Armstrong Whitworth D10 Demonstrator

W. G. Armstrong Whitworth of Elswick, Newcastle upon Tyne had a factory that, at its peak, stretched for more than a mile along the north bank of the river, close to the city centre. In 1927 they merged with Vickers Ltd to create Vickers-Armstrong. They were primarily known as manufacturers of armaments but they also built cars, ships, aircraft and locomotives.

Even major engineering firms, however, were caught up in the economic slump of the 1930s. An order for 327 'Black Five' 4-6-0s from the LMS – delivered in 1936/7 – was a major boost but Armstrong Whitworth were already taking steps to secure their future as locomotive builders. As early as 1919 they had obtained permission to build Sulzer and other diesel engines under licence and by the 1930s their Diesel Traction Department was developing its own range of internal combustion locomotives and railcars. Partnerships with firms such as GEC, English Electric and Crompton Parkinson – combined with an aggressive sales and marketing policy – further increased their manufacturing options, particularly with the overseas market in mind.

Armstrong Whitworth diesels built for export included some massive twin-unit locomotives but in 1932 the Scotswood works produced a diminutive 15-ton four-wheeled shunter with the works number D10. Powered by a transverse-mounted Armstrong Saurer six-cylinder engine producing 95hp at 2,000rpm and coupled to a Laurence, Scott and Electromotors generator, D10 was built as a demonstrator to help secure future orders on the home market. The lightweight locomotive could be driven either from the cab or by a man standing on the running board at either side, which facilitated one-man operation on shunting duties. Armstrong Whitworth were aware that, away from the main lines, he didn't have to be a fully-qualified driver, which would offer significant cost savings. Livery details, however, are unknown – all-over black, most likely, with lining on the buffer beams. An early works photograph shows D10 fitted with a simple cab roof but it acquired a fully enclosed cab before being sent to run trials, at Armstrong Whitworth's expense, at a number of locations – Appleby Frodingham steelworks in Lincolnshire, Lyons' confectionary factory at Greenford, Middlesex and Dunston power station on the banks of the Tyne, just across the river from the factory where it was built.

For several months in 1933, D10 – or 'The Mangle' as it was affectionately known – worked passenger and goods trains of up to 90 tons tare weight on the 4½-mile North Sunderland Railway between Chathill and Seahouses. Its roomy cab offered the crew some protection from the worst of the weather coming in from the North Sea. Its top speed – a sprightly 27mph – proved useful but the fact that the locomotive had no provision for train braking seemed to have evaded the Board of Trade inspectors. Liveried – we think – in black with red lining and buffer beam, 'The Mangle' averaged just under 300 miles per week or six round trips a day at around 4.5mpg. Such efficiency and reliability encouraged the North Sunderland to purchase from Armstrong Whitworth the 0-4-0 locomotive *The Lady Armstrong*, thus becoming the first wholly diesel-operated passenger railway in Britain.

D10, however, would remain the only locomotive of its type, and spent most of its career as the resident shunter back at Armstrong Whitworth's Scotswood Works. It could easily shift a load of 200 tons, the equivalent of 10 loaded 12T coal wagons. External modifications seem to have been mostly for operational reasons – the large, fully enclosed cab with which it had run trials reverted to a simple open-sided structure that gave better all-round visibility, a protective shield was added over the jackshaft and the short footboards at the cab end were extended to run the full length of the underframe, which was a help for shunters riding on the steps. The lined-out livery it had carried on the North Sunderland Railway was replaced by something altogether plainer, possibly dark green. But after Armstrong Whitworth had built its 1,437th and last locomotive in 1937, the workshops were once again given over to the infinitely more profitable business of armaments manufacture.

D10 was taken out of service in 1953 and cut up the following year, although some accounts give the date as 1957. Some Armstrong Whitworth locomotives, however, were still working in the late 1960s and even beyond.

Extras required

Alan Gibson 3ft diameter 'Pug' wheels (ref. G4836P) are recommended for this model. If you use Romford or Markits wheels, we cannot guarantee clearances will be adequate. A 10mm 'flatcan' motor, 15mm long should fit without any problems.

General Notes on Construction

Read the instructions carefully - preferably more than once - before starting work. Study the diagrams until you become familiar with all the parts and the assembly sequence. We have tried to make these instructions as comprehensive as possible, which may make some assembly sequences appear more complex than they actually are.

Leave the parts in the fret until they are required for use. This will protect them and makes identification simpler. Small holes can be drilled more easily while the parts are still attached. Where an accurate hole size is specified, holes are etched undersized so they can be drilled or reamed out to the correct diameter. Take particular care to remove all burrs, fret tags etc so they don't interfere with the alignment of parts – clearances can be critical and even a few thous' worth of surplus metal in the wrong place can cause problems. A number of parts need riveting – bonnet top frame and control console – and this is best done in one hit before assembly begins. Some parts – bonnet frame, front bonnet overlay and sides, cab front – also have half-etched holes which are drill starts that will need opening out before assembly. Try not to confuse the half-etched marks for rivets with half-etched drill starts!

An 'Optivisor' or similar magnifier is very useful to check the fit of parts and a 'Hold & Fold' is recommended, if not essential, for making very small, sharp bends. Some of the fine tolerances and clearances in this kit – especially with slots and tabs – are right at the limits of etching technology and an unwitting accumulation of dimensional drift can compromise alignments. All the same, think twice before reaching for a file in a bid to get parts to fit. As often as not, an accumulation of surplus solder is the problem.

Like all etched kits, this model is designed to be solder-assembled throughout for maximum strength. There are a couple of instances where you could consider using an adhesive for attaching detail parts, and we will indicate these when the time comes. It's best to clean up thoroughly as you go along – the cab in particular will gradually accumulate detail and it may prove increasingly difficult to access this area to get rid of stray deposits of flux and solder.

We want you to enjoy building your kit, but remember that even railway modelling has its risks. Frets contain sharp edges, soldering irons get very hot, adhesives may give off toxic fumes, knives and files are designed for cutting. Please be careful . . .

Body Assembly

Take the Footplate (1 – see Fig 1), remove the other parts from its centre and store them safely. Bend up the strengthening ribs – note the hexagonal nut recesses in what will become the top of the footplate – but **leave the footplate ends flat**, then set the part aside.

Refer to Figure 2. Try forming the practise rivets at the sides of the fret – you don't need to do all of them! – and once you're happy with the results, remove the Bonnet Frame (2) from the fret and punch out the rivets on the top surface. Don't confuse the half-etched locators for the rivets (bonnet top only) with the drill starts along the edges of the sides of the frame, which are for aligning the side overlays using wire.

Carefully clip the Bonnet Side Overlays (3 & 4) from the fret, straighten as necessary – they may be curved from the etching process - tin their rear faces and then drill out the small holes just mentioned until a length of 0.3mm wire is a snug fit. Use a 0.3mm/No 80 bit in a pin chuck or, if worried about breakages, go a wire size higher to 0.40mm and use a No 78 drill. Do the same for the outer face of the cab frame, including the area around the outer edges of the radiator grille but avoiding clogging the detail itself with solder.

Careful preparation of the parts will make assembly much easier, so ensure tags are properly filed from the edges, and that the overlays are perfectly flat and clean before fitting. Avoid trapping flux residue between layers as some types of flux can be highly corrosive unless washed off immediately. When fitting the bonnet sides to the frame, along with any additional solder required, work from the inner side of the frame in order to avoid clogging up the detail.

With the **bonnet frame still flat**, and doing one side at a time, use short lengths of 0.3mm wire, pushed through the pre-drilled holes, to locate the sides on the frames. Once in place, lightly tack-solder the wrapper to the frame, in one or two places only and away from the wires, so they can be removed.

View the piece from the back – there should be small parallel margin or ledge (where the curved bonnet front will eventually sit – see Fig. 3) with the bottom and rear edges of the wrapper more or less flush with the frame (the frame's tags protrude).

After having bent the double rows through 180 degrees so faces marked 'X' come together (**fold lines outside the bend)** try the Hinges (5 x2, 6 & 7) in place in order to establish they go through their slots, then remove them. Resting on a flat piece of softwood, tack-solder all the 0.3mm wires in place then proceed to solder the wrappers solidly onto the frame, applying rear side of the frame. Pushing down with a flat piece of softwood such as a lolly stick or coffee stirrer will help keep the parts flat and in alignment. Be careful you don't draw solder into the fine detail of the radiator grill, or the cab frame bend lines.

Now add the Hinges. Push them fully through their slots without forcing, solder in place and then file the outer ends of the hinges and wires, so they protrude beyond the detail by about 0.3mm. The bonnet frame should still be **kept flat** for the time being.

Identify the parts for the Air Filter Housing (8 x4 and 9), tin the rear surfaces and open out the central holes, so they are a good fit on a piece of 2mm wire. Slot these onto the wire and solder them tightly together, then after having carefully centralised the Air Intake Louvres (9) solder this in place. Note that the louvres are in two vertical rows, not horizontal. Grip the pin on the assembly in your minidrill and spin under power as you smooth off the outer edges until the parts look like one solid piece. You can now solder this in place on the bonnet side, using the central wire as the locator pin – make sure the louvers face downwards to match the bonnet sides. If you don't want to risk the layers coming adrift, glue the part on at any point after the bonnet is fitted to the footplate. **Don't fold** the bonnet sides yet.

Each assembly, when attached to the footplate, becomes part of the structure and so increases the overall rigidity of the bodyshell. This means that parts which are badly fitted, or soldered to a distorted footplate, will create errors which will be impossible to correct at a later stage.

With the bonnet **still flat**, try the frame's locators in the slots along the sides of the footplate, opening them out with a blade or broach if necessary, until all the tabs will go into their slots without forcing. The footplate is very flimsy at this stage, so don't try and force anything or you might bend it. **Now fold** the bonnet sides through 90 degrees and then solder this assembly to the footplate, making sure the footplate is straight – and the right way up: strengthening ribs on the footplate facing upwards, half-etched recesses for body-fixing nuts also thus. Apply the solder from the underside. Again, using a flat piece of wood will help hold the pieces flat and in alignment.

The side edges of the Bonnet Front (10) sit on top of the vertical frame sides (see above and Fig. 3). Only the bottom tabs engage with the footplate, which allows for variation in the fit, and any gap in this area will be covered as other parts are added.

Drill out the small holes in the bonnet front – you can add the handrails later – and then, using a 4mm diameter bar or drill bit, form the main curve - the start and finish of the bend is pretty much in line with the upper part of the ribbed detail, as shown. Try the part in place - the front should fit between the overlays at the top of the bonnet, with the bottom edge located in the footplate slots. Make sure you clean all the solder out of the top edges of the frame, and re- check the fit of the parts under a magnifier.

If the bend's not in exactly the right position it can be adjusted by flattening one end of the curve and bending the other a bit further. Once it's a good fit, solder the front to the bonnet frame assembly, and to the footplate, pressing the top section down and applying solder through the solder access holes, from the inside the bonnet. Run the iron around the inner corners for a solid seam with no gaps.

The Filler Caps (11 x2) can be soldered in place now, so they sit just proud as shown in Figure 6, or glued in position when putting the final touches to the model.

Fold the tiny tabs (A) on the Bufferbeams (12 x2) through 180 degrees (fold lines on the outside of the bend). Before assembling the beams, clip the buffers (13 x4) from the sprue and tidy up as required, making sure the mounting flange back surface is flat. Open out the holes in the beams and footplate ends, so the buffers' 1mm diameter mounting pins are a good fit. Do this carefully to avoid distorting the footplate.

Fold up the ends of the footplate noting that the radiused corners are at the top and then use the buffers to locate the beams as you solder everything in place. If necessary, trim off any excess length from the locator pins so they are flush with the beam's rear face, and then fit the cast Coupling Hooks (14 x2). Use a lightly-oiled bolt to locate and hold M1.6 nuts in place as you solder them into the recesses in the footplate, then remove the bolts.

Fold up the Battery Box Frame (15) and locate this in between the bufferbeam and bonnet, then solder it in place from below the footplate, and inside the bonnet. Add the Battery Box Sides (16 & 17), pre-tinned so you can 'dry-solder' them from outside without filling up the louvre detail. Slot the tiny Front Webs (18 & 19) into place, folding up the rear tab to hold them as you solder them in place and making sure they are sitting level and hard up to the rear of the beam.

Locate the Filler Panel (20) and solder it to the frame and the top of the bufferbeam, with the panel's front edge protruding slightly beyond the beam face. Drill through for lamp irons, as above. Go on to solder the Battery Box Front (21) in place – this sits in between the side details' leading edges, on top of the filler panel. Bend the small latches on the Battery Box Lid (22) through 180 degrees (bend lines on the outside of the bend) and then fit this so these details line up with those on the previous part, and fix in place. Add the thin rivet strip (23) to the battery box lid along the join with the bonnet front. Once this is in place, bend and fit the small handles on the bonnet front, using 0.3mm wire to represent them, and use the same wire for the latches directly below them (with circular mountings). The latches should be about 1. 5mm long and bent downwards, as shown in Figure 6. Though it goes against the grain, you may find it easier to glue these small wire fittings in place using a gel-type cyanoacrylate.

Cabs

The loco started life with a simple sheet metal roof, supported at the corners on lengths of angle iron. Later, when loaned to the North Sunderland Railway, front and rear cab sheets were added, although the sides of the cab were still completely open to the elements. Both variants are illustrated in Figures 5 to 8. The loco reverted to the original arrangement when it became the Armstrong Whitworth works' shunter.

Refer back to Figures 1 and 4. Before detailing, make a dry-run to check your Cab Front (24 in Fig.1 or 25, Fig. 6) fits into its locations in both the footplate, and at the rear of the bonnet - it should sit between the rear edges of the bonnet assembly. Prior to fitting, you can solder three short lengths of 0.4mm wire in place, filed to about 0.3mm proud of the face to represent small engine indicator lights (see Fig. 5). Add the Ammeter, Gauges and Valves (26, 27 x2 and 28 x2) now, or leave them until after painting if you prefer.

For the **original** cab, bend tabs 'B' (Fig 4) on part 24 through 90 degrees and strengthen the bends with solder.

For the **modified** cab, the exhaust pipe is formed using a length of 1mm wire. The shape is shown in Figure 8 but, for the modified cab, the wire is soldered directly to the inner face of the cab front and slotted into the location hole 'H'. The upper end of the pipe stops about 0.5mm below the front's top edge (to allow the roof to be fitted). For the **original** cab, this pipe will be fitted later.

For **both types** of cab, solder the cab front to the bonnet and footplate, working from inside the bonnet and under the footplate wherever possible.

Turning your attention to the Console (29, Fig. 4), for the **original cab only**, carefully file up to the half-etched, markers at the corners of the top surface (Fig. 5 & 7) so the 1mm roof supports will sit

right into these areas without protruding beyond the outer edges of the etch. The supports, which will sit on the ledges formed by Tabs B, can be cut the square bar material supplied, or you can use more prototypical 1mm brass angle which you'll need to source yourself.

For **both types**, punch out the rivets in the console and drill out the small holes to suit the parts shown in Figure 4. Bend over the top, followed by the sides and then, after checking for squareness, run solder along the inside corner joints. You can, if you wish, temporarily try the part in place to check alignment before soldering, but don't solder it to the structure at this stage.

On the real thing, the controls were linked and moved in unison, so make sure angle the controls so the two sides mirror one another. Start by bending the tags and then soldering the Power Controllers (30 & 31) in place, pushing them up through their slots. Thread two lengths of annealed 0.4mm wire across the locations for the front and rear levers and solder the wires in place leaving about 2.5 millimetres or so sticking out. Open out the holes in the small Lever Details (32 x2 & 33 x2), tin them on the reverse, fit them over the, 0.4 wire through and secure with solder, then bend the wire ends through 90 degrees. Use lengths of 0.4mm wire to represent the horn levers, trimmed so they protrude by about 1.5mm from the top of the console and then finish the console by adding the brass Shunting Controller Wheels (34 x2).

Clean up the Console Assembly and check the bottom edges of the sides are straight and level, smoothing off with a file as required. Try it in place, slotting the assembly forward so the tabs locate in the cab front and, as you go, clip the tabs at the rear down into locations in the footplate. Check all around, looking for gaps and making sure the footplate is straight and level – do not proceed until you are satisfied that everything is located correctly, and that the footplate is straight. Solder the console to the cab front, and to the floor.

There are two types of Cab Rear sheet (35 in Fig 1 or 36 in Fig 6) and the fitting procedure is the same for both. Trial-fit the part, making sure the rear is flat and that it goes fully home into its floor locations. When it's in place, mark where the top edge of the bufferbeam runs, then remove the cab rear and tin the area that sits behind the beam. Refit the rear and carefully solder in place making sure it's vertical, and hard up to the beam - tweezers are helpful to nip the parts together as you apply heat.

Starting with the lid, fold up the Storage Bays (37, Fig. 4) – all bends are 90 degrees. For the **original cab** only, bend the support ledges (C) down through 90 degrees and strengthen underside of the bends with solder.

For **both types**, try the bay assembly in place, cleaning out the locations in the floor as required. Once you've got it fitting nicely, solder it to the floor, and hard up to the cab rear sheet. Tin the rear faces of the Bay Sides (38 & 39) solder them to the bay frame and then fit the Rear Webs (40 & 41) between the box sides and the rear beam. They slot in place and then the tab can be fold up to hold the part level, or to allow adjustments to the angle. Watch you don't de-solder the buffers!

Now spot through the locators on the footplate and, using L-shaped lengths of 0.3mm wire, fit the cab handrails into their locations and solder in place, running between the floor and the holes in the console and box sides, as shown in Figure 5. Finish the cab area by fixing the handbrake stanchion (42) in place (hole D in Fig.1).

For a **modified cab**, fit the Joint Strip (43 – Fig. 6) to the inside, locating the notches over the top corners of the bay sides.

Steps

As detailed in Figure 5, carefully bend the angles at the very ends of the Cab Steps (44, 45) – a Hold 'n' Fold tool, whilst not a necessity, is a distinct advantage when doing this job, but if you don't have one, then a pair of good quality, small pliers will do as a substitute. Bend up the duckboards along the bottom edge.

For **P4 and EM models**, bend the sandbox mounting lugs (E) through 90 degrees and open out the holes to accept 0.4mm wire. **OO model** sandboxes are fitted to the chassis, later in the build.

For **all gauges**, remove the Wheelguards (46 & 47) from the fret and use a fine file to tidy up the edges, illustrated in Figure 5, then locate them centrally on the step assemblies and solder in place.

For EM and P4 models the half-etched area of the wheelguards crankpin clearance should be situated at the front end of the step assemblies and **for OO** you can site it towards the rear end for extra strength.

Bend the Footsteps (48 & 49) to shape. F**or EM/P4**, you'll need to fold out the sandbox brace (F) which can be snapped off for **OO gauge models**. Solder the footsteps in place.

For **P4 and EM models**, drill out the pipe holes at the bottoms of the Sandboxes (50 X4) to suit a 0.4mm wire, then clip ***two only*** from their sprues and file the rear mounting pegs completely flush. Use a short length of wire to assist and locate the boxes on the fold-out ledges 'E' at the rear of the steps, tack-solder to the fold-out brace. Make adjustments if necessary, so the box sits square and vertical and with the neck protruding above the cut-out, and then remove the wire and solder the box to bottom ledge for extra strength.

For **all models**, after making sure the footplate assembly is still flat, locate the completed step assemblies under the floor, making sure the tabs go fully home in their locations, and solder them in place. You should now have a totally rigid footplate.

Add the valances (51 x2, Fig. 1) between the bufferbeams, running along the innermost edge of the location recess and butted up to the top edge of the step assemblies. Position the part, tack-solder at one end first, check for distortion and then do the same at the other end. Now tack-solder at regular intervals along the valance and then work on a short length at a time and, running the tacks of solder into one another – heat only short lengths of the valance at any one time to prevent buckling.

For the optional front and rear lamp irons (Figs. 5 & 6) carefully open out the drill start holes in the front cover plate ('G' in Fig 1). For the **original type cab**, drill out the holes on the top surface of the rear bufferbeams (the drills-start is between the layers of the beams) then solder short lengths of 0.3mm wire into the holes, so they protrude by 3mm.

Cab Roof

Curve the Cab Roof (52) so the bend matches the formers (53 & 54) then gripping only the last half millimetre or so (using the Hold 'n' Fold or a vice with precise jaws) make the sharp bend for the rainstrip at the ends, which turns up by about 45 degrees.

For the **original cab shown in Figure 5**, fit the Cab Roof Front Former (53- note the triangular marker which goes inside the cab) to the underside of the roof, at the end nearest the exhaust outlet, and solder in place. Again, noting the ***orientation arrows,*** locate the Cab Roof Runners (54 x2) into this end, add the Cab Roof Rear Former (55 - circle marker on the inside) and solder in place.

For the cab roof supports, you can use 1mm square angle, soldered into the square recesses at the ends of the cab roof runners, orientated as shown. Cut the supports to length (front 17.5mm; rear 20mm) remove any burrs from the bottom ends, and solder them into the runners, trying to get them as vertical as possible.

Test-fit the roof assembly, slotting the bottom ends of the corner angles down into their locations – the front locates in the console with the rear sitting in the corners of the storage bays – in both cases, they should sit on the ledges provided. You may need to make minor adjustments, carefully heating the top joints if required, to get everything sitting level and square. You can leave the roof so it's removable or glue it in place, preferably after painting the complete body.

Detail can now be added by fitting the Horn (56) into its location. Drill out the holes in the Original Lamp Irons (57 x2) bend to shape and solder them over their location on the formers, using short lengths of 0.4mm wire to position them, as shown. For the exhaust, bend 1mm wire to shape, as shown in Figures 5 and 8, so it runs through the hole in the roof, when pushed tight into the inner corner of the brass, angle-section support. The pipe should be soldered to the support, with about 1mm protruding from above the roof and, when the roof assembly is fitted, the bottom of the pipe should be butted up to, and aligned with, the small marker 'H' on cab front.

For a **modified** cab (Fig. 6) attach the Horn (56) to the cab front, and then slot the Modified Lamps Irons (58) outwards, through their locations on the front and rear. Once located, bend up the outer sections and secure with solder. Add a short length of wire to the hole in the roof (52) to represent the top of the exhaust.

The roof locates over the tabs on the front and rear sections and then the tabs can be filed flush. It can be fixed with solder, or glue, but we recommended that you wait until the chassis structure is complete before painting the bodyshell, in case you need to make adjustments.

Chassis Assembly

Follow these instructions carefully and clean up thoroughly as you go along – the areas between the frames soon start to fill up and scrubbing away at residual flux deposits could be difficult. We suggest you defer painting the chassis until all the details have been soldered in place, the hornblocks are in position and you've tried the brakegear in place. Once the chassis is painted you can fit the gears and motor, add wheels, pick-ups and brake gear, and generally fine-tune the loco ready for the body and chassis to be fixed together.

The chassis can be built rigid, or with compensation to allow the wheels to follow the undulations of the track and significantly improve current pick-up.

Study Figure 9 before removing the frames (59 & 60) and straightening as necessary. For a **rigid chassis**, ream out all the axle bush locations in the chassis frames and solder the 1/8in axle bush bearings in place. Check that they're fully home and not at an angle.

For a **compensated chassis**, read all of the following carefully: Solder a 1/8in axle bush into the frames at the rear driving wheel location. Now go on to make the hornblock cutaways by carefully making a slot up the centre line of the front axle locations. Use a cutter in your minidrill, a fine fret saw, or a needle file. Bend the sides of these cuts back and forth, until the metal snaps off to form the rough cutaway shape. Dress the sides with a file using the remainder of the half-etched marks as a guide. Don't file anything from the top horizontal edge of the slots - this is used to set the hornblocks at the correct height. Note that the frames will be very weak over the front cutaway until the hornblock etch is added, so handle carefully.

If you plan to fit **plunger pick-ups** (Alan Gibson, ref. 4M62) read this section thoroughly first, then if you do decide to go ahead. At the front wheels, all gauges use the same holes (J) but at the rear this differs, according to gauge. P4 modellers should open out the lower holes (K) whilst EM and OO should use holes 'L' just above. Make the hole size so the plastic outer sleeve of the pick-up is a tight push-fit, then remove the sleeves to avoid melting them when soldering.

Solder 2mm bushes into the jackshaft locations (M). Open out the gearshaft holes (N) in both frames to suit the 2mm silver steel rod supplied. A push-fit is fine, but you don't want any slop at all so don't enlarge any more than is strictly necessary. Use a tapered reamer or broach for this, rather than by drilling, and then finish off by de-burring the holes, inserting the tip of a drill bit (of much larger diameter than the hole) and gently rotating it between your fingers.

Start the chassis construction, preparing the Rear Spacer (61 – also shown in Fig. 10) by making the right angled bends. Solder a length of 0.5mm wire into the bottom hole (which will be used to locate the brakes), trim it so about 1mm protrudes from the underside and remove the burrs from the wire. Make the two alternating bends to form the brake cylinder mount and add the Cylinder Cover (62) detail facing rearwards. Bend a length of 0.4mm wire to shape, slot this through the central holes in the parts then solder everything in place with the wire routed as shown to represent the feed pipe.

For a **compensated chassis**, open out hole 'P' in both the Front Spacer (63) and Pivot Carrier (64) front spacer, so they accept the length of 2mm rod used as a pivot - you'll fit the rod itself later in the assembly sequence.

For **rigid construction**, solder the Sump Filter (65 – Fig. 11) over the hole in the spacer, on the inside face. This part can be glued when the pivot is in place for a **compensated chassis** if you wish. To strengthen the assembly leave section 'T' in place for now – it can be removed later.

For both **compensated and rigid** types, make the main 90 degree bend in the Front Spacer then assemble the frames using the front and rear spacers. Follow up with the Pivot Carrier, springing the frames apart to fit it.

For **EM and P4** models, solder short lengths of 1mm wire into holes 'Q' in both the front and rear spacers. Trim the wire so about 1.5mm protrudes upwards and remove any burrs. Open out the corresponding holes on the underside of the bodyshell to the same size (see Fig 1). These 'locator pins' will ensure the chassis locates centrally so the rear wheels don't short inside the console

Using a carborundum disc in a mini-drill, cut the jackshaft from the 2mm silver steel rod supplied and deburr the ends. Depending on gauge, its length can be calculated as the width of the chassis over the jackshaft bushes plus approx. 4.5mm to allow for the thickness of the castings for the flycrank, the pinion wheel and minimal running clearence. Then cut two gearshafts, equal to the distance across the frames. They don't need to be exact at this point, as long as they aren't too short, but be sure to wear effective eye protection – cutting discs can and do disintegrate if they snag. Dress the ends to get rid of any ragged edges.

Fold the side lugs on the Motor Mount (66) through 90 degrees, but do not add any solder to the bends. Go on to fold the gear spacers (R – see Figs. 12 & 13) and strengthen these bends with solder. Slide lengths of gearshaft through the locations in both the frames and spacers as you locate the mount on the frames, and then solder the whole assembly in place using the lugs on the outside of the triangular gearbox.

You can now offer the chassis up to the body, temporarily fastening them using the M1.6 fixings, using a small jewellers' screwdriver slotted through the access hole in the chassis endplates. Check the top of the frames sit hard up to the underside of the footplate, making minor adjustments with a file as required.

Now is a good time to trial-fit the gears (including the axle and final jackshaft gears) as shown in Figures 12, 13 and 14. You can check they rotate freely and make adjustments without things getting in the way. Power is transmitted via the rear axle, with the gear-driven jackshaft being purely cosmetic and not physically connected to the siderods.

Check that the gears themselves are free from any dust or swarf left over from manufacture. The stage 1 double gear can be one of three types, depending on overall ratio (see Fig. 14). It has angled teeth to mesh with the worm, and is identifiable by a single dot on the side face. Fit the stage 1 gearshaft and the double gear, followed by the stage 2 shaft and double gear (this has two dots and straight teeth) then turn the geartrain using your finger - the gears should run without resistance.

The side faces of the stage 1 and 2 gears should run quite happily against one other, although a small amount of sideplay is necessary to avoid jamming. If this isn't the case and you've checked for burrs or anything else that may take up space, then the gear spacers may need a small sideways tweak.

Slot the jackshaft through the frames and include the 23Tooth jackshaft gear. Temporarily fit a 1/8in axle along with the final brass 23T gear. Align all the gears so they mesh - for final assembly, the sideplay of the parts is controlled but, for the time being, just keep an eye on them to ensure correct meshing. Test the whole geartrain, turning it by hand – it will turn more easily from the top - and when all is well, remove the components and store safely.

Siderods and Connecting Rods

Open out the holes in the Side Rods (67 to 69 in Fig. 15) to suit the components shown in the diagram. Make the holes a tightish fit - you can always open them out a touch more later – and be very careful as drills or cutting broaches can easily snag and twist the thin metal.

Use the fret diagram to identify the parts, remove them from the fret, building one rod at a time to avoid confusion. Push a tight-fitting drill bit or broach (lightly oiled) through one end of the rod, using use a cocktail stick to align the holes at opposite end. Make sure they're parallel and square to the rod face as you nip and solder the layers together. When you have a pair of rods, dress the top edge of the bosses using a fine file and then carefully open out the cork holes, solder in 0.3mm wires and trim slightly proud of the tops.

Add stubs of 0.8mm wire to the central holes, solder in place and then trim the wires until they are proud of the front by about 0.6mm. Now you can add the Springbox Details (70 x2) followed by the Springbox Covers (71 x2), bent to shape, slotting it over the end of the wires. It's perfectly fine to glue these parts in place. Complete the rod assemblies by dressing up the edges of the finished rods, so they look like one solid piece.

For **compensated only**, you'll need axle jigs to position the hornblock units. Prepare and assemble the hornblocks as per their instructions and locate them, so the small tongue (which sets the height) is butted up to the top of the front, frame cutaway. Add the bearings and then use the axle jigs, in conjunction with the siderods, to set the wheelbase. Check the units are square and vertical, that the edges of the hornguides are parallel to the slots in the frames, and then tack solder in place at one point only. After a final check, remove the bearings to avoid the risk of soldering them solid, and seam-solder around the edges of the hornblock etches. To complete the compensation system, fix a length of 2mm silver steel between the holes 'P' to form the pivot for the front axle.

Chassis Details
Open out hole 'S' in the left frame and use a length of oiled 1mm wire to site the Journal Detail (72 – Fig. 10) which should be soldered to the inner face of the right-hand frame. Open out the Handbrake Journal (73) for the same wire, then push the journal's mounting tag through the rear spacer and fold the inner end through 90 degrees to lock the part in place. Slide a length of wire through the right hand frame, to check alignment, solder the journal to the spacer, then remove the wire.

Fold the Handbrake Lever (74) through 180 degrees (bend line on the outside). Detail the link using a short length of 0.4mm wire to represent the pin (and also to align the halves) and solder it all solid before trimming the pin almost flush.

Slot a length of 1mm wire though the journal, frame and linkage assembly, with the latter positioned so its rod runs horizontally and centrally through the opening in the spacer. Solder the wire and linkage in place, then trim the 1mm wire back until it is very slightly proud of the journal and frame faces. Locate the Under-slung Box (75) on the rear spacer, and solder in placer. Finish off this area by adding a representation of the handbrake screw using a short length of 0.4mm wire, running between the end of the handbrake linkage (you may need to open out the hole) and into the spacer.

With all the inner details fitted, you can finally add the Chassis Endplates (76 and 77 in Fig. 9). Before fitting the front, solder in the short brake location pin, as you did for the rear. Once the endplates are in place you can, if you wish, remove the central section 'T' (see Fig. 11) of spacer 65 and tidy up the rough edges.

Brake hanger pivots can now be fitted using lengths of 1mm O.D. tube soldered in place at locations 'U' with equal amounts protruding at either side. The total length of the tubes should be 20mm for P4, 19.3mm for EM and 17.3mm for OO.

At this point you might wish to paint the chassis.

Brakegear
Tin the rear faces of the Brake Hangers (78 x2 & 79 x2) and open out the holes at the top and middle – the bottom hole is a dummy. Use the central holes to locate the hangers on the Stretchers (80 & 81 – OO, EM or P4) and solder them in place, making sure the top holes also line up. Trim the wire flush at the back and very slightly proud of the brake shoe (at the front) then carefully bend up the ends of the stretchers. On the front hanger assembly, add the tiny Pullrod End (82) using a length of lightly oiled wire (so it won't get soldered in place) to locate the part as you solder it to the top surface as ***shown.*** Once in place, you can drill out the horizontal cavity, carefully solder in a length of 0.4mm wire to represent the pullrod and trim so about 5mm sticks out.

Make sure the central location holes in both stretchers (V) are opened out so a length of 0.5mm wire is a sliding fit. Offer up the brake hanger assemblies, slotting their location holes over the pins protruding from parts 61 and 76. As the hangers' top holes line up with the tubes, slide a length of 0.5mm wire though to hold everything in place. You can test fit and axle and wheel to check the position of the hangers, and then remove them.

Drill out the holes in the bottom of the remaining Sandboxes (50 – see above). Solder the front pair in place on the frames – for OO and P4 gauges, push them hard up to the frames' For EM gauge, include the Sandbox Packers (83) which should be folded double thickness, with the fold lines on the outside of the bend. OO modeller will also need to attach the rear sandboxes to the frame sides, using the location holes provided.

Temporarily fit a wheelset and route the sandpipes (0.4mm wire) down to the wheels. Alternatively, leave this job until nearer the end to avoid damage.

Pick-ups

The mechanism and brakegear limit pick-up options, but plungers (Alan Gibson, ref. 4M62) are one possibility, although the rear pair will need to be situated very close to the final drive gear. For P4, there's enough lateral clearance to allow you to use the lower holes without the pick-up tails catching. For EM and OO, the larger wheel flanges mean the upper holes can be situated slightly further away from the wheel centres, allowing the back of the plunger to sit just behind the gear. For all gauges, the plastic sleeves (both front and rear) should be slotted tightly into their holes and the brass pick-ups fitted before the wheels go on. For P4, where the wheels run close to the frames, you may need to up to 1mm from the outer end of the brass plungers for optimum performance.

The second and more traditional alternative involves running suitably-shaped wiper pick-ups - made from phosphor-bronze or 0.33mm hard brass wire – out to the wheel rims from strips of copperclad glued across the bottoms of the frames, being careful to avoid fouling the gears. This operation can be done after painting. Solder the wires to the motor first, and then fit the pick-ups so they're not disturbed by subsequent soldering.

Bend the Pinion Cover (84 – Fig. 15) to shape but be sparing with the solder. Be especially careful that free movement of the Pinion Wheel (85) isn't inhibited by any fillets of solder you run around the inner joints for extra strength. Drill out the holes 'W' in both the frames and the cover and test-fit the cover. It can be secured in place by slotting two lengths of L-shaped 0.5mm wire down thought the holes. You might want to paint the pinion cover before you go any further.

Open out the central hole in the Pinion Wheel (85) and push it onto the length of 2mm rod you're using as the flycrank. Epoxy it in place, making sure it's flush with the end. Later on you'll need to check that it's quartered correctly – the jackshaft assembly has 90^{o} right hand lead just like the driving wheels. Use the same glue to fix the etched Balance Weights (86 x4) in place on the wheels. Make sure they don't sit proud or they may catch the rods. Slot the jackshaft through its location in the right hand frame. Refit the traction motor cover and check the pinion wheel can rotate freely within, then remove the parts.

Now's a good time to clean everything up and paint the remaining parts, ready for the final assembly sequence. If you haven't already fitted them, you can shape the rear sandpipes and solder them in place, or glue them in last thing. Paint the body assembly, then glue in any parts and details you may have painted separately.

Final Assembly

The wheelsets ***must*** be fitted after the gearshafts and jackshaft parts are in their final positions. If you don't have the gearshafts cut to exact length (equal to the width across the outside of the frames) do this now, then fit them as you did before, along with the gears, into their locations (see above). Test for free-running of the gears, one stage at a time, before gluing the shafts whilst paying particular attention to make sure no adhesive gets onto the gears themselves.

Refit the Jackshaft parts, as above, but this time with the Flycrank (87) at the opposite end of the shaft, and be sure to include the 23 Tooth, 2mm bore, Hybrid Gear (with grubscrew). Quarter the jackshaft cranks, check there is running clearance only and then secure the flycrank with glue before trimming the shaft flush with its face. Make a final check for free rotation and then add the pinion cover and secure with wires, as above.

Test the motor and then fit the worm onto the motor shaft (at the mounting screw end) so its mid-point is about 6mm from the motor face (so the worm lines up with the stage 1 gearshaft when the motor is fitted into the gearbox). Some brass worms supplied to us are fractionally tighter than others, and if

they aren't an easy push-fit, use a broach to ease the fit and then, if necessary, secure the brass worm with a small drop of Loctite 601 at the outer end of the motor shaft. Depending on what motor you've used, there could be clearance issues inside the body. Check this carefully – you may need to shorten the shaft so it's flush with the end of the worm with only a few millimetres of shaft protruding at the rear end. To avoid short circuits be careful when routing of pick-up wires to the motor terminals.

Using a magnifier if you have one, check the mesh depth - there should be 'a fag paper's worth' of daylight between them, but avoid having too much backlash. If necessary, loosen the screws, adjust the position and re-check. Try the mechanism under power, first without, then with the stage 1 gear, then the Stage 2 gear finally the final drive gear (23T) on the rear axle.

There should always be a small gap between the side faces of the brass centred gears, and the double gear that meshes with them (see Fig. 14). For this reason, it important to eliminate any sideplay on the driven axle (and the jackshaft) so we've included axle washers of varying thicknesses. Check for clearance by pushing the components sideways to the limit of their travel.

Fit and quarter the wheelsets - the right hand cranks lead by 90 degrees, complete with crankpins. Due to the limited space behind the steps, **P4 modellers** must aim for minimal running clearance only at the rear wheelsets. Additionally, crankpin bushes must be trimmed so they are only fractionally longer than total rod thickness and crankpin nuts thinned down to avoid catching the wheelguards.

Be sure to include the final drive, hybrid gear on the rear axle and the plunger pick-ups assemblies for both axles. Give the mechanism another test with the wheels in place and then fit the crankpin bushes and the rod assemblies – remember, you don't need any crankpins for the jackshaft - check for free running and then fit the securing nuts to the crankpins. Loosen the jackshaft grubscrew, rotate the shaft so the position of the cranks matches the wheels and then re-tighten the screw.

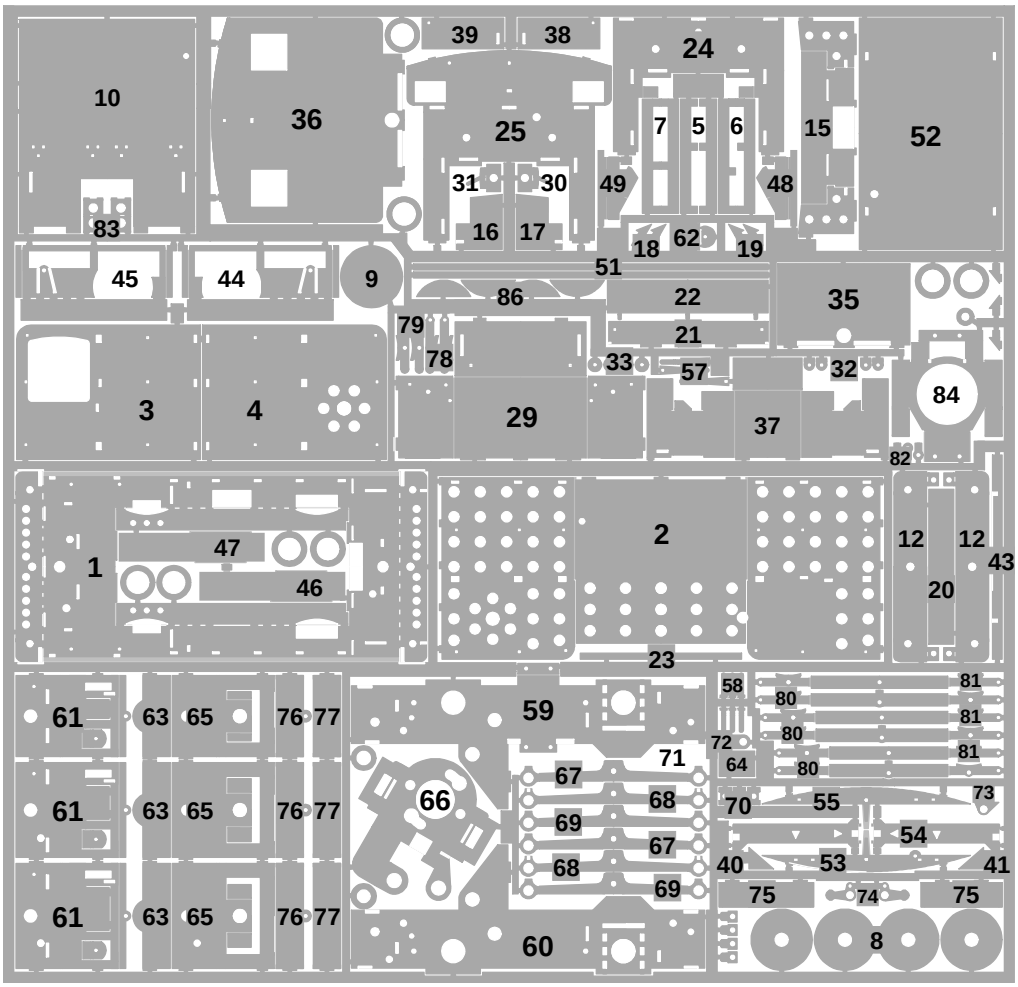
Now you can wire up the loco. For wiper pick-ups, glue thin copperclad strips (remember to gap them first!) across the underside of the frames, taking into account where the brake pull rods will run and the position of the railguards if you're going to fit them. Solder pick-up wires of 0.33 wire to the strips, so they make light contact with the backs of the wheel treads. A simpler solution is to glue the gapped copperclad to the chassis endplates (76 and 77 in Fig. 9) and run busbars of 0.7mm wire between them, with pickups of 0.33 wire soldered directly to the busbars. Attach the power leads to the motor at the same time. Note where the locating holes for the brake gear are – you don't want to obstruct them. For plungers, wire up feeds from the plungers to the motor.

With all soldering on the bodywork complete, you will need to add weight to the space inside – strips of lead flashing glued inside the bonnet are one option, or lead shot (liquid lead) mixed with Plastiscene. Aim for an all-up weight of approximately 3oz (90g), more if you can manage it. With the weighted bodyshell in place, give the chassis a good run on the track. Be sure to give the wheels a thorough cleaning first (for best performance with any lightweight, small-wheeled loco you'll need to do this on a regular basis anyway). If there's a tight spot, whatever you do, don't try winding up the controller in an attempt to blast through it - with a powerful can motor and big gear reduction that would be asking for trouble! Better to investigate and, if necessary, dismantle the mechanism, working backwards through the assembly sequence, until you find the cause.

When you're satisfied all is well, refit the brakegear (see above) use wire running through the pivot tubes. If you induce a slight bend into the wires, this will make them tight inside the tubes and less likely to slide out. A final refinement might be to add railguards front and rear, attached to the endplates. A length of flat-bottom rail should do the trick – that's what Armstrong Whitworth used.

With the chassis completed and running smoothly, you can add the finished body, securing it with M1.6 bolts. A little tweaking may be necessary but check first for anything that might interfere with the fit and prevent the body sitting level – clearances are very tight in some places! If you haven't bent and fitted the sandpipes, as described previously, do this now. Finally, finish painting the details and touch in any scuff marks incurred during assembly.

ARMSTRONG WHITWORTH D10



PARTS LIST

1. Footplate
2. Bonnet Frame
3. Bonnet Side (LH)
4. Bonnet Side (RH)
5. Single Hinge (x2)
6. Double Hinge LHS
7. Double Hinge RHS
8. Filter Housing (x4)
9. Air Intake Louvres
10. Bonnet Front
11. Filler Caps (x2)
12. Bufferbeams (x2)
13. Buffers (x4)
14. Coupling Hooks (x2)
15. Battery Box Frame
16. Battery Box Side (LH)
17. Battery Box Sides (RH)
18. Front Web (LHS)
19. Front Web (RHS)
20. Filler Panel
21. Battery Box Front
22. Battery Box Lid
23. Battery Box Strip
24. Original Cab Front
25. Modified Cab Front
26. Ammeter
27. Pressure Gauge (x2)
28. Valve (x2)
29. Console
30. Power Controller LHS
31. Power Controller RHS
32. Front Lever Detail (x2)
33. Rear Lever Detail (x2)
34. Shunting Controller (x2)
35. Original Cab Rear
36. Modified Cab Rear
37. Storage Bays
38. Bay Side, LHS
39. Bay Side ,RHS
40. Rear Web ,LHS
41. Rear Web ,RHS
42. Handbrake
43. Joint strip
44. Cab Step, LHS
45. Cab Step, RHS
46. Wheelguard, LHS
47. Wheelguard, RHS
48. Footstep, LHS
49. Footstep, RHS
50. Sandboxes (x4)
51. Valance (x2)
52. Cab Roof
53. Cab Roof Former, Front
54. Cab Roof Runner (x2)
55. Cab Roof Former, Rear
56. Horn
57. Original Lamp irons (x2)
58. Modified Lamp Irons (x2)
59. Chassis Frame (LHS)
60. Chassis Frame (RHS)
61. Rear Spacer OO/EM/P4
62. Cylinder Cover
63. Front Spacer OO/EM/P4
64. Pivot Carrier OO/EM/P4
65. Sump Filter
66. Motor Mount
67. Siderod, Rear Layer (x2)
68. Siderod, Centre Layer (x2)
69. Siderod, Front Layer (x2)
70. Springbox Details (x2)
71. Springbox Covers (x2)
72. Journal Detail
73. Handbrake Journal
74. Handbrake Lever
75. Under-slung Box OO/EM/P4
76. Chassis Endplate, Front
77. Chassis Endplate, Rear
78. Brake Hanger, Front L, Rear R
79. Brake Hanger, Front R, Rear L
80. Brake Stretcher Front OO/EM/P4
81. Brake Stretcher Rear OO/EM/P4
82. Pullrod End
83. EM Sandbox Packer
84. Pinion Cover
85. Pinion Wheel
86. Balance Weight (x4)
87. Flycrank

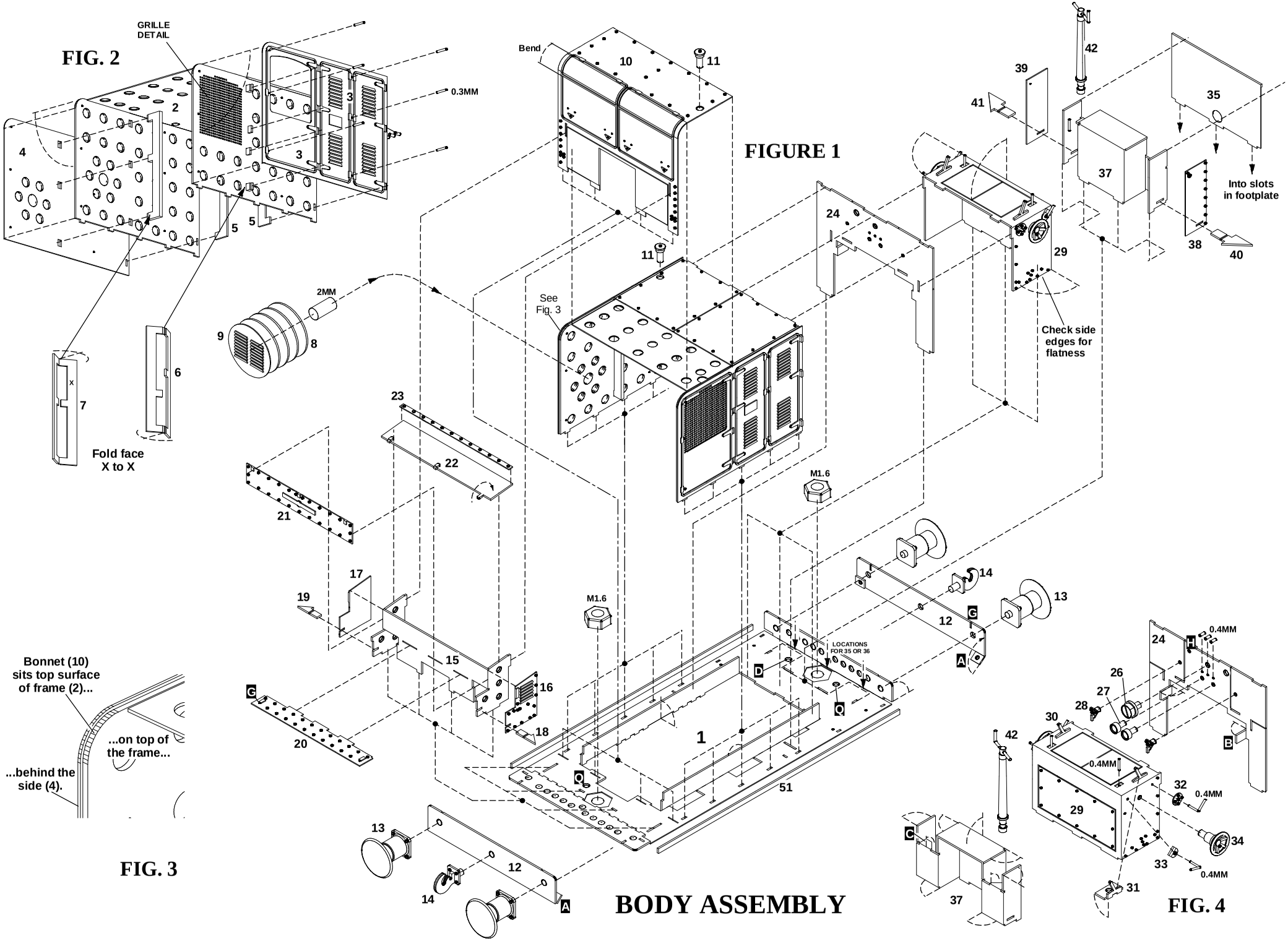


FIG. 2
GRILLE DETAIL
0.3MM
Fold face X to X
FIGURE 1
Bend
See Fig. 3
2MM
M1.6
LOCATIONS FOR 35 OR 36
Into slots in footplate
Check side edges for flatness
Bonnet (10) sits top surface of frame (2)...
...on top of the frame...
...behind the side (4).
FIG. 3
BODY ASSEMBLY
0.4MM
FIG. 4

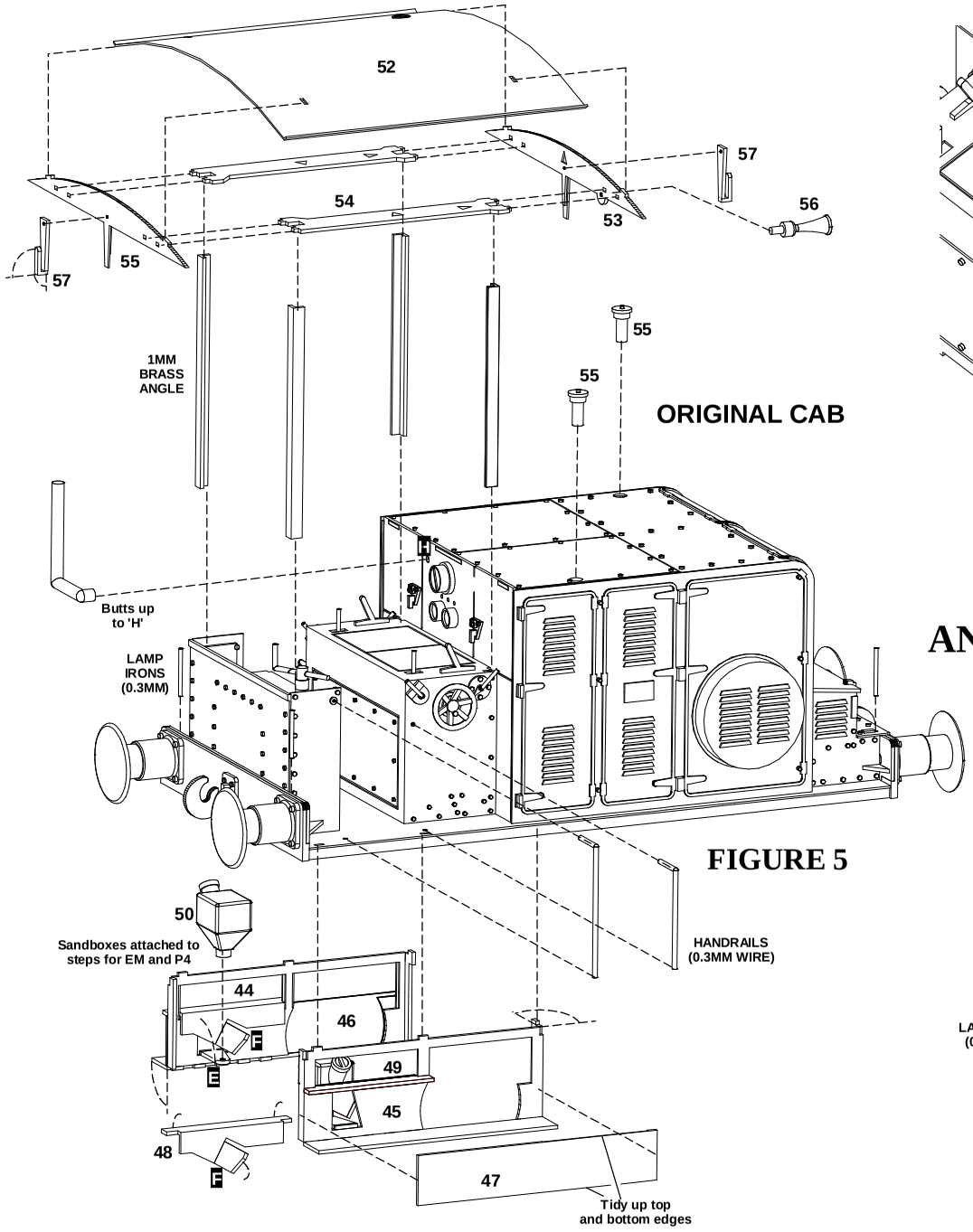


FIGURE 5

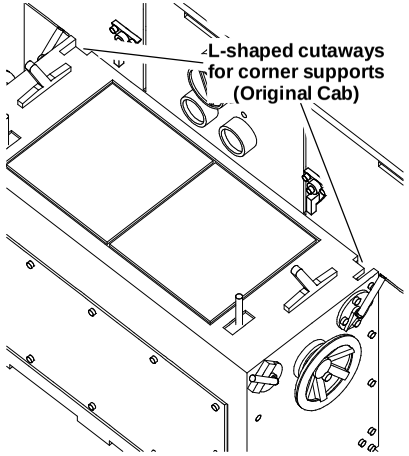


FIG. 7

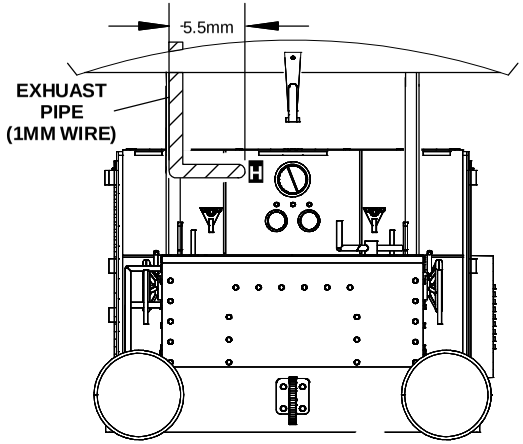


FIG. 8

CAB TYPES AND DETAILING

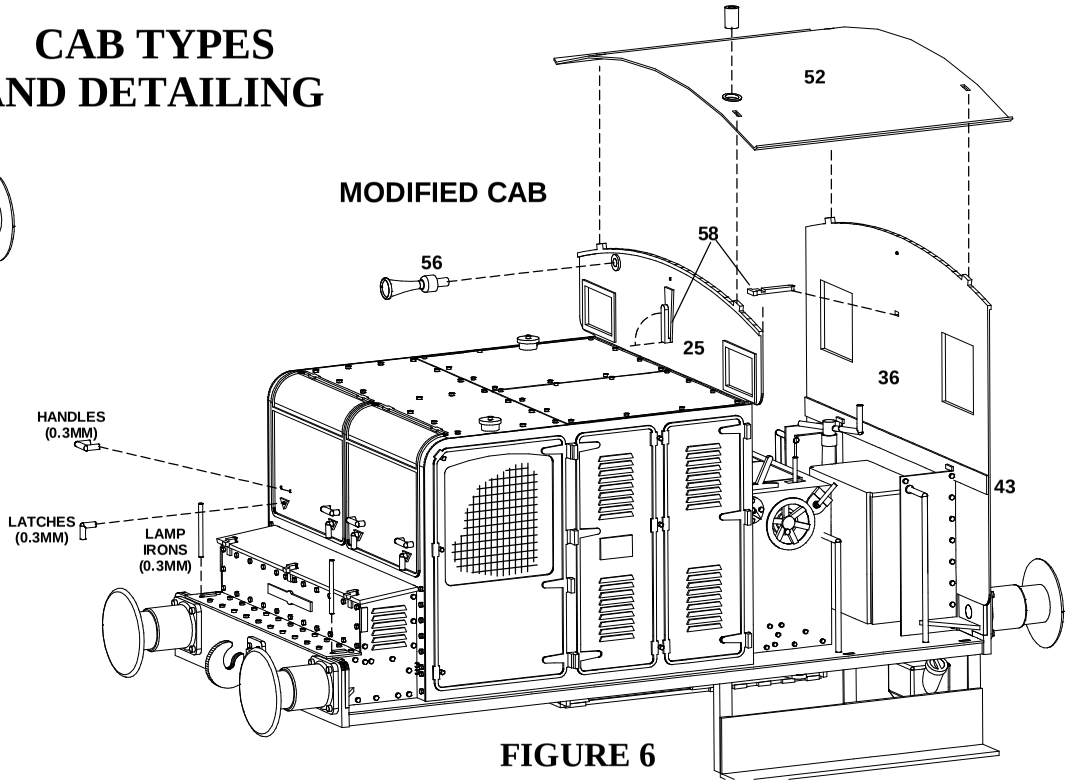
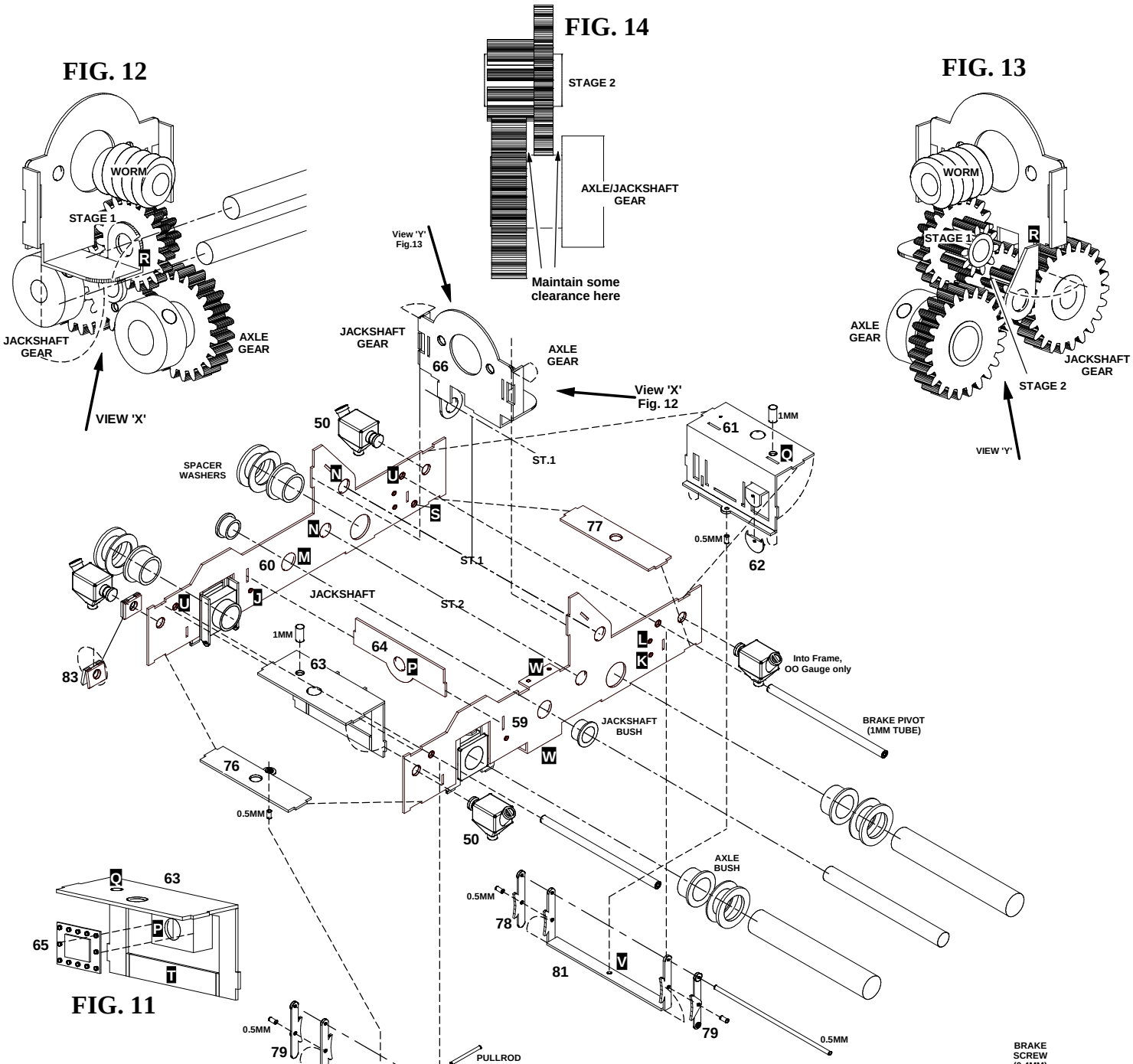


FIGURE 6

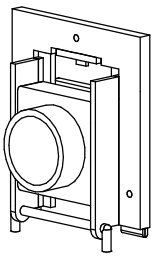


CHASSIS CONSTRUCTION

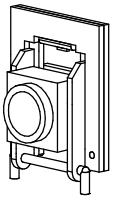
HIGH LEVEL

www.highlevelkits.co.uk

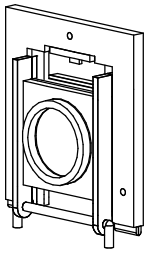
These instructions cover three types of High Level Hornblocks:



STANDARD

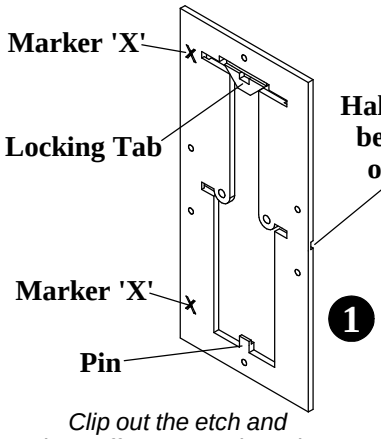


MINIBLOX



SPACESAVER

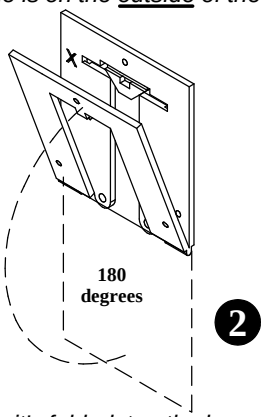
Although their size may differ, the procedure for folding the hornblock etch is the same for each type.



1

Clip out the etch and clean off any mounting tabs.

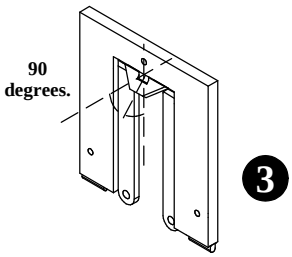
Fold the etch through 180 degrees, so the markers 'X' face each other. The half-etched line is on the outside of the fold.



2

When it's folded, tap the layers between two pieces of hardwood, so they sit absolutely flat.

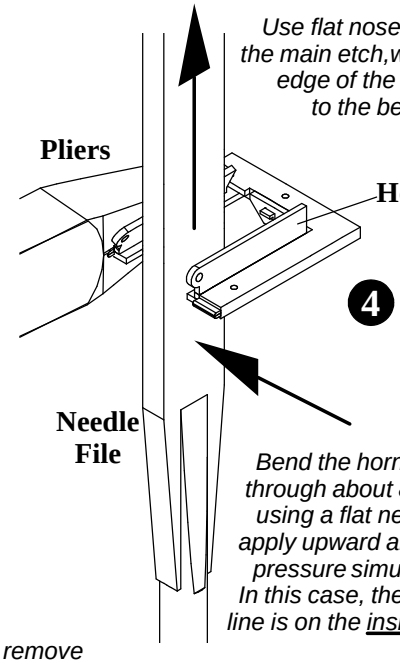
Hold the layers tightly together and fold the locking tab through 90 degrees, so it locates on the small pin.



3

The end of a flat, pointed needle file is a good tool for this job. The tab locks the layers together, eliminating the need for solder.

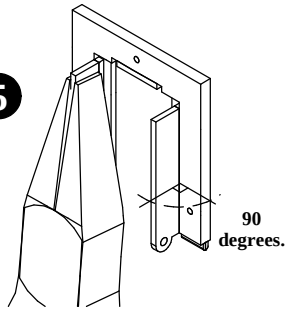
Use flat nose pliers to grip the main etch,with the straight edge of the pliers close to the bend line.



4

Bend the horncheeks up through about 80 degrees, using a flat needle file to apply upward and sideways pressure simultaneously. In this case, the half-etched line is on the inside of the fold

5



Finish off the horncheek bends so they are at 90 degrees. Check this through a magnifying glass and adjust as necessary.

For SpaceSaver 'CSB' units, follow the instructions (overleaf) at this point...

Use fine emery to clean up the bearing, remove any burrs and then try it in place - the groove on the block locates on the front layer of the etches.

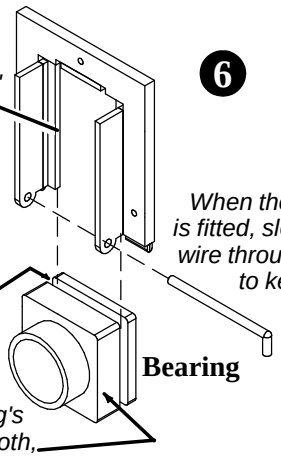
If the bearing's tight in the etch, check that these edges aren't 'bottoming out' in the groove...

6

...If they are, use a file to remove the sharp 'cusp' from the edge of the etch...

When the bearing (and tag) is fitted, slot a length of 0.4mm wire through the bottom holes to keep it in place.

... so there is clearance in this groove...

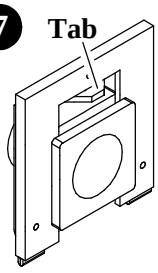


...then polish the bearing's side faces until it's a smooth, sliding fit in the etch.

To fit Standard or MiniBlox 'CSB' Tags, turn to the instructions (overleaf) at this point...

The completed assembly can now be soldered to the inside face of the chassis, using axle jigs. If you fit it with the bearing in place, make sure the sliding surfaces are lightly oiled, to prevent the bearing being soldered to the etch.

7



The top edge of the cut-outs on most loco chassis is 4mm above the axle centre. For 'Standard' and 'SpaceSaver' hornblocks, butt the tab up to the top of the cut-out, to set the unit at the correct height.

For MiniBlox, the top edge of the tab is 3mm above the axle centreline.

HIGH LEVEL, 14 TUDOR ROAD, CHESTER-LE-STREET, CO. DURHAM, DH3 3RY.
TEL. 0191 3882112.