plate on and off many times before the locomotive is finished and the solder fillets will help prevent any getting broken with handling. Ensure that all the horn-blocks are orientated with one edge parallel to the bottom of the frames, temporarily attach the keeper plate with M2 screws and check once more that the drivers spin freely.

Attach the counterweights (E17, 47 & 48) to the driving wheels with superglue.

Thread the phosphor bronze washers and bearings onto the worm shaft and place it in one gearbox half along with the idler gear. Apply a smear of plastic compatible grease, such as Labelle 106 to the gear, add the second half of the gearbox and fasten the two halves together with the M1.4mm screws provided. Do not over-tighten the screws and check that the worm shaft rotates freely by hand to drive the idler gear.

Form the motor mounting bracket (E55) to shape and reinforce each bend with a fillet of solder. Fasten the motor to the bracket using the two M2 x 2mm screws provided with the motor and then fasten the bracket to the chassis with two M2 x 3mm screws (P/N108072). Slip the piece of silicon rubber tubing supplied with the gearbox over the input shaft and over the motor shaft and lower the gearbox over the driving axle. Fasten the gearbox in place with the bottom keeper plate and two M1.4 x 5mm screws. Do not over-tighten the screws and check that the motor shaft turns freely by turning the rubber tubing over by hand. Hook up some test leads and check that the motor and gearbox combination runs freely at a range of voltages; especially that it operates smoothly at low speed. Once satisfied, remove the gearbox and the motor, because they will just get in the way while the cylinders and motion gear are assembled.

Rods and Valve Gear

Coupling Rods

When assembling the motion gear, please note that it is most important to check each and every stage of assembly for free movement before going on to the next.

The connecting and coupling rods (E 13, 14 and E 15, 15) respectively are to be laminated in two layers, to produce scale thickness. Tin the mating surfaces of these parts and remove them from the sheet, but **do not** remove the tags connecting the front and back halves.

Fold the front half over the back half and align the holes and edges. Place the parts face down on a hard surface such as a ceramic tile and sweat the two layers together. As you solder, press the layers together with a pointed probe. After soldering, remove the tags, clean up the cusp edges of the parts by careful filing and polish with a fibre-glass eraser.

Take care that the coupling rods stay straight during all this filing and fettling. Use a set of taper broaches to clean up the crank pin holes in the coupling rods so that they are a neat fit on the crank pins, with just a small amount of clearance; about 0.1mm. Note that the main crank pin is 2mm diameter and all the others are 1.6mm.

Place the coupling rods over the main crank pins and add the six hex-head crank pins to the other driving wheels. The screws will self tap in the crank bosses of the wheels and use the long M4 grub screw as a socket spanner. Take care that

each screw is driven into the crank boss with its axis perpendicular to the plane of the wheel and **do not over-tighten the screws**. It will help in this regard if the grub screw is filed slightly shorter to reduce the depth of the hexagon recess.

Check that the wheels still turn over freely. If they do not and there is a 'bind' at a particular position, take note of where the bind occurs. Remove the coupling rods on the side where the rods are closest to the 3 o'clock or 9 o'clock position and use a taper broach to very slightly increase the diameter of the crank pin holes, although it is best to leave the main crank pin hole with just minimum clearance of about 0.1mm. Replace the coupling rods and check again for free movement. Repeat this step as many times as necessary until the chassis can be pushed up and down a length of track with everything turning freely.

Cylinders

Drill a 1.0mm hole in the centre of the piston rod gland in the middle of each slide-bar casting (L6) and polish the piston rod incorporated in each crosshead casting. Insert the piston rod into the slide-bar casting from the back and check for free movement. Polish the slide-bars by draw filing and test that the crosshead moves freely up and down the slide-bars. Use a piercing saw and/or fine needle files to polish and fettle the channels at the top and bottom of each crosshead until they can move very freely up and down the slide-bars. Make sure that the slide-bars are parallel, straight and perpendicular to the plane of the gland casting in the middle. Once satisfied with the alignment and free movement, set the parts to one side in matched pairs.

Assemble up two cylinders, one L/H and one R/H, from parts W7, 8, 9 and 10. Remove the cusp edge from the circumference of the rear covers (E12) and check the fit with the slide-bar castings. When satisfied, solder the rear covers and the slide-bar castings to the rear of each cylinder assembly, ensuring that the plane of the slide bars is parallel to the inner face of each cylinder block casting. Bend the plating (E99) to shape and solder it to the rear cover, positioned up against the gland casting. Drill down through the centre of each valve guide casting (W10) and into the cylinder block with a 0.7mm drill.

Slide a crosshead into its appropriate slide-bar casting and check the length of the piston rod. It should be possible to slide the crosshead away from the cylinders, until the rear part of the crosshead is at the end of the flute cast into the side of the slide-bar, without the piston rod falling out of the gland casting. A length of piston rod about 10.5mm beyond the collar cast as part of the crosshead will be about right.

Connecting Rods

Assemble the two connecting rods (E15 & 16) in the same way that the coupling rods were laminated together. Add the brass bearing plate (E79) to the outer face of the big end. Remove the connecting tags, file the cusp edges and polish with a fibreglass burnishing brush. Clean up the holes with taper broaches until the big end fits over the main crank pin and the small end fits over the pin cast on the back of each crosshead. When a good fit is achieved, check that you have the R/H connecting rod with the R/H crosshead and place the small end over the pin on the back of the crosshead, followed by the retaining plate (E78). Secure the retaining plate with a small amount of solder along the top and bottom edges, ensuring that the connecting rod can still move freely. File the back of the crosshead smooth, removing any excess solder. Repeat for the L/H parts.

Drill 1.0mm holes through the link support brackets (part of the motion bracket, L51 & 49) and through the centre of each expansion link (part of the return crank assembly) at the points marked *e on fig 7, as well as through the little eye on the top edge of the radius rod (part of the valve gear assembly riveted to the crosshead).

Solder each motion bracket to the respective side of the frames, ensuring that they are square to the frames and vertical. Check the fit of the plates E100 and E101, but leave these off for now. Offer up the cylinder assembly and check the fit.

It will probably be necessary to file the slide-bars slightly shorter, so that the cylinders locate in the holes in the frames and the slide bars butt up against the motion bracket without forcing.

When satisfied with the fit, slide the crosshead into the slide bars and thread the valve spindle (part of the linkage riveted to the crosshead) into the hole drilled earlier in the valve guide (W10). You may need to trim the valve spindle a bit shorter, depending on how deep the hole is drilled in the cylinder block. Now thread the rear end of the radius rod through the opening in the front of the motion bracket (at the point marked *d on fig 7) and position the cylinders with the pegs locating in the holes in the frames. Temporarily thread a 14BA screw (P/N 108030) through the link support brackets and through the eye on top of the radius rod (marked *d and *e on fig7) Tack the cylinder casting in place with a small amount of low-melt solder at the top and bottom edges.

Position the chassis on its side and place a couple of etched washers (2 x E20 or 1 each E19 & E20) on the main crank pin. Now put the big end of the connecting rod on the crank pin and rotate the wheels by hand. Check that everything moves freely. Points to watch are that the combination lever (the vertical lever in the valve gear assembly) doesn't bind on the rear edge of the valve guide casting, that the piston rod doesn't go too far into the cylinders and hit the front cover and that the back of the crosshead clears the crankpin on the leading driving wheels. You may need to break the solder

tacks and remove the cylinders to undertake some filing and trimming. Only when you are satisfied that all is moving freely should the cylinders be soldered in place with a fillet of low-melt solder along the top and bottom edges.

Valve Gear

Check the fit of the head of the M1.4mm pan head screw in the recess cast in the return crank. If necessary use a 2.0mm drill twirled between the fingers to clear the recess of any extraneous casting dags. Also check that some 0.45mm nickel silver fret waste can be slid through the slot cast through the expansion link. If necessary, enlarge the slot slightly by careful use of a jeweller's piercing saw.

When satisfied, remove the 14BA screw and put the expansion link in place between the link support brackets, with the radius rod passing through the slot in the centre (marked *e on fig7), then replace the 14BA screw. Make sure you have the R/H assembly positioned on the R/H side of the locomotive or vice-versa. Attach the return crank to the main crank pin with the M1.4 pan head screw and check for binding by rotating the wheels by hand. Points to watch are that eccentric rod doesn't foul the head of the M1.4 screw, that the slot in the expansion link is long enough to accommodate the radius rod and that 'wagging' of the expansion link doesn't cause it to foul the motion bracket. If necessary the head of the screw can be reduced slightly by filing until it is flush with the face of the return crank casting and the amount of 'wagging' of the expansion link can be reduced by rotating the main crank pin very slightly in the driving wheel. The crank pin is only pressed in place and the return crank can be used as a handle to apply gentle rotational pressure to reduce the throw of the crank.

Only when you are satisfied that all is moving freely should the 14BA nut (P/N108030) be threaded onto the 14BA screw. The excess length of screw can be trimmed with some side cutters (wear eye protection) and put a touch of solder on the screw where it emerges from the nut. To improve appearance, some of the screw head can be filed away until the slot disappears. You may also wish to fit the plate E101 at this point, although it is quite a fiddle to get it in place and hardly noticeable if it's missing.

Repeat the procedure for the other side.

Turn the chassis upside down and drill three 0.8mm holes and two 0.9mm holes at the marks in each cylinder casting. Attach the drain cock castings (L43) in the 0.9mm diameter holes and short handrail stanchions (P/N109566) in the 0.8mm diameter holes. Add operating rods formed from 0.4mm wire, threaded through the holes in the stanchions and attach the other end to the bottom of the respective motion bracket.

Leading and Trailing Trucks

Check that the lead truck wheelset can rotate freely in the casting (W20). If necessary, polish the slot until the axle spins freely and ensure that there is one washer on each side of the casting when the axle is in place. Attach the truck frame (E54) with a 12BA x 3/32" screw (P/N108031) but ***do not over-tighten the screw.***

Select the parts for your chosen trailing truck (W13-15 for cast or W16-18 for fabricated) and drill 1.7mm diameter holes in the sides of the front fixing bracket (W15 or 18). Check that the bearings can be pushed into the hole cast into the back of each side-frame and, if necessary, make the bearing hole deeper by twirling a 2.0mm drill between the fingers.

Secure each bearing with a touch of low-melt solder and assemble the side-frames to the cross-member (E53) with two 12BA x 3/32" screws. Leave the screws loose to allow the wheelset and the respective fixing bracket to be installed to be installed between the side-frames. Now tighten, but ***do not over-tighten the screws.*** Solder the front portion of the booster engine (W19) to the cross-member.

Assemble a drawbar from two layers of brass etching (E38 is scale, but E39 is more suitable for an operating model). Attach the drawbar to the rear of the chassis with an M2 x 5mm screw, half a spring and an M2 nut (P/N 108074, 108432 & 108105 respectively). Leave the nut flush with the end of the screw and secure with a touch of solder, so it can't work loose.

Drill 1.4mm diameter holes into the underside of the ball joints of the rear section of the booster engine (L47) and attach the booster engine to the chassis with the M2 countersunk screw (P/N108090).

Attach the leading and trailing trucks with the shouldered screw and the M2 screw with bush (P/N 108031, 108077 & 109624 respectively) and check that the trailing truck can move from side to side freely.

Injectors

Cast brass injectors are provided (L46 & 48), but they can safely be ignored if you are building an engine with a booster. The injectors are hidden by the booster piping and will make life difficult assembling and removing the upper body from the chassis. If you are building a model of X36 without a booster then solder the appropriate injector into the vee of the rear beam casting as shown in the detail view of the R/H side on fig7. Solder an overflow formed from 0.7mm wire to the injector and to the brackets hanging below the rear headstocks. Add a short stub of wire pointing towards the cab to represent the steam supply. The delivery pipe is best left for later. If you are building an engine with a booster, just solder a length of 0.7mm diameter wire to the brackets below the rear headstocks and route it in the direction of where the injectors *should* be.

Brake Rigging and Pick-ups

File a gap in the centre of each piece of copper plated circuit board and use 5 minute epoxy to attach them to the bottom of the cover plate; one centrally between axles 1 and 2, and one immediately behind the cut-out for the gearbox. Form the phosphor-bronze pick-ups (P/N E116/1717) to shape, so that each end does a 'U' bend around the etched driver spring for axles 1,2 and 3, but it will need to do a 'Z' joggle for the rear driver in order to clear the trailing truck frame.

Make sure that each pick-up rubs on the back of the respective driving wheel tyre and solder the central tag to the copper circuit board, generally as shown in the detail view on fig6. Solder linking wires between the patches of circuit board, which can be insulated wire or just lengths of 0.4mm brass wire. Add leads from the rear patch, routed through the holes in the back end of the keeper plate and up to where the motor goes.

Use a taper broach or 0.7mm drill to enlarge the holes in the ends of the brake shoes, the pull rods and the brackets hanging below the cover plate (E26 & 27, E50 and E11 respectively). Thread 25mm long pieces of 0.7mm wire through the brackets in the cover plate and through the holes in the pull rods. Position the pull rods centrally and about 7mm apart, so that there is no risk of them contacting the pick-ups installed earlier. Solder the wires to the brackets and to the pull rods, with equal amounts of wire projecting on either side. Thread each brake shoe over the projecting end of the 0.7mm wire and solder in place, so that the face of the brake shoe is flush with the driving wheel tyre and the curved edge of the shoe is parallel to the wheel tread. Trim the excess wire, so that about 0.3mm of wire projects through the brake shoe.

If you like you can re-install the motor and gearbox at this point and run the wires from the pick-ups to the tags on the motor. The wire from the R/H side should go to the + motor tag. You can support the model on blocks and connect some test leads to the motor, to see that the chassis operates smoothly and if all is OK, then test run the chassis up and down a length of track. It may be necessary to adjust the pressure and/or the shape of the pick-ups.

Cab

Refer to Drawing 5

Bend the armrests (E31) to shape and solder one in each of the open cab side windows of the appropriate cab (E25 or E28 for Belpaire and wagon top boiler respectively). The long leg of the angle is positioned on the inside wall of the cab, with the short leg projecting through the opening.

Fold the cab walls and floor to shape along the half etched lines. Cut sections of clear plastic to fit the front window openings. The L/H one can be larger than the opening by 0.5mm all round, but the R/H one should be a neat fit. Put these aside in an envelope. Solder the door (E43) to the R/H side of the cab front and make a door handle from 0.3mm wire. Solder the junction box (L29, shown on fig10) to the cab front above the door.

Solder the appropriate reinforcement to the bottom section of the rear wall (E80 & 40 or E81 & 29 for Belpaire and wagon top boilers respectively). Form handrails from 0.4mm wire and solder them to the rear wall of the cab. File any projecting wire flush on the inside face of the rear wall. Add the rear window covers (E89) below the window openings, orientated so that the two tags that represent the hinges are at the top.

Solder the rear wall into the cab, so that the rear wall goes *between* the sides. There is a small step where the curve at the top of the rear wall meets the straight side edges. Position the rear wall so that this step is even with the top edge of the cab sides.

Place the cab upside down on a block of wood, so that it is supported by the top edges of the side walls. Solder lengths of 0.5mm wire to the top edge of each cab side, to represent the gutters. Trim these wires flush with the front and rear walls, then add down spouts from 0.4mm wire, located by the marks etched on the side sheets.

Bend the tags on the fall plate (E83) down at 90° and put them in the slots etched in the lower floor incorporated in the main cab etch. Place the etched wood-grain floor (E 41 or E30 for Belpaire or wagon top boiler respectively) over the floor, trapping the fall plate. Solder the floor around the edges, so that it is flush with the opening in the rear wall and the fall plate can hinge up and down.

For a model with a Belpaire boiler, enlarge the opening in the L/H side outer floor section (W25) to clear the staff exchanger incorporated in the driver's seat (W24).

Solder the outer floor sections in place and add the cab seats (W23 & 24 or W23 & 52).

For a model with a Belpaire boiler, drill a 0.4mm hole through the top of the triangular arm cast on the back surface of the staff-exchanger recess. Form a 'Z' shaped horn from 0.4mm wire and fix it into this hole with superglue. Drill the upper mark cast on the back of the operating arm 0.4mm diameter and attach the lever (E44) with a short length of 0.4mm wire.

Drill 0.7mm diameter holes in the backhead for the regulator and reverser wheel (L24 & L23 respectively) and solder each in place.

Leave the backhead and roof separate for now.

Boiler and Footplate Refer to Drawings 9 to 12

The order of assembly described here doesn't exactly match the sequence shown on the drawings, but has been worked out so that each item added won't make it too difficult to add later parts.

Check the fit of the firebox with the boiler and file and fettle the castings until a good fit is achieved. Use low-melt solder applied from the inside to attach the firebox to the boiler.

Drilling

Drill holes in the boiler at the places marked. Refer to the appropriate drawings, because not all the items listed are applied to a locomotive with wagon top boiler and it is only appropriate to fit smoke deflectors to an engine that has the modified front end with the larger funnel.

Drill 0.8mm for handrail knobs and injector starting valves (on the sides of the firebox), 0.6mm for smoke deflectors brackets, reverser reach rod guide brackets and whistle shroud, 0.9mm for the whistle, three 0.7mm holes for conduit junction boxes on the smokebox, and 1.0mm holes for the boiler feed check valves. Note that for wagon top boilers there is a choice of either top feed, using the positions cast in front of the dome, or side feed located as per the detail drawing on fig 10. If fitting the side feed then carefully file off the bases cast in front of the dome. The version with wagon top boiler also has a choice of single stage or cross compound air pump. Refer to fig10 for the location of the different pumps and bear in mind that the single stage pumps only lasted in service a couple of years. The choice of pump will also affect the location of the forward sections of handrail on the RH side of the boiler.

Drill 2.0mm holes for the dome, funnel and air compressor as well as the turbo generator on the Belpaire firebox. The wagon top firebox just needs a 0.5mm hole to locate the etched bracket for the turbo generator.

Drill 1.1mm holes in the top of the firebox for safety valves.

While in drilling mode, drill the top face of the footplate for the various details. Note that a locomotive with wagon top boiler will not have A6ET brake equipment (no distributing valve and reservoir), or mechanical lubricator with the attendant steam manifold and atomiser castings.

Drill 1.1 mm for the reverser weigh-shaft and sand box fillers, 1.5mm for the reverser cover, mechanical lubricator, distributing valve and the forward sections of booster piping (W41 & 42). Note that if the locomotive is to have the booster exhaust direct to atmosphere behind the dome, then the hole for W42 is located 26.5mm in front of the cab and 3.8mm in from the edge of the footplate. Drill two 0.4mm holes for the base of each smoke deflector and for each stool (E104) which is used to support the booster piping. Note that there will not be any stools on the R/H side if the booster exhausts direct to atmosphere.

Drill 0.5mm holes for the manifold casting (L31) and the atomisers (L41). Drill 0.9mm holes at the locations where the boiler feed piping, the piping from the injector starting valves and the blow down muffler exhaust go through the footplate. Refer to fig 12 for locations. Also drill two 0.9mm holes in each side of the turret cover (W30) for the piping.

Detailing the Footplate

Install the cab on the footplate, attaching with low-melt solder along the bottom edge of each cab side. Form the forward section of the frames and guard irons (E18) to shape and add the detail plates (E9). Check the fit against the underside of the footplate, to make sure that the front of the frames finishes flush with the front of the footplate. It may be necessary to slightly enlarge the holes in the etching to allow it to fit over the pegs cast in the bottom of the footplate. When satisfied, solder the frame extension to the footplate with low-melt solder.

Check the fit of the boiler on the footplate. If necessary give the boiler a rub over on a large file to ensure that the base of the firebox and the bottom of the smokebox saddle are in the same plane. Temporarily attach the boiler to the footplate with an M2 x 8mm screw and M2 nut (P/N 108077 & 108105). The nut can be fixed in the smokebox with careful use of 5 minute epoxy or low-melt solder. Fit the two dry pipes (W39) between the smokebox and the footplate, but only solder

the pipes to the footplate. The centre of each pipe should be in line with the centre of the small access door cast in the surface of the footplate. With the boiler still in position, drill 0.7mm holes up through the footplate from underneath and into each dry pipe by about 3mm deep. Insert some reinforcement of 0.7mm wire in each hole and secure with superglue. Now remove the boiler.

Add the various details to the footplate, securing with low-melt solder from underneath. Start with the reverser weigh-shaft (L50), then the reverser covers (W38), the sand box fillers (W46) and the support stools (E104) for the booster piping. Bend a joggle in the crank arm of the reverser weigh-shaft, so that the top is displaced outwards by about 3mm. For a version with Belpaire boiler also add the distributing valve and reservoir (W45), the mechanical lubricator (W37), the steam manifold (L31) and the atomisers (L41).

For a version with wagon top boiler and booster exhaust behind the dome, there will only be stools on the L/H footplate. For this version trim the forward section of pipe from the steam separator (W42) and drill 1.6mm holes in either side before soldering this casting to the footplate. Bend a short section of 1.6mm wire to represent the section of pipe from footplate level beside the firebox up to the separator and fix it in place with low-melt solder. Don't fit the exhaust pipe yet; it will only get in the way.

For both versions, trim the forward section of the L/H booster pipe (W41) so that the pipe butts up against the L/H dry pipe. Locate the main section of booster piping (W40) in the support stools and secure with a touch of low-melt solder at each stool and to the footplate at the firebox end. Also attach the forward section to this pipe, the footplate and the L/H dry pipe with low-melt solder.

If you are building a version with wagon top boiler, it is worth adding the steam pipe from the R/H dry pipe which ran under the boiler and connected with the L/H booster pipe just in front of the L/H dry pipe. Bend a section of 1.6mm wire to shape, as shown in the detail view on fig 10 and check the fit. Note that it is also necessary to bend a 'sag' of about 1.5mm in this pipe, so that it can run under the boiler without interfering. Support each end of the pipe on some 1.5mm polystyrene packers and tack the pipe in place with low-melt solder. Check the fit of the boiler. If necessary break the solder joints and bend the 'sag' a bit deeper until the pipe clears the underside of the boiler. When satisfied, remove the boiler and solder the pipe in place. This pipe is concealed by the smoke deflectors and the booster exhaust on the Belpaire boiler version and can safely be ignored.

For the Belpaire version, temporarily attach the boiler and solder the steam separator and pipe (W42) to the footplate, so that the forward end of the pipe is against the smokebox. Position the booster exhaust pipe (W44) in the support stools, so that the front of the pipe locates against the steam separator and secure it with low-melt solder.

Drill 0.4mm holes at the locating marks in the curved cover in front of the smokebox saddle and make a handle from 0.4mm wire, securing it with superglue.

Bend the lamp base (E35) to shape and solder it to the front left side corner of the footplate. Add a cast lamp (W48) if desired.

Finally, trim any locating pegs flush with the underside of the footplate and file smooth.

Front Headstocks

There are two groups of three holes along the bottom edge of the headstock (E32). Drill 0.35mm diameter through the centre hole of one group of three and into a block of wood. Insert a length of 0.3mm wire into the hole and trim so that about 5mm is left projecting. Repeat for the centre hole in the other group of three.

If you are fitting a white-metal lattice cowcatcher (W49) there are three raised bumps along the top edge on each side which represent the fixing bolts. Drill a 0.35mm hole through the centre of the middle bump on each side of the cowcatcher and use the holes to locate the cowcatcher over the lengths of wire projecting from the headstocks. Attach the cowcatcher with low-melt solder and trim the wires, so that a small amount is left to represent the fixing bolt. The optional brass lattice cowcatcher already has the holes cast in place and it can be attached with normal solder.

For the plate cowcatcher, drill holes in all six positions and into the block of wood. Insert a length of 0.3mm wire into the centre hole on each side, fold the cowcatcher (E82) to shape and position it over the wires using the holes etched in the cowcatcher. Put additional lengths of 0.3mm wire into the other holes and into the block of wood before soldering everything in place. Trim the wires, but leave a small amount projecting on the front to represent the fixing bolts.

Solder the brake hose (L39) into the hole to the left of the position where the coupler pocket will go.

Form the uncoupling lever brackets (E91) to shape and also bend an uncoupling handle from 0.3mm wire. Thread the brackets and the arm (E90) onto the handle and solder the brackets to the headstock. Solder the arm to the handle in the centre, so that it projects horizontally when the handle is down.

Solder a tail disc, either open or closed (E33 or 34) to the top edge of the headstocks, so that it overlaps the headstocks by about 1mm and the centre of the disc is located 3mm to the left of the locomotive centre line.

Attach the buffers and the coupler pocket (W5 & W26) with low-melt solder, soldering from behind. Make sure that the crescent shaped cut-outs in the buffers are orientated as shown on fig10 and that the narrower slot in the coupler pocket is at the top.

Trim any projections flush with the back of the headstocks and file smooth.

Drill a 0.7mm hole down through the centre of the coupler pocket, through the shank of the dummy coupler (W51) and through the screw coupler. Secure the couplers with a length of 0.7mm wire. For an operating coupler you can drill a similar hole through the shank of a Kadee No5 or No58 coupler and cut the shank short, so that it will fit in the pocket.

For best appearance, cut the trip pin off below the coupler head, if you fit a Kadee coupler.

Now offer up the headstock subassembly to the footplate and position it so that the top edge is flush with the footplate and there is an even amount projecting on either side. The guard irons and frame extensions provide a useful guide to ensure that the headstocks are square to the footplate. Secure the headstocks with a fillet of low-melt solder along the underside of the join.

Boiler and Details

Solder or glue the two guide brackets for the reversing gear (L53) to the boiler.

Attach the boiler to the footplate with the M2 x 8mm screw and check that it lines up with the cab. When a satisfactory fit is achieved, fasten the firebox to the footplate and cab with a fillet of low-melt solder on the inside of the firebox.

Also solder the lower firebox sections (W31 & 31) to the footplate, fastening them with a fillet of low-melt solder on the inside. Note that a locomotive with a wagon top boiler should have the blow-down mufflers cut from each lower firebox section.

Smokebox

Solder the smokebox front to the smokebox, taking care to position it with the hinges on the right and horizontal. Drill the smokebox front where marked with 1.5mm for the headlight, 0.8mm for the handrail knobs, 0.7mm for the marker lamps and central hand wheel and 0.4mm for the handles in the lower hinge strip and left side of the door.

Bend a short section of 0.4mm wire into an arc that matches the holes drilled for the handrail knobs and thread four short handrail knobs (P/N109566) onto the wire. Fix the knobs to the smokebox front and the wire into the handrail knobs with superglue. When the joints are strong, cut the wire so that two short handrails are formed with a gap in between for the headlight. The wire should project from the knob at either end of each rail by about 0.4mm.

Solder the marker lamps (L10 & 12) to the lugs on either side of the front and solder the headlight to the hole in the centre at the top.

Bend handles for the left side of the door and the bottom hinge from 0.4mm wire and secure these handles and the hand-wheel (L20) to the door with superglue.

Large Details

Attach the funnel, dome and turret cover (W33 or 53, 34 & 30) to the boiler with low-melt solder or 5 minute epoxy. The large funnel (W33) should be used on locomotives with modified front end, i.e. a model with either boiler, but operating from about 1940 onwards. Such a locomotive will almost certainly also have smoke deflectors. The shapely, capped funnel (W53) should only be used on locomotives with wagon top boiler prior to the MFE and without smoke deflectors. Take care that the dome and funnel are straight, vertical and centred.

Air Pump and Blower

The next steps describe the installation of the cross-compound air pump, but the procedure is basically the same for the single stage pump, originally used on engines with wagon top boiler. Drill 0.5mm holes in the air pump for the steam supply and exhaust, suction and delivery pipes before soldering or gluing the pump to the boiler. Drill a 0.5mm hole through the pump governor casting (L21) and into the suction strainer (L30). Solder the suction strainer onto a length of 0.5mm wire, bend it 90° and solder it to the right side of the pump. Note that the version with wagon top boiler didn't have A6ET brake equipment and only had a single element for the pump governor, even when fitted with a compound pump. This can be represented by filing the governor in half. Thread the governor onto 0.5mm wire and form a supply pipe to shape which runs from the forward hole in the turret cover to the pump.

A blower pipe made from 0.4mm wire runs parallel with this pipe from the cab front to the fitting cast on the side of the smokebox adjacent to the R/H dry pipe. Install these pipes together and secure them by drilling 0.35mm holes into the

boiler above and below the wires and forming little clips from 0.3mm wide strips cut from 0.005" phosphor bronze. For the wagon top boiler, these pipes ran straight along the boiler as shown in the photo on the front of the booklet of illustrations and didn't have the joggle drawn on fig12. Form the delivery and steam exhaust pipes to shape from 0.5mm wire and just bend them to run to the bottom of the boiler at the centre where they can be secured with low-melt solder.

Electric Lighting

The turbo-generator (W35) can be attached directly to the top of the firebox for a Belpaire version, but the bracket (E49) is required for the version with wagon top boiler. Orientate the turbo generator so that the turbine section, which is thinner, is to the right when viewed from the side. Drill a 0.4mm hole and add an exhaust pipe from 0.4mm wire. Also add the conduit junction boxes to the boiler and form conduit from 0.3mm wire. The main conduit run is from the cab front, through a junction box adjacent to the turbo generator and up to a junction box on the smokebox, with a conduit then running over the smokebox to the headlight and marker lamps. There is another junction box in front of the funnel with a branch running to the headlight. Form loops of 0.25mm copper wire to run from the junction box on either side of the smokebox to the underside of each marker lamp. Secure the main conduit run by drilling 0.35mm holes above and below the wire at each boiler band and making little 'U' clips from 0.25mm copper wire.

Boiler Feed and Piping

For a locomotive with wagon top boiler and booster exhaust direct to atmosphere, the booster exhaust pipe can now be formed to shape from 1.6mm wire, as shown on fig10 and fig12. The exhaust outlet should be vertical and on the locomotive centre line, with the top even in height with the top of the dome. Secure the pipe to the boiler with a saddle, formed from a 0.9mm wide strip of 0.005" phosphor bronze.

Solder or glue the boiler feed check valves (L14) into the boiler. If the boiler has top feed, the check valves should be horizontal, but directed outwards at an angle of about 30° to the boiler centre line. Bend feed pipes to shape from 0.7mm wire to run from the check valves back down the boiler and along the footplate towards the front of the firebox. The booster piping tends to get in the way and makes this a tricky job, but it also helps to conceal the fact that the pipe doesn't run continuously to the injectors below the cab. Open up the hole in the centre of a flange (L26) with a 0.7mm drill and thread a flange on each pipe, located as shown on fig12.

Reverser

Enlarge the hole in the front of the reverser reach rod (E56) until it will fit over the crank arm on the weigh shaft (L50) at the front. Slide the rear end into the opening etched in the cab front, position the reach rod in the guide castings, the end over the crank arm and secure with a touch of solder to the crank arm.

Firebox Details

Attach the safety valves to the top of the firebox.

Drill two 0.35mm holes into the L/H side of the firebox immediately in front of the clip with fine piping cast onto the firebox, at the clip where five pipes become three. Run two pieces of 0.25mm copper wire from these holes to the top of the booster pipe. There are three small divots cast on top of the booster pipe near the rearmost support stool. Use the two forward locations to finish these pipes.

For a locomotive with Belpaire boiler, drill a 0.8mm hole at the point marked at the lower front corner of each side of the firebox. Check the position of the blow down valves (L44) before drilling a 0.7mm hole through the footplate for the operating rod on each side. Glue or solder the blow down valves in place and add the operating arms (E84 & 85). Drill a 0.5mm hole in the inlet position (to the side) and a 0.7mm hole in the outlet of each blow down muffler. Form pieces of 0.5mm wire to run from each blow down valve to its adjacent blow down muffler. Also form exhaust pipes from 0.7mm wire, to run from the outlet, through holes drilled in the footplate earlier and up the side of the firebox. Secure each pipe to the side of the firebox with the usual clip of 0.005" phosphor bronze, inserted in 0.35mm holes drilled in the firebox.

Drill a 0.4mm hole through the handwheel (E88) and into a block of wood, about 4mm deep. Stand a piece of 0.4mm wire up in the hole and solder the wheel to the wire. Trim the wire nearly flush on the top and remove the assembly from the block of wood. Drill a 0.4mm hole about 2.5mm deep in the back of the gearbox, which is part of the blow down muffler bracket that's cast on the bottom of the L/H lower firebox. Glue the handwheel and its wire shaft into this hole.

Drill a 0.7mm hole into the top and bottom flange of each injector starting valve (L34) and a 0.4mm into the back flange. Solder a short length of 0.4mm wire into the back flange of each valve and trim so that the wire reaches the cab front and just enters the hole etched adjacent to the front window. Attach each valve to the firebox with superglue and run pipes formed from 0.7mm wire from the top of each valve to the rearward hole in each side of the turret cover on top of the firebox. Also form pipes from 0.7mm wire to run from the bottom of each valve down to the footplate, with a flange (L26) installed on each pipe, as shown on fig 12.

Drill a 0.4mm hole through the valve (L36). Drill a 0.9mm hole into the top of the firebox just in front of the left front corner of the turret cover. Solder or glue the valve in place and run a short length of 0.4 mm wire from the valve to the forward hole drilled earlier in the left side of the turret cover. Bend another length of 0.4mm wire to run from this valve

down to the rearmost of the three divots cast on the top of the L/H booster pipe. This pipe needs to run close to the surface of the firebox once it is above the reverser reach rod, so that it will run under the handrail when it's installed later.

For a locomotive with wagon top boiler, bend the large tag at the top of the grate dump bracket (E36) at 90° and laminate the detail layer (E37) in front. Bend the narrow arm at the right of this part into a joggle of 30° so that, when the bracket is attached to the bottom front corner of the firebox on the L/H side, the narrow strip can be fastened to the back of the firebox as a brace. The operating handle extends backwards and should have the last section bent out at 90° and the entire arm bent up at about 10° to clear the trailing truck frame.

Whistle

For a locomotive with Belpaire boiler, form the whistle shroud (E92) to shape and install the whistle (L19) and shroud on top of the boiler in holes drilled earlier. Add an operating rod formed from 0.3mm wire.

For a locomotive with wagon top boiler, drill a 1.0mm hole in the boiler, just below the bottom of the dome and 4mm behind the dome centre line. Fix the whistle (L9) in place, so that its axis is vertical.

For both versions, make an operating rod from 0.3mm wire to run from the whistle to the hole etched in the cab front, just to the side of the turret cover. Drill a 0.4mm hole in the boiler about halfway along the length of this operating rod and make a support out of a 0.4mm wide strip of 0.25mm brass fret waste, soldering the support to the boiler and the rod.

Handrails

Use a 1.1mm drill rotated by hand to carefully counter-bore, about 0.3mm deep, the hole drilled earlier for the handrail stanchion in the boiler course immediately behind the dome. This step allows a long stanchion to recess slightly in the boiler and the handrail to run in a straighter line from the firebox to the front of the boiler.

For a locomotive with Belpaire boiler, form the access ladder (E93) to shape. Cut a length of 0.4mm wire to just run between the front of the injector starting valve and the air pump. Thread this wire through the holes in the ladder stiles and add two short and two long stanchions to the wire, positioned so that the short stanchions will be on the side of the firebox and the long stanchions on the boiler. Attach the stanchions to the boiler and the wire to the stanchions with superglue. Fasten the feet of the ladder to the footplate with low-melt solder or superglue.

For a locomotive with wagon top boiler and cross compound pump, this handrail is the same, but there is no access ladder and it will be necessary to bend a joggle in the handrail to clear the booster exhaust pipe running up the boiler.

Install the rest of the boiler handrails in the same way, ensuring that short stanchions are used on the side of the firebox and long stanchions at all other positions.

For an engine with wagon top boiler and side feed, it is also necessary to bend a joggle in each handrail to clear the check valves, as shown in the detail view on fig10, although this joggle is only needed on the L/H side if a cross compound air pump is fitted.

Smoke Deflectors

Smoke deflectors were only fitted to locomotives with the modified front end. This could be either a Belpaire or wagon top boiler from about 1940 onwards, but only with the large funnel (W33).

Solder a short length of 0.4mm wire into the hole in the centre of each smoke deflector near the top. Form handrails from 0.4mm wire. Solder the long rail to the intermediate support first and then to the smoke deflector itself at either end. Solder a short rail to each smoke deflector and then trim all the handrails flush on the inside face. Form supports to shape from 0.5mm wire, using the template etched into the 0.015" brass fret, adjacent to where a cab used to be, as a guide. These supports locate in holes drilled in marks cast into the smokebox front and into the side of the smokebox.

The tabs on the bottom corners of each smoke deflector locate in holes drilled in the footplate earlier. Solder the smoke deflectors to the footplate from underneath, with low-melt solder and solder each upper support to the adjacent smoke deflector.

Final Assembly

Position the boiler and footplate assembly on the chassis, so that the supports incorporated in the rear wall of the cab are behind the rear headstocks of the chassis and the front of the chassis frame plates fit between the frame plates soldered under the front section of the footplate. Check that an M2 x 8mm screw (P/N108077) can be inserted through the frame cross member between the cylinders and into the tapped hole in the smokebox saddle. It may be necessary to slightly elongate the hole in the chassis cross member with a needle file. Attach the boiler and footplate to the chassis with the M2 x 8mm screw into the smokebox and two 12BA x 3/32" screws through the lower cab support and into the rear headstocks of the chassis.

Booster piping

The horizontal sections of booster piping below the footplate and cab are made from 1.6mm wire. The vertical sections are investment castings, with L52 on the R/H side of both versions, but L32 and L26 used on the L/H side of the versions with wagon top boiler and Belpaire boiler respectively. The joggle in L26 was needed to clear the staff exchanger. Drill a 1.2mm hole about 1.2mm deep into the upright face of the top ball joint of each of the selected pipes. Also drill a 1.3mm hole about 1mm deep up into the bottom ball joint of each of these pipes.

Make a curved bend of about 45° near one end of a section of 1.6mm wire. File the bent end, until the section of wire will be able to lay in one of the large grooves cast in the underside of the cab floor, while the filed end will meet the underside of the footplate and look like a continuation of the booster pipe above the footplate.

A shoulder needs to be filed on the straight end of the 1.6mm wire, to reduce the diameter to 1.2mm for about 1mm length, so that this reduced section can be fitted into the hole drilled in the top ball joint. Check the length of the section of 1.6mm wire, so that the angled end meets the footplate at the appropriate position and the straight end will also have the top ball joint at the correct position when the shoulder is filed in place. Refer to the views on fig12. You may need to make the slot cast under the R/H side of the footplate about 1mm longer by careful use of a Dremel tool and ball ended cutter. File the shoulder on the straight end of each of these pieces of 1.6mm wire and solder the top ball joints in place.

Position the model upside down and hold these pipes in position temporarily with some Blu-Tac. Position the lower booster pipe sections (L45) so that they are located by the holes drilled in the ball joints of the booster engine and the joints at the bottom of the vertical pipes. You may need to shorten the vertical legs of the lower sections, so that they look like the views on fig12. Also check that the vertical sections are still vertical and the lower ball joints of these pipes are just in front of the rear headstock casting. When satisfied, solder the lower sections of pipe into the ball joints incorporated in the booster engine (L47).

Now remove the Blu-Tac and fix the upper horizontal booster pipes to the underside of the cab and footplate with low-melt solder. When the boiler and footplate are removed from the chassis the vertical pipes will go with the footplate, leaving the booster engine and the horizontal pipes attached to the chassis.

Injector Piping

Bend pieces of 0.7mm wire to shape to represent the delivery pipe from each injector to run from just behind each vertical booster pipe (where the injectors would be located, if it was practical), forward under the cab to the sides of the firebox, as shown on fig12. Install a flange (L42) on each of these pipes.

If you are building a model of X36, you should have included the injectors as described earlier. In that case, bend the pipes to run from close to the delivery flange of the injector and forward under the cab floor, as described above. Do not solder the pipe to the injectors, so that the boiler and footplate can still be separated from the chassis.

Speed Recorder Drive

Drill a 0.8mm hole in the underside of the front L/H corner of the cab floor and 0.6mm holes at the points marked on the underside of the footplate for the speed recorder drive brackets (E94 & 95). Also drill 0.4mm holes for the drive shaft in the gearboxes (L25 & 37). Form the forward support (E95) to shape and attach it to the underside of the footplate with low-melt solder. Solder the rear gearbox to the underside of the cab floor, ensuring that the hole drilled for the drive shaft is facing forward. File the step at the top of the intermediate support (E94) about 0.5mm deeper. Thread a length of 0.4mm wire through this support and into both gearboxes. Trim the wire to length so that the forward gearbox can be located in the hole incorporated in the forward support. Locate the intermediate support in the hole drilled in the underside of the footplate earlier and fix it in position with low-melt solder, so that the drive shaft runs in a straight line between the two gearboxes. Add an angled support formed from 0.4mm wire, to run from the hole, located part way up this support, to the underside of the footplate, as shown in the side view on fig12.

Cab

Re-install the motor and gearbox in the chassis, solder the leads from the pick-ups to the motor tags and fasten the boiler and footplate to the chassis. Bend the motor tags close to the back of the motor and cover them with small pieces of electrical tape.

Check the fit of the backhead in the cab and ensure that it isn't interfering with the motor. It may be necessary to remove a small amount from the backhead by careful use of a Dremel tool and ball ended cutter. Alternatively, the backhead can be spaced back slightly by arranging some packers of etched fret waste between the cab front wall and the backhead. When satisfied, fix the backhead in place with a fillet of low-melt solder across the top. Remove the boiler and footplate from the chassis and add more low-melt solder to the join from the inside of the backhead, where it meets the cab floor and front wall.

Check the fit of the cab roof. Clean up any flash that interferes and adjust the shape slightly, if necessary. The appearance will be improved if the underside of the rear overhang is filed so that it tapers smoothly to a thin edge of about 0.4mm. The rivet strip along each side edge may also overhangs the gutters, so the appearance can also be

improved if these are also removed with a large file. Take care to leave the beading on the top surface of the roof. A representation of the rivet strip may be reinstated by scribing a line about 0.6mm above the bottom edge of the roof and then pressing in a row of small, evenly spaced, depressions with a sharp pointed instrument. Leave the cab roof separate until after painting.

Painting and Finishing

Now that assembly is complete, disassemble the boiler and footplate from the locomotive chassis and remove the motor and gearbox. Also remove the body of the tender from the underframe. Give each section a wash in methylated spirits to remove flux residue from the solder paste and then a wash in warm water and 'Ajax' liquid or similar, scrubbing with an artist's bristle brush. Rinse and allow everything to dry. Avoid handling the model in bare hands, because oils deposited on the model from your skin can interfere with paint adhesion. Wear some rubber gloves while the motor and gearbox are returned to the chassis.

Spray all parts with a mixture of grey and black self-etch primer, with power connected to the motor leads so that the driving wheels are turning while painting. Paint can be removed from the wheel treads and pickups with a small brush dipped in methylated spirits and/or a fibreglass eraser.

Remove the cab roof and paint the interior cab walls above window sill height a biscuit colour. Paint the reverser wheel, regulator handle and the handwheels along the top of the backhead red and paint the seat cushions dark green. Cut small pieces of clear plastic to glaze the cab front windows.

Attach the cab roof with a small amount of contact cement.

Lubricate the model sparingly with grease on the gears and light oil on driving axles as well as the motion gear pivots.

Number Plates

Select a number from the plates provided and cut them from the sheet. Make a loop of masking tape with the sticky side out. Attach the plates to this loop and paint them with grey etch primer. Allow them to dry before painting them with white enamel. Allow the enamel to dry for at least a week before painting the background of each plate with Indian ink. Use a damp cloth to remove any Indian ink that strays onto the surface of the raised letters or plate surround.

Attach the plates to the model with a touch of silicon sealant. Single 'X' goes to the left of the front coupler, with the number to the right. A combined X and number plate goes on the centre of the tender rear, with the bottom edge 8mm above the headstocks. Combined X and number plates go on the cab sides, with the bottom edge 6mm above the bottom edge of the cab and the front edge 5.5mm from the front of the cab.