



## **NORTH STAFFORDSHIRE RAILWAY BEL 2 0-4-0 BATTERY ELECTRIC LOCOMOTIVE**

Standard-gauge battery locomotives were built for a number of operators (including the War Office) in the years before and after the First World War. The best known – because it has survived into preservation – is probably the one that worked between 1917 and 1963 at Thomas Bolton & Sons' Oakamoor Copper Works in Staffordshire. The products of the little-known Yorkshire firm of Electromobile were similar in appearance, and there were others with the same basic outline.

The Oakamoor engine – the one featured in this kit – was unusual (if not unique) in that it was entirely an industrial design, based throughout its life at an industrial plant, but was built, owned and operated by a main-line company. The locomotive was designed by J. A. Hookham, Locomotive Superintendent of the North Staffordshire Railway, in association with his Electrical Engineer, A. F. Rock, and was capable of handling a trailing load of 90 tons on level track. There was a 250v motor on each axle; instead of conventional brake hangers and shoes, brake bands acted on drums situated behind the wheels and were operated via levers running from a hand-operated wheel in the cab. A series of holes drilled in the plankwork dispersed fumes from the wet-cell batteries, situated under the sloping bonnets at either end of the bodywork. There were electric headlights above each buffer and the locomotive had a 12v Klaxon horn with which shunting movements and warnings were communicated.

The engine carried the number 1 in pre-Grouping days. If the condition of the preserved locomotive is to be believed, it was painted in full North Staffordshire livery of deep red, lined in gold. It was not renumbered by the LMS but in BR days it became BEL 2 – BEL 1 was an ex-Midland Railway battery locomotive that worked at Poplar Docks in London. BEL, of course, stood for Battery Electric Locomotive – a system of shorthand that anticipated BR's numbering of its diesel and electric fleet with D and E prefixes as appropriate. In the North Staffordshire era the engine was maintained at the company's shops in Stoke-on-Trent until the works were closed as an economy measure in 1926, after which it made its own way to Derby for overhaul, a practice that continued at intervals throughout LMS and BR days – something for the prototype-for-everything department perhaps?

The livery of BEL 2 is open to conjecture. From photographs it appears to be black, with vermilion buffer beams, but some sources say it was painted a flat, unlined maroon (with black underframe) and in certain lighting conditions this appears equally plausible. After Oakamoor Copper Works ceased production in 1963, BEL 2 was stored at the back of Nuneaton shed while a decision was made about possible preservation (by then it was one of only two NSR locomotives still surviving). Restored to North Staffordshire condition, it was displayed initially at Shugborough Hall but later moved to the National Railway Museum in York. It has subsequently been on loan to the Churnet Valley Railway, close to its original base.

### **CONSTRUCTION NOTES**

Despite the small size of the prototype, this is not a simple kit to build. While the parts have been drawn and mastered as accurately as possible, much depends on the individual modeller's skill and, in particular, on patience and dexterity. It is emphatically not a kit for the beginner, although we'll do our best to help you out if you do get stuck. Almost every conceivable cosmetic detail has been faithfully reproduced, with numerous lost wax castings and finely-etched parts, whilst super-smooth, low-speed performance is delivered by a fully-compensation motor bogie with a unique and totally concealed 4-wheel-drive system. This level of sophistication in such a tiny model inevitably requires a good measure of care and finesse from the builder.

Power comes from a Mashima 1020 motor and the kit requires 12mm 8 spoke (open) wheels from Alan Gibson, ref 4001 – we advise against using Romford/Markits wheels as you'll need to take them off their axles in order to fit them to the loco, which isn't easy. You'll also need suitable three-link couplings.

Read through the instructions and study the diagrams - preferably more than once - before beginning work. Think ahead, anticipating when you are going to paint the model, for instance, and what kind of pick-up arrangements you will make.

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 required, holes are etched undersized so they can be drilled or reamed out to the correct diameter.

Some of the feeds on the lost wax castings are used to locate parts on the model. Use the illustrations to identify these locators before cutting the parts from the sprues. Where lost-wax parts need drilling to allow pipework to be fitted, drill starts have been provided.

As we say, this is far from being a shake-the-box kit but we can assure you that it **will** go together exactly as described in these instructions, and **without any modification** to the parts supplied. If any procedure appears over-complicated, there will unquestionably be a reason why – try to ask yourself what the alternative (if any) would have been.

The model is built as a sequence of sub-assemblies, which only come together at the very last. They fit together in a very particular way - and come apart again. These sub-assemblies clip-fit or are screwed together. They should not be fixed permanently.

Except where you have an exposed edge, such as a cab side or sidebar, it is advisable not to file off the cusp around the edges of components - the slight alteration to their dimensions could be enough to affect the way they integrate with other parts. Other than the routine cleaning-up and filing-off of parts as they are detached from the frets or sprues, you should not need to modify any of the components in any way. High Level's own pilot models were assembled absolutely straight, without modification, from the same parts you have here. Some parts, however, may be deliberately etched over-size to allow for accurate trimming. This is allowed for in the instructions.

When soldering parts in place, tack-solder first in one spot only and then check that everything is as it should be before final soldering along the joint. Moving a part that isn't aligned correctly can be difficult if it has been tack-soldered at more than one point.

If something isn't right, think twice before reaching for a file or drill. Any problems with the fit or alignment of components are likely to have been caused by errors earlier in the assembly sequence. Distortions and misalignments can build up and it becomes increasingly difficult to get parts to fit until, eventually, the kit becomes almost unbuildable. Backtrack through your work and look for things like excess solder, tabs not fully filed off, inaccurately formed parts or alignments that are not quite true. If you modify any of the components - other than purely cosmetic alterations to model a freelance locomotive rather than that on which the kit is based - you might well be storing up trouble for yourself.

As always, plan ahead and think through every move before soldering any parts together. If you are patient and careful, you will find that building this scale model locomotive becomes an immensely rewarding experience and will, we hope, take you to a whole new level in your loco-building. 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...

## MOTOR BOGIE

Remove the Motor Bogie Etch (1) from the fret and progressively ream out the gearshaft and axle bush locations in end A (the rigid end) of the etch, shown in Figure1, so the components are a tightish, push-fit in their holes. Remove burrs by inserting the tip of a drill bit (of much larger diameter than the hole) and gently rotating it between your fingers. Solder the 2mm bushes in place at end 'A' of the etch, with the larger-diameter shoulders on the opposite side of the etch to the bend lines.

Very carefully bend out the body fixing platforms 'C' – to avoid distorting the etches, position your flat nosed pliers right up to the bend lines as make the bend. Do the same for the small braces above the platforms and strengthen the bends with generous amounts of solder (Figs 1 & 2). Bend out the motor fixing locking tabs (D) through 90 degrees, followed by their small tales to brace them, and apply solder to these areas to secure them to the sides of the bogie - flooding with solder will add strength, but make sure you can still locate the small holes in the tabs, which should be opened up to accept 0.5mm wire.

Fold the tabs on the Motor Mounting Plate (2) through 90 degrees and strengthen the bends with solder. Fold up the main Motor Bogie Etch (1) and make the corner bends at the overlaps - side 'X' must be bent before 'Y' - but before soldering anything, locate the motor mounting plate in its slots, as shown. Check the frames are square and then, doing one end at a time, line them up using a lightly oiled tapered broach (or similar) which can be pushed through the bottom holes 'E' (see also Fig 2) – make sure you don't enlarge the holes. Once you've accurately located the halves, nip the overlaps with small pliers (to ensure they sit flat on one another) and then solder them together. Open out the bottom hole 'E' at end 'B' so the 1mm steel rod is a good, tight fit and remove any burrs, then make sure the inner faces of the halves are smooth and free from solder, particularly at end 'B' where the compensation unit will pivot.

Form the control console (3) solder it in place on top of the bogie then open out the hole in the console. Solder the central wire to the hole, leaving about 1mm proud of the console, but don't fit the delicate controller lever yet as it may get damaged. Layer up the Gauges (4) and their backing piece (5) to give thickness and solder both parts in place on top of the bogie. Make sure the parts' locator tags do not protrude inside the bogie, filing them flush if they do.

Open out the holes in the corners of the Resistor Bank End Plates (6 x2) and solder the parts into the locations at the underside of the bogie. If you wish, you can detail the Plates by soldering wires into the corner holes to represent threaded ties, trimming the ends of the wires so they protrude by about 0.3mm. Figure 20 shows the completed and fully detailed assembly in situ.

Spring the bogie sides slightly, and solder in the Pivot Mount (7) at end 'B' – the central hole should be a tight fit on 1mm silver steel. Finish off the bogie structure by bending the traction motor covers (8 & 9) to shape and solder the cover 8 to end 'A'. Open up the hole in part 9 and use 1mm silver steel to line it up as you solder it to end 'B', and to the Pivot Mount for extra strength.

Now you can prepare the bogie's internal components. Before making the Gear Cradle box (10) bend the re-enforcement tabs 'F' through 180 degrees (bend lines on the outside) and line these up with the central holes using a broach or oiled wire, solder them in place then open out the central pivot holes so they are a good fit on 1mm steel. Now open out the rest of the holes in the Gear Cradle to suit the axle bushes, shafts and wires, as above. Solder axle bushes into the Gear Cradle, so the shoulders on the bushes are on the **same side** as the bend lines, file the non-shouldered ends of the bushes flush with the etch, remove the burrs then fold the etch to shape to form a box - the overlapping strips on the cradle can be lined up and soldered in the same way as the main bogie (above, using a broach).

When the cradle is complete, strengthen the corners with solder, check the sides run parallel and then brace the unit using a length of 1mm wire, as shown. File this wire flush at the outside of the cradle and try the unit in place in the bogie using a length of 1mm silver steel as the pivot. Check it rocks freely on the pivot and set aside.

Fold up the rigid geartrain Multi-spacers (11 & 12). Bend the sides first, followed by the ends, strengthen with solder as above, then check 2mm shaft will slide **easily** through the holes in the spacers.

Cut two gearshafts so their length is the same as the overall outside width across the bogie frames, and two more to match the outside width of the gear cradle. Make sure the shafts are free from burrs or marks - any imperfections may cause the shafts to snag in their holes and the excessive force needed to shift them could distort the delicate etches. It makes fitting easier if you chamfer the ends very slightly.

Give the bogie, Multi-spacers and gear cradle a good scrub with household cleaner, rinse and allow to dry. You can paint the main bogie black now or, if you wish, after first having a dry-run assembly with the internal components temporarily in place.

Attach power leads to the motor and test. Once you're happy with the running, fit the worms onto the shaft, so their mid-point is about 5mm from the motor faces (see Fig. 3). Note that some brass worms supplied to us are fractionally tighter than others so, if they aren't an easy push-fit, use a broach to open them out slightly and, if necessary, secure them with a small drop of Loctite (or Superglue) at the outer end of the worm. When push-fitting the worms, hold the motor by the rear of the shaft and don't use excessive force or the shaft may bend.

Now you can fit the components into the bogie. Throughout this process, refer to Figures 4, 5 and 6, which shows the gear and spacer arrangements at both ends of the bogie. Starting at End 'A', slot one of the longer lengths of gearshafts through the stage 2 location. As you do this, include both etched Multi-spacers, along with a Stage 2, 20/10T gear. Check the gear is free to spin, swing the spacers so they hang outside the bogie, then fasten the shaft to the bogie sides only, at both ends, using a tiny amount of glue. Be careful the glue doesn't jam up the gears or spacers.

Take one of the shorter lengths of shaft and fit this into the Gear Cradle at the Stage 2 location, along with the remaining 20/10T. gear and its collar. Carefully glue the shaft in place in the cradle, making sure none of the adhesive penetrates to the gearwheel, and let the adhesive set. Now glue the collar to the shaft, pushing the gear up to side 'X' of the cradle, checking the gear rotates freely, but with minimal sideplay - the large diameter part of the gear should run in line with the clearance slot at all times.

At end 'B' of the chassis, manoeuvre the gear cradle into its location (see Figure 2) then slide in the steel pivot pin – leave the pin over-length and **do not fix** it in place just yet. Check the cradle will rock freely on the pin.

Take the remaining short gearshaft and slide it through the Stage 1 slot in the bogie, passing through the gear cradle and the tabs protruding from the motor mount - as you do this, include the stage 1 gear (27/10T.) with a Stage 1 Thrust Washers (13 x2) at either side of the gear. Once you have all the parts in place on the shaft, check the gear cradle is still able to rock freely as you turn the gears by hand.

When the 'B' end Stage 1 shaft is in place, all the components situated along its length must be free to slide as the cradle swings, so it's absolutely essential to secure the shaft to the **cradle side only**. Glue, or very carefully solder, the shaft to side 'X' of the cradle – this should be enough to hold the shaft in place, although you can also secure the shaft to side Y if you feel confident. Once the glue is set, test once again, then slide out the steel pivot pin, but leave the cradle in place.

Now you'll see why we recommend Alan Gibson wheels for this loco. Make a note of the back-to-back measurement and then remove all four wheels from the axles and file off the axles' pin-point ends. A small chamfer on the axle ends will make it easier to push through the gear. For P4 models (and, to a lesser extent EM) clearance between the wheels and the 'W' irons is small so it's important that the axles are flush with the outer face of the wheels when remounted.

You may wish to ease the holes on the 20T final drive gears very slightly with a reamer - they are interference fit on the axle and may be too tight for comfort. If you haven't already done so, remove the chemical blackening from the tyres of the wheels, using fine wet-and-dry paper.

Before fitting the axles make a mental note (or write it down) **never push or force the axle through the bogie when the pivot pin is in place**. This will almost certainly damage the pin, or the etches, or both...

With the pivot pin removed fit the axle at end 'B' as shown in Figure 2. Hold the bogie with side 'X' facing downwards, and push an axle down through the axle location in side 'Y' of the bogie, and through the uppermost side of the gear cradle. Once the shaft is inside the cradle, slot a 2mm collar

(it's the same as an axle bush – see Fig 4) and then a 20T single gear (boss facing upwards to 'Y') onto the lower end of the shaft. Hold them in position as you place the bogie on a suitable surface, so the lower axle bush is supported (over the corner of your workbench or vice jaws) and push or gently tap the axle through the gear, so it emerges from the lower side (X) of the cradle and bogie – take great care not to damage the body mounting lugs as you do this.

Once the axle is located in side 'X' of the bogie, slot a suitably-sized tube over its end, and then carry on pushing the axle until it is centred in the bogie. Now slot in the pivot pin and re-check the amount the axle protrudes at the sides. Make sure the gear is pushed right up to side 'X' of the cradle and the cradle is not leaning to any one side. Remove the pin if you need to make fine adjustments to the axle/gear position - the shaft should be exactly central in the bogie and cradle, when the gear is against side 'X' of the cradle and the pivot pin is in place.

Once satisfied with the position of the components and axle, make a final check that the gears revolve freely, then glue the collar to the axle, hard up to the side of the cradle that's opposite the gear (side 'Y'). Note that, due to minimal clearances, axle length and position is crucial, so P4 modellers are advised not to permanently fix the axle/gear/collar position, until the body and sideframes have been tried in place.

Fit the remaining 20T. final drive gear, collar and axle to the rigid end 'A' of the bogie, centralising the axle in the same way as above – this time with the boss on the gear facing side 'X' - and test the gears for free running and then glue the collar in place to eliminate sideplay, as above (except P4 models). Don't fit the wheels just yet

To install the motor, working from end 'A' of the bogie, make sure the ends of the etched Multi-spacers are sitting down on the axle as shown in Figure 3. Guide the motor over the top of the Stage 2 gear, through the bogie and up to the mounting plate, then fix the motor in place using the screws that came with it. Slot a 1mm retaining wire, shaped as shown, under the motor, sliding it along the tapered slot until it reaches the narrow end. It should tighten up to the motor and then the retaining wire can be locked in place by slotting in a short length of 0.5mm locking wire, the ends of which can be bent over to prevent it from working loose (see also Fig. 20).

Now swing the shorter of the two multi-spacer (Part 12) back outside the bogie and joggle the remaining 27/10T Stage 1 gear into position – this may take a couple minutes but it will go in. Now slide the gearshaft through the Stage 1 location in the frames and spacers (which you will need to swing into position) along with the 27/10T. gear. Lightly glue the gearshaft at one end only.

Test the bogie under power and then fit the wheels. Trim the steel pivot pin to length and secure with glue at the outer end. If at any stage you need to remove the motor, take off either one of the wheels at end 'A' and drift out the stage 1 gearshaft. Remove the gear and position the Multi-spacers as you did when fitting the motor (above) clip the locking wire off and slide out the 1mm motor retaining wire, then loosen the motor screws and draw the motor back through end 'A'.

The tricky job of fitting pick-ups to the model is further exacerbated by the model's highly detailed underside, which is clearly visible from most angles, so it's not a bad idea to wait until the superstructure is complete before doing the job – this allows you to route the wires around the various under-slung details. You may have your own preferred method of doing pick-ups, but one possible suggestion is to short out the wheels on side 'Y' (the side with the brakes) by soldering lengths of wire between the tyre and axle, and then wiring the bogie frame to one of your motor terminals. On the opposite side, glue a small piece of paxolin to the bogie side, just under the floor level, attach wipers to this (shaped to make contact with the backs of the tyres) and then wire this side to the remaining motor terminal. Even with the motor fitted the complete bogie weighs very little, so it's advisable to add some temporary ballast before test running on the track.

## SUPERSTRUCTURE

### Footplate

Remove the footplate (14) from the fret and check the slots in the etch are fully formed – some are very narrow and may need opening out with a blade. Don't worry too much about scratching the upper surface as none of this will be visible.

We've provided practice strips of small and medium-sized rivets at the sides of the fret. Practice forming these until you're happy with their appearance – a proper riveting press is the easiest tool to use but if you're careful, it's not too difficult to form them using the tip of a large, blunt needle. Try and keep the pressure consistent. The drawings also show large rivets, though the etched guide holes are the same size as medium. These are designed for presses with multiple anvils but if you only have a simple one-size riveting tool, we suggest forming the rivets marked large as you would for medium. If we etched the holes any larger, it would cause the point of the riveting tool to wander.

In your eagerness to press on, don't be tempted to start punching out rivets on the actual model, until you're absolutely satisfied with the practice ones - if these look bad on the strips, they'll look a million times worse on the model so, if you're in any doubt, leave the rivets off altogether.

When feeling confident, punch out the rivets near the edges of the footplate, shown in Figure 9.

The footplate bends should be done in a specific order, starting with the outermost and working inwards. Study Figure 7 and then clamp the edge of the footplate in the jaws of small vice, as shown. Use a flat piece of hardwood to apply pressure as you make the first of the right-angled bends, with the fold lines on the **inside** of the bend. Do the opposite side, then reposition the footplate and take the second pair of bends, going as far as you can go in the vice (Fig.8). Remove the part and finish off these right angles by hand, taking great care not to start the third bend.

Now make the last bend by hand, but note that this time the bend lines are on the **outside** of the bend and are 180 degrees - and as you do this, tabs should locate in the slots, as shown in Figure 10.

When both sides are done, invert the footplate and, working on flat surface, very gently, using a piece of wood to distribute the force, tap along the top surface of the angles with a small hammer to square up the bends (Fig. 11). View the footplate from the ends and tweak the bends until you are happy they are all square.

Place the footplate on a flat, heatproof surface and use your tweezers to press down at the areas of footplate either side of the tabs with small and apply solder to the top of the tab, doing one at a time, as shown in Figure 12. Do this at all the tabs, then invert the footplate, place it on a flat, heatproof surface and run a fillet of solder along the inside corners, holding the angled section down with a piece of hardwood as you go (Fig. 13).

Move on to Figure 14 and finish the footplate by using a lightly-oiled bolt to locate two 14BA nuts directly over any two diagonally-opposed holes 'G'. Solder the nuts in place, remove the bolts, check they can be easily fitted from the underside and then clean up the finished footplate.

## BODYWORK

Punch out the small rivets at the corners of the cab halves (15 & 16) and then make the bends. Open out the holes at the top, to suit 0.5mm wire. Carefully fit the cab halves in their slots (H) in their respective ends of the footplate – accurate location is essential, so if they won't go in fully, clean out the slots until the bottom edges of the sides sit on the footplate. Solder the cab halves in place making sure the overlapping tabs at the top lie correctly on one another with the tabs from end 'A' on the inside – you can use wire to line them up but don't solder it into the holes at the top just yet.

Add the Door Panels (17 & 18) panels to the rear faces of the cab doors (19 X2) making sure the stripes are facing the correct way. If you feel confident, open out the small holes and detail the doors

by soldering in short lengths of 0.4mm wire to represent the tiny latches and handles - be careful not to flood the grooves in the panels with solder - and, when in place, file the wires almost flush with the rear door face.

Locate the tabs at the bottom of the doors in slots 'J' in the footplate, then slot a length of 0.5mm wire through the holes in the tags at the top of the doors, and the cab frame. Solder the doors to the footplate then tabs at the top of the door and cab halves together and solder them solid at the tags. Do this at both sides then trim the top wire flush at the outside face of the tabs.

Flux the footplate's outer edges and, with a hot clean iron, add solder so it runs between the layers, but be careful not to linger with the heat or the footplate may buckle or become completely de-soldered.

The next step is to remove the tags from the footplate edges. Use masking tape or, better still, a piece of thin shim to protect the rivet detail at the cab corners.

The simplest method – if not the best – is to file the tabs off individually using a needle file, then to dress the edge of the footplate using emery paper on a flat surface.

A better technique, but one which requires more experience, involves using a large (9ins or over) single-cut, flat file with a safe (smooth) edge. The use of such a tool may seem a bit drastic for a small job like this, but the inherent flatness of the file makes it easier to obtain a true, straight edge along the footplate. Although this pattern-makers' technique takes a bit of getting used to (it's best to practice first) it gives excellent results. Stick some masking tape to the cab sides to avoid damage and then carefully hold the footplate edge against the file as you move the latter back and forth, with the safe edge of the file sliding on the edge of the bench and supporting the file's weight. You can easily vary the degree and angle of the pressure applied against the file, depending on where you wish to remove material but, due to potential ferociousness of the file's large cutting surface if used over-zealously, pressure should be minimal and mainly for guidance, as you allow the job to 'float' on the file. Keep checking and measuring the job as you proceed - you'll notice how more material is removed from leading corner (the one nearest to you) and so it's important to turn the job after every few strokes to even this out.

Punch out the large and small rivets in the bonnets (20 x2) and then straighten the parts as necessary. Whilst they're still flat, try each of the sides in place, to check the small tabs will clip right down into their locations 'K', cleaning out the slots if necessary. Make the bends in the thickening pieces, at the bottoms of the bonnet ends in the order shown, with the lines on the outside of the 180 degree bends - you'll end up with sandwich of three layers, which need to be nipped together so they sit flat on one another. Tap them between two pieces of hardwood to ensure they sit flat, and solder them together. Now fold the main bonnet corners, check for squareness then go on to fit the bonnets to the footplate, clipping the small tabs 'K' into the slots at the sides of the cab – these tabs determine the longitudinal position of the bonnets. Check for gaps along the bottom edges and push the sides up to the cab frame as you solder them to the framework and footplate - don't linger too long with the iron or you'll draw solder from between the footplate layers. Working from the inside, add solder to joints at the footplate ends - Note: there may be a small gap between the footplate and bonnet ends.

Noting the different sizes, carefully punch out the small and medium rivet detail in the bufferbeams (21 x2). Tin the rear face of the beams and then hold them up to the footplate ends. Use the Ribs (22 x4) to locate them, slotting these parts into their locations at the bonnet ends. Bend the ribs' locking tabs over at the inside (the top and bottom tabs go in opposite directions) then, after checking they are in the correct position and sitting square and straight, tack them in place from the inside before you go on to solder the whole beam to the bonnet end. When all the parts are soldered securely in place, file the bufferbeam ends and underside so the beams' layers look like a solid, thick piece.

## Detailing

Before removing the corner straps (23 x2, 24 x2) from the fret, make a thin pencil mark (or faint scribe line) along their centres, using the etched lines on the fret for position. Clamp one of these etches in your vice and, with a piece of hardwood to protect the rivets, line the pencil mark up so it is just visible above top edge of the wood (just above the jaw). Make the bend using another piece of wood to apply pressure, then remove the etch and tweak the bend as necessary. Do this for all four etches, before soldering them to the corners of the loco paying particular attention to orientation of the rivets as you do so. When fitted, file the tops of the straps flush with the top edges of the bonnets.

Add the Plank Straps (25 x4) to the sides of the bonnets using short lengths of 0.4mm wire to locate them, then grind the wire flush with the outer faces.

If necessary, clear away excess solder from the rear of the main solebars, so the tabs in the 'W' Irons (26 x2) go fully home in their locations. Bend up the footsteps on the Irons and tack them in place behind the solebars using the minimum of solder. In order to provide clearance for the wheels, P4 modellers will need to cut away the top sections of the Main Step Assemblies (27 x2) in line with the etched guide lines (Fig 14). Push the steps through the slots in the irons, make the bends then solder the verticals hard up to the back faces of the 'W' irons so the footboards on the steps are horizontal. Refer to Figure 15 and fit the Under-slung Box sides (28 x4) to the footplate - they also have a tab that locates in the rear of the 'W' Irons - and solder them in place. Detail the Brake Rod Assembly (29) using the Brake Adjuster (numbered 30 in Figure 14) and short lengths of wire to represent the pivots, file the wires almost flush. For EM and P4 gauges, solder the whole assembly to the underside of the footplate. For OO gauge, the brakes will catch the wheels, so you can either leave the brakes off altogether, or fix them hard up to side face of the bogie unit, running them behind the wheels (if clearance allows) or trimming the ends as required.

Bend the detailed end of the Battery Charger Socket (31) back through about 15 degrees and add it to the opposite side, just behind the step. Punch out the medium rivets in the beam braces (32 x4) and bend them through 90 degrees, making sure you don't flatten the rivets. Solder these in place in the corners of the solebars, as shown. As these parts are quite tricky to punch out neatly, we've provided etched alternatives (33 x4) which don't need to be bent to shape.

Using your vice (or Hold & Fold) bend over the lateral girders (34 x2) then solder the top sections (35 x2) in place. Solder these girder assemblies in place at either end of the loco, then cut 10mm lengths of 0.4mm wire and slot these through the girders, behind the solebars and into the holes 'K' in the footplate (see Figs 14 & 15). Solder them in place then add the lost wax dampers (36 x4) to the ends of the wires, secure them and then trim the wires so they protrude below the dampers by about 0.5mm.

Clip the axlebox castings (37 x4) from their sprues, trim off the feeds and locate them on the W irons with the pins at the tops slotted fully home in the holes in the solebars. Solder them in place and grind the locator pins absolutely flush with the rear face of the etches.

Solder the sandboxes (38 x4) in place in their location holes. Early works photos show the loco in NSR livery with the sandboxes mounted centrally, under the cab, as in Figure 16. For this arrangement, you should use holes 'L' in the footplate (see also Fig. 14) with the casting locating on smaller diameter part of the fixing pin.

Later in the loco's life, the sandboxes were moved to the ends of the footplate (holes 'M' and using the larger part of the pin) behind the bufferbeams (Fig. 17).

Add the lamps (39 x4) then fix buffers (40 x4) with the flats on the mounting pin at the sides in place, as shown in Figure 15. Solder the Claxon (41) to the cab front at end 'B' (15 in Fig. 14) and trim the pin almost flush inside the cab. Open out the holes for the handrail knobs near the cab doorways, solder the knobs in place then fit 0.4 wire for the rails, trimmed flush with the outside of the knobs, as shown.

Clip the Window Cills (42 x2 in Figure 14) from the fret, try the tabs into their slots in the cab fronts and, if necessary, open out the slots using a blade or broach. With the cills removed, adjust the angle of the bends at their corners, so they look like right angles when viewed from directly above. Be sure



the cab fronts are straight and locate the tabs on one of the cills in the slots in the cab. Use your thumb to control the angle as you push the front of the cill fully home in the slots, at a downward angle of about 20 degrees. Check the cill's side pieces should run horizontally under the side windows, hard up against the cab and sitting on top of the small ledges, as shown, and tack the sides in place. Go on to secure the rest of the cills to the cab front, tack-soldering at intervals and making sure the cab remains straight as you do so. When you've done both ends of the loco, run a fillet of solder along the top joints, doing short lengths at a time to avoid getting the cab front too hot which would cause it to bow.

Locate the Bonnet Latches (43 x2) in their slots in the bonnet ends, pushing them fully up to the inner face of the bonnet and (Fig 18) tack them in place at the inside.

Refer back to Figure 14. Detail Bonnet Lid 'A' (44) using the handbrake wheel overlay (45) and short lengths of wire, as shown – the longer wire should protrude down by about 5mm with a small 'pip' at the top for the central securing nut. The shorter wire sticks up by about 1mm. Bend up the box shape - part of bonnet lid 'B' (46), fit the lids to their respective ends of the loco and then make the box and brake wheel level by pushing them downwards slightly. Once soldered in place, make the bends at the ends of the Bonnet latches (44), pressing them flat against the end panels, and solder in place (see Fig. 19). Add the lid half sections (47 x2) using the holes underneath for solder access solder – the lids should butt up to the cab front, under the cills, and be flush at the sides.

## FINAL ASSEMBLY

To improve the smoothness, road-holding and haulage capabilities, you can add weight inside the bonnets, then offer up the Motor Bogie to the underside of the body (Fig. 15) making sure it is facing the correct way; it should be a snug fit, with minimal clearance. P4 Modellers in particular can relish the challenge of minimal clearance between the outer edge of the rocking wheelset and the W irons, necessitating exact central positioning of the wheelset in the bogie in order to prevent shorting.

Manoeuvre two 14BA fixing bolts into position their holes in the bogie's mounting platforms and use a small flat-bladed screwdriver to tighten them (don't use excessive force or you'll strip the delicate threads) and then try the model on the track. When all is well, remove the bogie and add the Controller Lever (48 – Fig. 1) to the top of the bogie. Refit the completed unit and detail the sandboxes using 0.5mm wire to represent the sandpipes, which should run down to the wheels as shown in Figure 17 or 18.

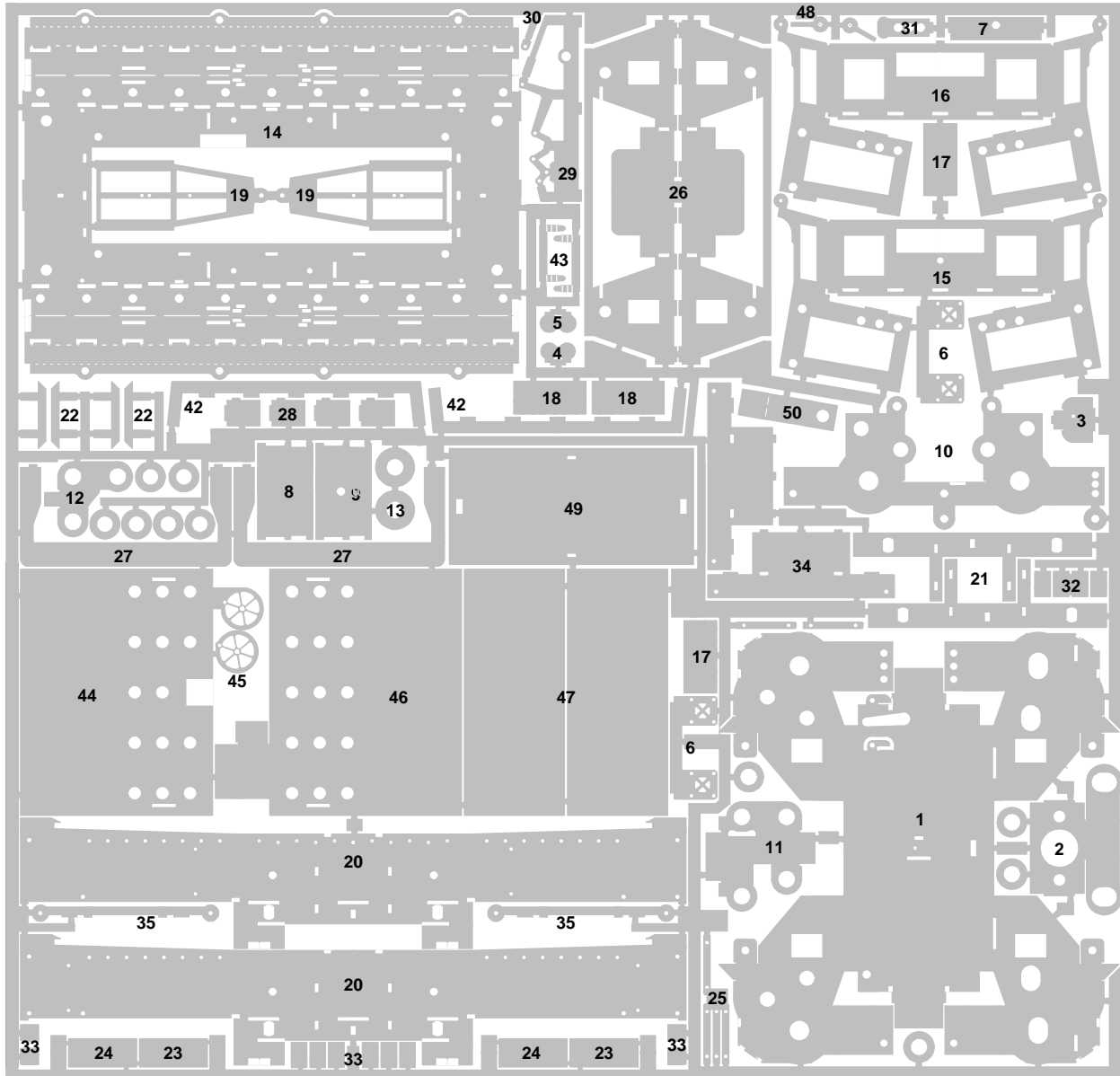
Clip off the wires on the inside the tags at the top of the cab and file them flush at all sides. Put a slight bend in the Cab Roof (49) and then locate it over the tags, file off the excess tags at the top and clean up the top surface. Remove the roof and bend the Electrical Panel (50 in Figure 14) to shape, then paint this along with the loco body and roof. Using the preserved loco as a guide, the cab interior should be a tan colour (to represent a grained wood effect) with the handbrake wheel and controller and panel in black; the control box (part of lid '46') is the same colour as the loco body. Glaze the cab, then position the Electrical Panel using the rectangular recess in the underside of bonnet 'A' for location, and glue it in place. Finally, finish off by gluing on the cab roof.

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# N.S.R. BEL 2 BATTERY LOCOMOTIVE



## PARTS LIST

- |                             |                                |
|-----------------------------|--------------------------------|
| 1. Motor Bogie              | 26. W Irons (x2)               |
| 2. Motor Mounting Plate     | 27. Steps (x2)                 |
| 3. Console                  | 28. Under-slung Box Sides (x4) |
| 4. Gauges                   | 29. Brake Rod Assembly         |
| 5. Gauge Backs              | 30. Brake Adjuster             |
| 6. Resistor Bank x2         | 31. Battery Charger Socket     |
| 7. Pivot Mount              | 32. Beam Braces (x4)           |
| 8. Traction Motor Cover (A) | 33. Beam Braces (etched)       |
| 9. Traction Motor Cover (B) | 34. Lateral Girders (x2)       |
| 10. Gear Cradle             | 35. Girder Tops (x2)           |
| 11. Multi-spacer (large)    | 36. Dampers (x4)               |
| 12. Multi-spacer (small)    | 37. Axleboxes (x4)             |
| 13. Thrust Washer (x2)      | 38. Sandboxes (x4)             |
| 14. Footplate               | 39. Lamps (x4)                 |
| 15. Cab Half 'A'            | 40. Buffers (x4)               |
| 16. Cab Half 'B'            | 41. Claxon                     |
| 17. Door Panel (Y,L; X,R)   | 42. Window Cills (x2)          |
| 18. Door Panel (Y,R; X,L)   | 43. Bonnet Latches (x2)        |
| 19. Cab Doors (x2)          | 44. Bonnet Lid 'A'             |
| 20. Bonnet (x2)             | 45. Handbrake Wheels Overlay   |
| 21. Bufferbeams (x2)        | 46. Bonnet Lid 'B'             |
| 22. Ribs (x4)               | 47. Lid Half Sections (x2)     |
| 23. Corner Strap (A,L; B,R) | 48. Controller Lever           |
| 24. Corner Strap (B,L; A,R) | 49. Cab Roof                   |
| 25. Plank Straps (x4)       | 50. Electrical Panel           |

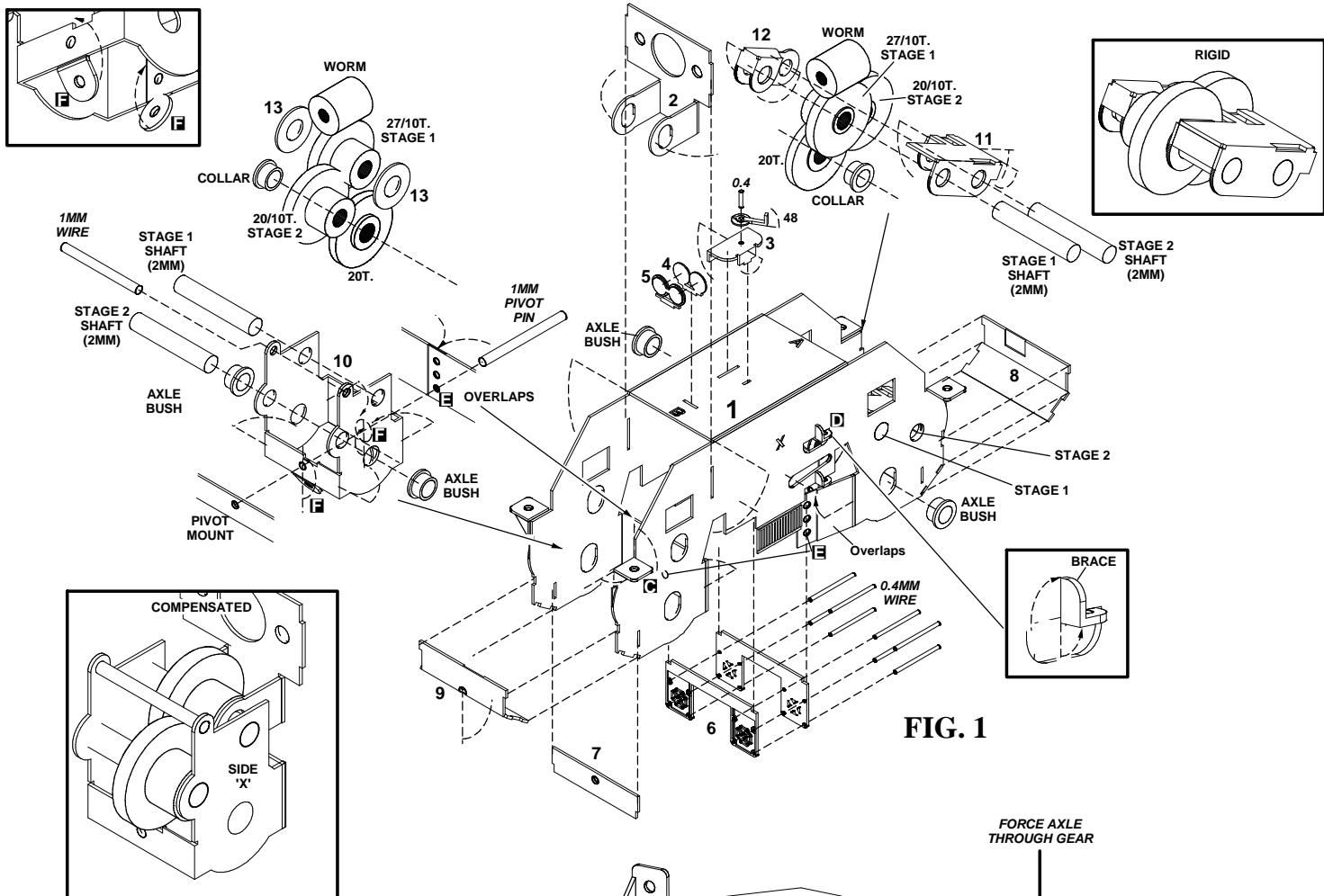


FIG. 1

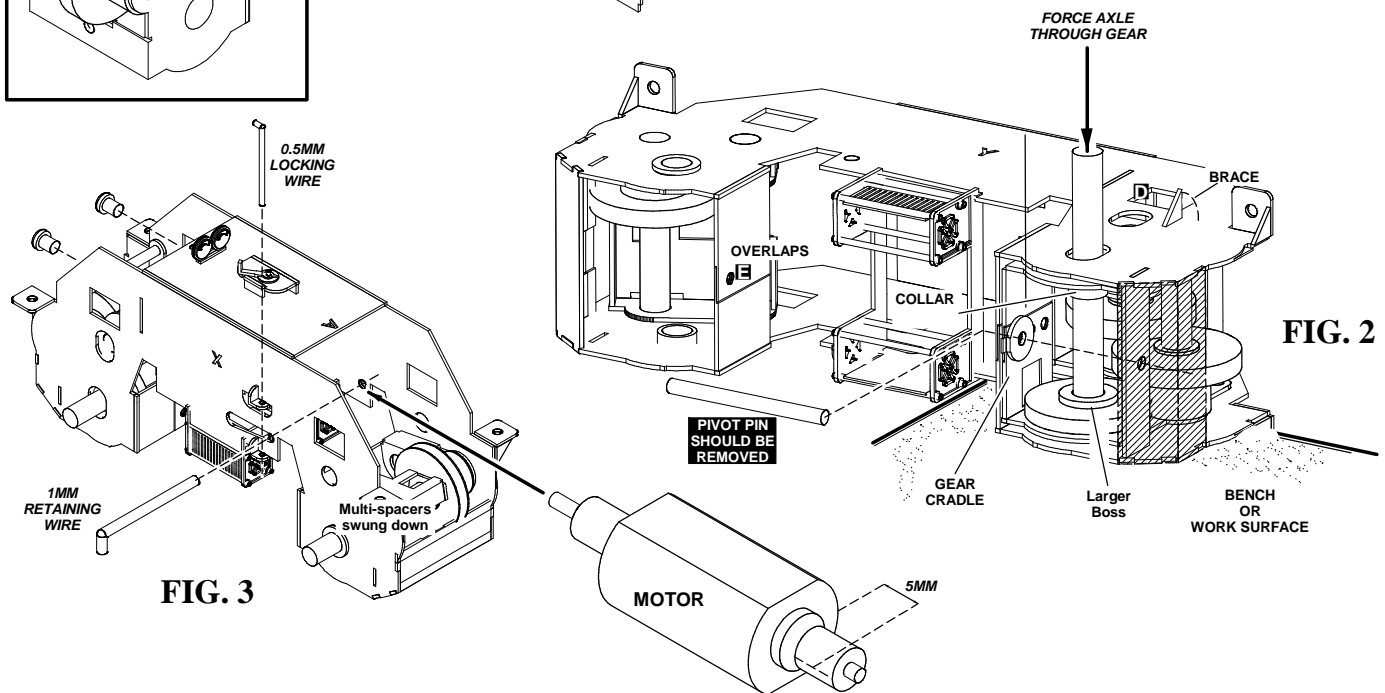


FIG. 2

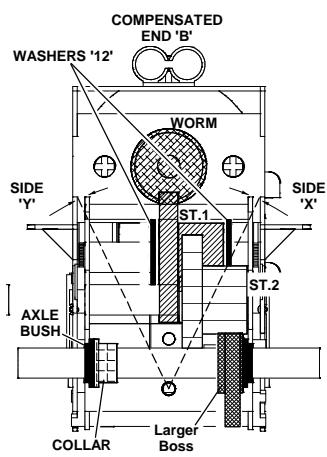


FIG. 4

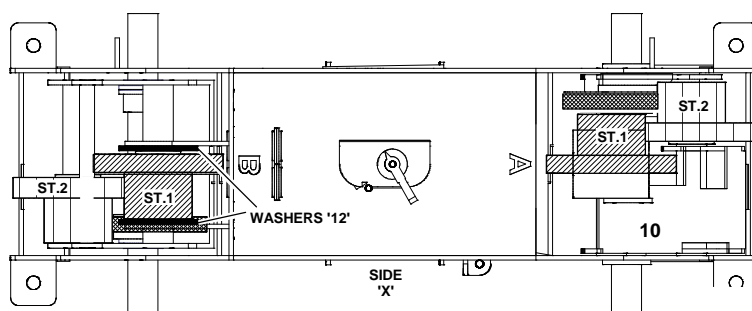


FIG. 5

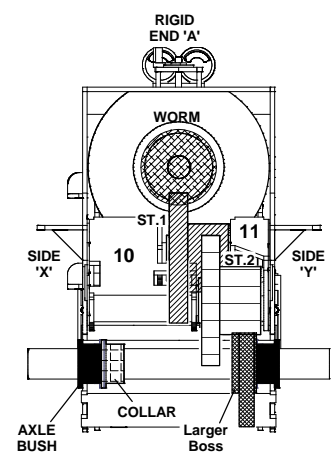
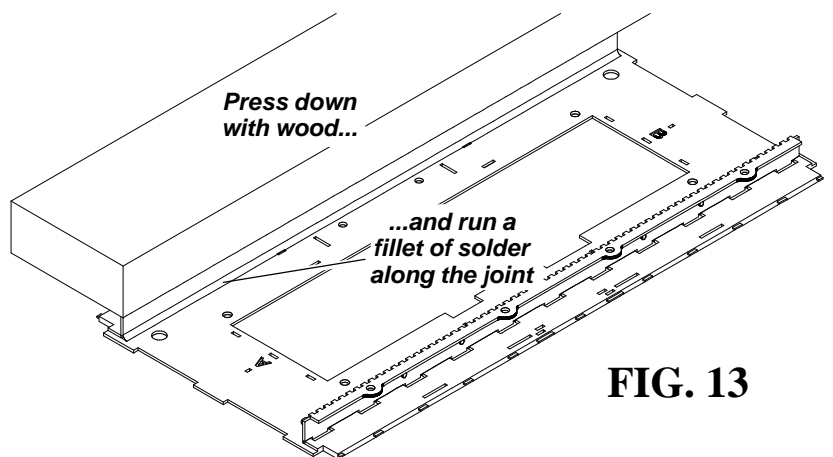
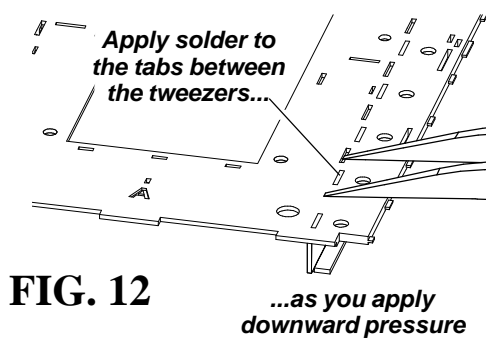
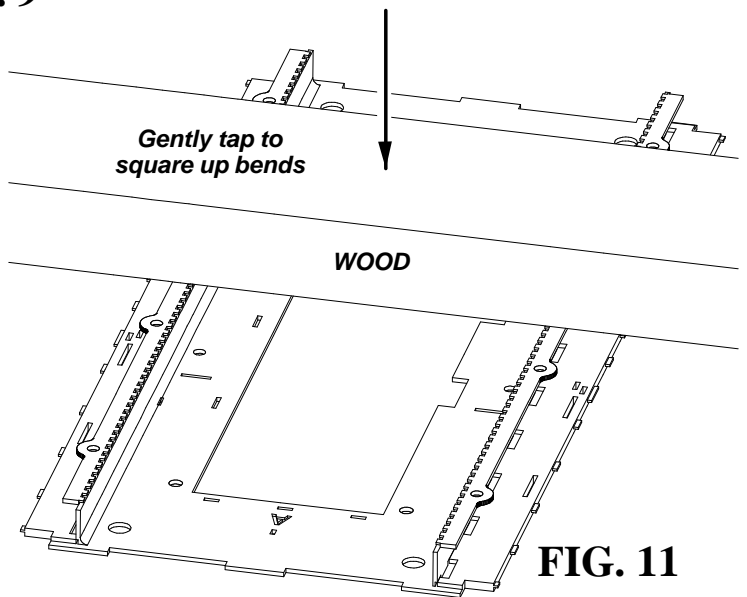
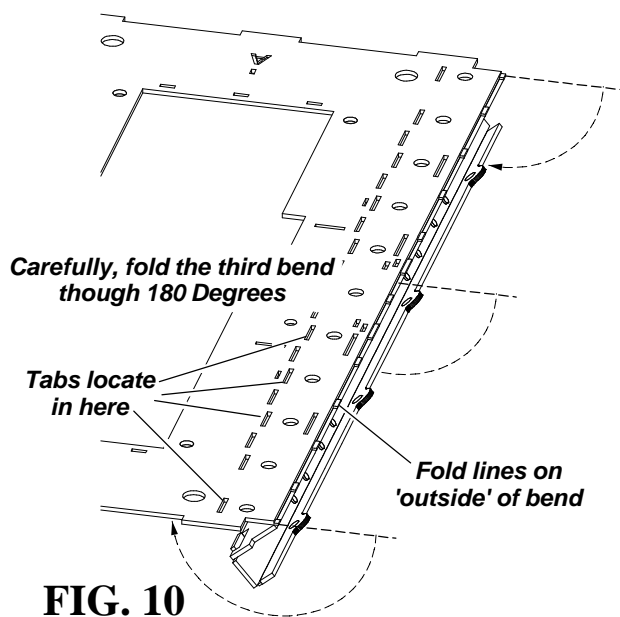
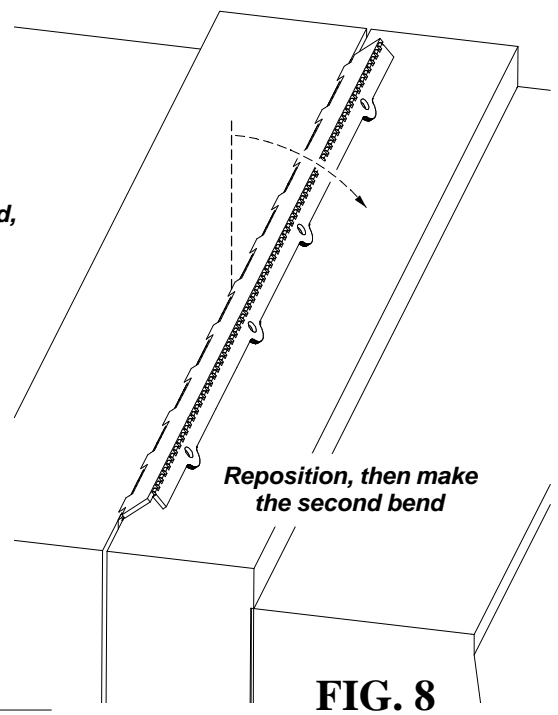
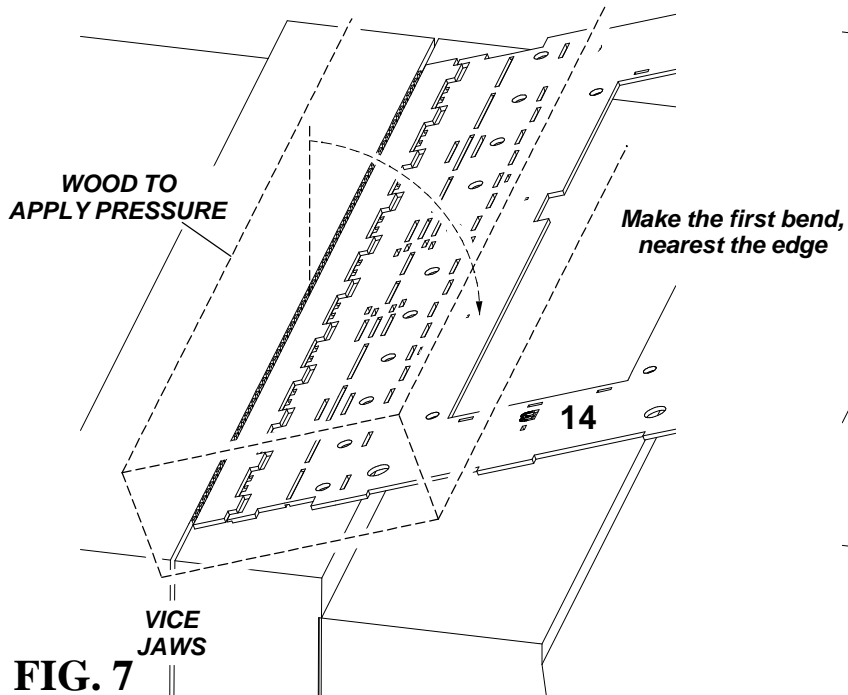


FIG. 6

# FOOTPLATE CONSTRUCTION



## BODY ASSEMBLY

