GWR 94XX Chassis Kit

This kit was initially conceived in anticipation of the Bachmann RTR 94xx but, as release was put back, our thoughts also turned to the earlier Lima 94xx – useful bodyshell, shame about the chassis. The kit is therefore designed with body mounting arrangements to suit the Lima model and additional fixing slots to allow other makes, such as the evergreen Wills/South Eastern–Finecast whitemetal kit, to be used with minimal adjustment.

A little prototype class history first . . . War had left the Great Western with an accumulation of life-expired locomotives for freight, shunting and light passenger work and the only realistic option was to build new. Construction of the 96xx pannier tanks had continued throughout the war (and would run on well into 1949) and there was a move to develop the design still further for post-war production. The outcome was the 94xx 0-6-0PT but it turned out not be an 'improved pannier' at all, but something quite new. Often thought of as a tank-engine equivalent of the 2251 class 0-6-0 tender engines – boilers, cylinders, motionwork and coupling rods were in common – the 94xx was a substantially an original design, in so far as the conservative Swindon tradition would allow such a concept.

Only the first ten – 9400-9 – were true Great Western engines in the sense of having been built at Swindon while the GWR was still in existence and being delivered in plain green livery with the letters 'GWR' on the tank sides. They were the only class members to have superheated boilers. The remaining 200 members of the class, unsuperheated, were built after Nationalisation by outside contractors. The actual sequence is a bit untidy – 9410-59 (1950-1), 9460-89 (1951-3) and 8480-99 (1952) came from Robert Stephenson & Hawthorns Ltd, this last batch sub-contracted from Hudswell Clarke whose builder's plates they carried; 9490-9 (1954-5), 8450-79 (1949-52) and 3400-9 (1955-6) were built by the Yorkshire Engine Co as sub-contractors to Hunslet; and 8400-49 (1949-54) were from Wm Bagnall Ltd. Many of the contractor-built engines carried pre-assembled boilers shipped in from Swindon and all were delivered in plain BR black, with copper-capped chimneys and GWR-style cast number plates.

Though some sources suggest the position of the tank filler caps may have varied slightly, detail differences among the contractor-built engines were disappointingly minimal – variations in the shape of the chimney cap as cast, and very occasionally the rear step arrangements were altered following works visits. On the first 10 locos these steps had been mounted laterally on the rear buffer beam, but on the remainder the rear steps were turned through 90^{o} and were now inboard of the buffers. Vertical handrails on the outer ends of the bunker sides were another new feature found only on the contractor-built engines. Some but not all of the GWR engines were altered to suit and some but not all later lost the sloping cover plate below the protruding smokebox that was unique to this batch. No 9404 was very late in acquiring a smokebox number plate, but had one by 1959. Unlike other Western Region tank locos, none of the class members was repainted by BR into green livery, lined or otherwise, and comparatively few carried the later pattern of BR emblem.

The straggling pace of delivery and the haphazard order suggests turbulence below the surface. The GWR had dealt with the major procurement issues in a frantic bout of activity immediately prior to Nationalisation but it was left to British Railways to accept delivery and arrange payment to the contractors. The legacy was a very good locomotive that was perhaps not quite what was wanted. The 94xx engines were no more powerful than their immediate predecessors but at around 55 tons 7cwt they were a good eight tons heavier than the typical 57xx or 96xx. This limited their route availability – and hence their general usefulness – and pushed them into the 'red' category alongside the 'Counties', 'Halls' and 2-8-0T/2-8-2T classes. As a consequence 94xx locos were unlikely to be found on rural branch lines – they were more of a main-line type, working in and around the larger urban goods yards or on station pilot and ECS duties. A fair number were in South Wales, where they replaced elderly 0-62Ts on Valleys coal traffic and worked local passenger turns on these steeply-graded routes.

On delivery, many of the later locomotives were – according to contemporary reports in *Trains Illustrated* – placed directly into store. There was little work for them and the fact that so many were ordered has long been seen by enthusiasts as a damning indictment of BR's profligacy, without considering for one moment the cost to the Government of cancelling orders placed by the GWR. To anyone familiar with the workings of large organisations, whether in public or private ownership, the only surprise is that the powers that be didn't order more, and the analogy with the Western Region's later extravagance with the Swindon-built six-coupled, diesel-hydraulic is an uncomfortable one. The last 94xx, No 3409, was delivered in October 1956 and the first ones started to be withdrawn as early as March 1959, just two and a half years later. Echoing the farcical 9F saga, some of the Bagnall and Yorkshire Engine Co locos had working lives of barely five years while No 9499 holds the unenviable record of having the shortest lifespan of any GWR-designed loco in BR times, beginning in July 1955 and ending just four years and two months later in September 1959. No 8403 had the longest innings,

being delivered in October 1949 and not being officially withdrawn until June 1965. Half the class had gone by the summer of 1962, though many of the survivors would have been stored out of use, possibly for some time. A handful continued to be active at places such as Radyr, Worcester, Southall and Old Oak until 1964-5 but that summer their fires were dropped for the final time. Like other 'big tank engines' – the LNER J50s spring to mind – they were of little interest to the early preservationists and other than No 9400 itself, which had been earmarked for Swindon Museum at a very early stage, the only other survivor was No 9466 which had made it through to the safe haven of Dai Woodham's yard at Barry.

Wheels required are 4ft 7in, 14 spoke from...

Alan Gibson, PO Box 597 Oldham Ol1 9FQ. Tel 0161 6781607 – don't forget crankpins.

Markits Ltd. PO Box 40, Watford, Hertfordshire. WD2 5TN. Tel. 01923 249711 (www.markits.com). These are self-quartering wheels available in OO and EM gauge only.

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.

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 . . .

ASSEMBLING THE CHASSIS

The chassis can be built rigid, or with full compensation, so the wheels follow the undulations of the track. Study Figure 1. Carefully remove the Frames (1 & 2) from the fret. If you have a rivet press, you can punch out the crescent-shaped rivet detail along bottom of the frames. Forming rivets can be quite tricky – poorly executed, they'll stick out like a sore thumb, so try forming the practice rivets along the sides of the fret and then, if you're happy with the results, go on to do the frames. As the process may cause the frames to distort, you may need to straighten them afterwards.

Carefully remove the Firebox Sides (3 & 4) from the fret, making sure you leave the pull rods (A) attached, then bend the small location tabs through 90 degrees. Using short lengths of 0.4mm wire in conjunction with the tabs, locate the firebox parts flat against the inside face of the frames (the face without the spring detail) solder them solidly to the frame and to the Dummy Pullrod 'A'. File or grind off the ends of the firebox tabs and remove the circular locators from the bottom edge of the double-layered rods (see Fig. 2).

Using flat-nosed pliers, fold over the Front and Midway Springs (5 x4) to make them treble thickness (see Figure 3.) noting that, unlike most bending operations, the fold lines should be on the outside of the bend. Do the same for the Rear Springs (6 & 7) which are a handed pair. When these parts are absolutely flat (this can be done by gently tapping them between two flat pieces of hardwood) solder them in place with their detailed faces on the inside of the frames. Clean off any excess solder.

For a rigid chassis, ream out all six of the axle bush locations in the chassis frames and solder the circular 1/8in axle bush bearings in place. Modellers building to 16.5mm gauge will need to trim some length from the rear bushes to allow clearance for the gearbox but this can be done later. If you're going to fit plunger pick-ups (Alan Gibson, ref. 4M62) open out the holes 'B' so the plastic outer sleeve of the pick-up is a tight push-fit.

For a **compensated chassis**, read all of the following carefully. To make the hornblock cutaways, using a cutter in your minidrill, a fine fret saw, or a needle file, carefully make a slot up the centre lines of the axle locations, taking care not to damage the springs. Now bend the sides of these cuts back and forth, until the metal snaps off to form the rough cutaway shape. Dress up 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 slot - this is used to set the hornblocks at the correct height. Finally, use a 0.4mm bit to open out the datum holes (C) in the frames and make sure a length of 1mm silver steel will pass through the holes D in spacers 8 & 9.

For all types of chassis, select the Spacers (parts 8 - 11) for the gauge in which you model. Open out the holes in the Front Spacer (8) and Motion Bracket to suit the wires, as shown in Fig 4. Bend up and fit the Front and Rear L-shaped Spacers (8 & 11), followed by part 10, noting the small notch is to the right, and then finally Clip part 9 (detail facing backwards) into its location and solder in place.

Siderods

Refer to the fret diagram, and to Figure 15. Open out the holes in the rods (12 - 17) to suit the components shown in the diagram, and layer them up. Make the holes a tightish fit - you can always open them out a touch more later. Take the middle sections of the rods (12 x2 & 15 x2) and then add the inner and outer layers. Use the fret diagram to identify the parts, remove them from the fret in pairs and solder them to the middle layers, building one rod at a time to avoid confusion.

The rods have an articulated knuckle joint which uses a 0.8mm Valve Gear Rivet as the pivot. For a smooth running chassis, it is essential that these rivets are a good fit in their holes. When the front and rear rod sections are assembled, lightly countersink the holes at the rear of the 'forks'. Put a small amount of oil on the 'tongue' of one of the front rods and slide this into place in the 'fork' on the rear rod. Slot a rivet through the assembly and, very carefully, secure in place by soldering it to the rear rod sections only. Finally, trim the rivet almost flush at the back. Check the joints pivot freely. Do the same for both sides.

Dress the top edge of the rod bosses using a fine file and then carefully open out the cork holes. Add short lengths of 0.4mm wire to the holes, solder it in place, and then trim the wires until there are proud by about 0.5mm.

For a **compensated chassis**, bend up six Hornblock Etches, using the separate instructions supplied with them. When the units are fitted, the horizontal ledge which protrudes from their front face (see Fig. 5) butts up against the top edge of the frame cutaways.

Before fitting the bearings into the etches, file off the circular boss from the back of the hornblock bearings for the front and rear axles - this will allow clearance for the slidebars and the gearbox. The middle bearings can be left as they are, or filed to match the others if you prefer.

Position a hornblock assembly at the middle driver location, making sure you include a 1/8in Brass Hornblock Bearing, which should be lightly oiled to prevent it from being soldered to the etch. Use a short length of 0.4mm wire slotted through the axlebox datum holes ('C' in Figures 1 and 5) to locate it, check it sits vertically and then solder the etch in place. Position an etch and bearing at the opposite side, slot an axle through the bearings, adjust the etch so the axle it is at right angles to the frames and then solder the etch in place.

You'll need to trim a small about from the leading edge of the front hornblock etches (see Fig. 5) so they clear the front spacer. Although the hornblock units can be assembled without any solder, it will make the job easier if you run a small amount between the layers of the hornblock etches. When you've trimmed the hornblock etches, use the coupling rods in conjunction with axle jigs, to position remaining pairs of hornblock assemblies (complete with lightly oiled bearings, as above) in the chassis and, after having made a final check that everything is as it should be, solder the etches in place.

Inside motion

The inside motion (shown in Figs. 4 & 12) is highly detailed and greatly enhances the model. If you wish, you can simplify things by using only the radius arms and slidebars (parts 18 & 19, 24 & 25) and ignoring the other parts. This may be the most sensible option for OO models, as it's difficult to see between the narrower frames.

Bend up the Slidebars (18 & 19 - these are handed parts) slot them through their locations in the spacers and solder them in place, making sure the cutaways are at the bottom and nearest the frames. If the bars are a bit tight in the slots, use a blade to remove the cusp from the edges of the bars.

Whilst still in the fret, drill out all the holes in the Droplinks (20 -23), the Radius Arms (24 & 25) and Connecting Rods (26 & 27) to suit the wires shown in Fig. 4. Make the 0.7mm holes a fairly loose fit, so a wire can pass easily through them.

Make sure both the 0.5mm holes in the connecting rods are opened out to the correct diameter, manoeuvre one of them into position and then carefully locate the front end of the rod into the slots in the slidebars ('E' in Fig. 4) springing the bars gently apart to do this. Slot a length of 0.7mm wire through the holes 'F' in the frames, and use this to locate the rear end of the connecting rod and, after checking it runs parallel to the frames, solder the rod into the slidebars. Now gently slide out the 0.7mm wire from the rear of the rod and then repeat the procedure for the second connecting rod, then remove the support wire.

Noting that the two sides are different, use short L-shaped lengths of 0.5mm wire to locate the droplink and radius arm parts together. Solder them up to make a pair of valve gear assemblies and then trim the wires just proud of the etches to represent the pivots.

Refer to Figures 1 and 12. First, tin one of the faces of the Reverser Lever (28) and open out the holes so suit the wires shown. Locate the ends of the valve gear assemblies in the outer (smallest) holes near the centre of the motion bracket. As you hold them in place, slot a length of 1mm wire through the reverser shaft holes 'G' in the frames and use this to hold the valve gear assemblies in place – don't forget to include the reverser lever at the right side of the chassis with the tinned surface against the frames. Solder only the shaft in place in the left hand frame then position the reverser so it's vertical and solder its hard up to the right hand frame - both the valve gear assemblies must be free at this stage – then trim the ends of the 1mm shaft very slightly proud of the frames. Now slot a length of 0.7mm wire through holes 'F', through the assemblies and the rear of the conn rods and solder it into the frames at one side. Make any necessary adjustments to the parts, so they sit vertically and run parallel to the frames, and then solder them to the support wire and the reverser shaft.

Bend the end of the Slidebar Top Layers (29 x2) to shape, and solder them in place. Use a length of 0.5mm wire to locate the Crosshead Details (30 x2) on the slidebars and connecting rod ends, noting that the pin hole is very slightly offset towards the front. You can solder or glue these parts in place, and then trim the wire almost flush at the front of the crosshead.

For the valve spindles, slot lengths of 0.8mm wire through the front spacer, into the holes in the motion bracket, and solder in place. Because of the width (or lack of it) these have been omitted for OO gauge engines. Finish off the valve gear by adding the piston rods, which can be represented using 2 lengths of the same wire, pushed through the front spacer with the ends located in the notches in the crossheads,. The easiest way to do this is to use longish lengths of wire, which will enable you to manoeuvre them into position before soldering them in place. When they're secured, use a burr to cut off the excess length, so the ends are more or less flush with the front face of the spacer.

Chassis Details

Refer back to Figure 1. Without bending the tabs, slot the tabs on the Front and Midway Footplate Supports (31-34) through their locations in the chassis, then bend the tabs protruding from the inside through 90 degrees, so they nip the supports in place. Check the position of the supports, so that they are vertical and square and then solder them to the frames. Slot the tabs on the Rear Footplate Supports (35, 36) through the Rear Footplate Support Details (37 x2) then locate both parts on the frames and bend over the tabs before finally soldering in place. Now fit the handed Front and Rear Bufferbeam Braces (38 x2 & 39 x2) again, bending the tabs to locate and hold them, and then solder the Brace Details (40 X4) and handed Midway Rivet details (41 & 42) to the chassis.

Bend the ends of the Vacuum Pump Body (43) through 90 degrees and then cut a length of 1.6mm O.D. tube, so it's a snug fit between the ends. Use a length of 0.8mm wire to locate the tube, slotting the wire through the ends and through tube, as shown, then solder the parts together leaving about 5mm of the wire proud at the right of the assembly. Now slot the tab on the Pump Top (44) into the location in the body, solder it in place, then trim off the excess tab flush at the rear of the plate. Bend the small lugs on the rear of the pump assembly up through 90 degrees and then use these to locate the finished pump on the inside face at the left hand frame, slotting the protruding 0.8mm wire through the motion bracket as you do so. Once it's soldered in place, you can add the optional pipe detail to the top, using a length of 0.3mm wire soldered into the small hole at the top off the pump, running it up to the notch 'H' at the top of the frame.

Fitting the Lima Body.

This kit is designed primarily to carry the Lima bodyshell, which needs some alteration to make it fit. There are various ways you can improve the moulding; how far you go with this depends on your level of, skill, patience and ambition...

Disassemble the bodyshell into its three main parts. Take the footplate and, using cutters, chop off the underside of the side tanks, going back almost as far as the firebox front. Cut back the extended firebox sides – these run along the top of the tool boxes and up to the firebox front - and then tidy up this surface and form a neat corner. If you wish, you can also remove material between the back of the midway splashers and the firebox front, but be warned, this is not easy and it will weaken the footplate considerably.

Staying with the footplate, refer to Figure 6, cut off the area with the raised ridge (the smokebox location) but leave the top, flat surface intact. Unless you've chosen a prototype has them in place, cut off the two rectangular pieces which sit on the top of the footplate, between the front and middle splashers. Finally, invert the footplate and remove the pair of columns, situated behind the front bufferbeam.

With the smokebox removed from the body you can cut two strips to make up the 1mm missing from the rear of the smokebox saddle, using styrene sheet. When in place, shape the sides to match the saddle profile, but ensure there is a gap between the strips so part 49 can pass up as the boiler is fitted (Figs. 6 &12).

The front of the chassis is fastened using the existing Lima bolt, screwed into the hole in the smokebox saddle. For EM and OO gauges, the front of the frames will sit too high in the recess under the saddle, so you'll need to add some material to make this area level with the footplate underside.

To fit the Rear Body Mount, fold up the mount (45) into a box shape, doing the underside followed by the sides (noting the bend lines are on the **outside** for the sides only) and then solder an M2 nut into the recess on the ledge. Try this assembly in the footplate moulding, as shown in Figure 7, making sure the top corners of the box go right up into the locations on the footplate - the bottom of the mount should be flush with the underside of the plastic lip at the back of the bufferbeam, so it carries the weight of the body on the top of the frames. Once you're happy with the position, glue the mount in place and then fit the chassis using M2 bolts to secure it.

With the mounting points sorted, you can try the chassis in place and make any adjustments necessary to make the body fit. Problems are most likely to be caused by obstructions, such as moulding pips, or areas where the plastic obstructs the etch, for example, inside the splashers. Because of variations in mouldings, you may have to fine-tune the fit using packing to get the chassis sitting absolutely perfect, but this should be minimal.

On its own, the footplate is weak and very flexible, so it may pay to glue the parts together to form a solid unit, but don't do this until you've finished all detailing work and you're sure the chassis is a good fit.

Compensation

Slot a 9mm length of 1mm diameter silver steel rod through 'D' in spacers 8 and 9, so it bridges between the two holes - this will be the pivot for the front wheels.To fit the compensation beams, cut two lengths of 1.6mm O.D. tube, so they fit snugly between the firebox sides, inside the frames, but without being tight. Ream out the central hole in the compensation beams (46 x2) so the tube is a good fit, and then open out the beam pivot wire hole 'J' in the frames to 0.8mm diameter. Carefully smooth off the cusps from the 'feet' of the beams taking off the minimum amount of material (0.1mm or less).

Position the beams 1mm from the edge of the tubes, and solder them in place to make a handed pair. Manoeuvre the assemblies into position, so the 'feet sit on top of the brass hornblocks - this is illustrated in the cutaway view in Figure 12 - and then slot a length of 0.8mm wire through the holes ('J' in Fig. 1) in the chassis, and through the tubes. Check the beams pivot freely - if they don't, look for obstructions: tabs or wires which may be protruding inside the frames; if the beams are catching on the hornblock etches or the sides of the slot in the firebox front spacer. Ensure that the beams sit parallel to the frame sides. It's essential that the beams and hornblocks work correctly together, in a smooth see-saw motion with no tight spots.

Finishing the structure

Solder the two halves of the Reverser Linkage (47 & 48) together and locate the forked end over the top of the reverser lever, using a short piece of 0.4mm wire to keep it in place. Solder the rear end of the linkage into the slot in the spacer (see Fig. 12) and to the top of the reverser lever, then trim the wire slightly proud of the outer faces. Solder the Front Boiler Mount (49) into the frames making sure it sits vertically. Bend the boiler (50) to shape and try it in place, as illustrated. Take time to get the boiler exactly to shape, so it stays in place by itself, and without forcing. This can be tricky, but we found the following method worked well: First, bend the boiler around a rod or bar, which has a smaller diameter than the one you require (say about 12mm) working the radius right to the end of the metal with your fingers. Now press the part over a larger rod (or similar object) which has the diameter you're aiming for (in this case 18mm) making sure there are no kinks.

If you wish, you can solder the boiler in place, but a better alternative would be to fit it after painting which will make it easier to paint the inside motion and to apply the boiler bands (made from tape). You can, if you prefer, use epoxy to keep it in place although, as the boiler is a slight interference fit, it shouldn't really need anything to hold it. If the boiler protrudes beyond part 49, you may need to trim a touch from the front edge, in order to prevent it catching the saddle.

Offer up the chassis and fasten it to the footplate, without the body fitted – this allows you to see where it is most likely to catch. Slot the back end into the bufferbeam then swing the front up into place and secure it using an M2 bolt into the hole in the smokebox. If you've added extra material to the smokebox saddle, the clearance between the side pieces will be limited. After having made any necessary adjustments, remove the chassis.

To fit the Front Railguards (51 & 52) first make a 45 degree bend on the strengthener (this is part of the frames) then make the top bend on the front railguard and position is so the top corner just covers the marker on the frame and the rear edge of the guard in line with the rear of the strengtheners, as shown in Figure 8. Solder the right and left guards in place.

Go on to form the rivets in the Rear Railguards (53 & 54) and then fit them but, this time, don't bend the strengthener and leave the guards flat. When all guards are securely in place, make their remaining bends and carefully strengthen these with solder. Using a 0.4mm bit, pre-drill the holes at the bottom of the Front Sandboxes (55 & 56) and secure them to the frames. Bend up the etched rear sandboxes (57 & 58 - see Figure 8) and then add the small Sandbox Lids (59 x2) using a piece of wire to position them. Use adhesive to secure the boxes to the rear face of the steps – the bottom of the etch lines up with the bottom edge of the steps, with the leading corner almost in line with the leading edge of the steps and the filler visible in the centre of the step cut-out.

Brakegear assembly

This method of assembly creates a set of brakegear that is fully removable, as well as totally prototypical in appearance. Do not solder anything until the instructions specifically say so. Figures 12 and 15 show the how the completed brakegear assembly integrates with the chassis.

At the mid and rear wheel locations, solder the Hanger Brackets (60 x2, 61 x2) onto the frames, using lightly oiled 0.5mm wire for positioning and a length of 0.4mm wire to set the angle and. The 0.4mm wire can be soldered into the frames and ground flush at both sides, but the pivot wire must be removed when the parts are in place.

Drill out the small holes in the Steambrake Lever halves (62 & 63), to suite the wire sizes shown in Figure 1. Use a short length of 0.4mm wire to locate the parts as you solder them together and then trim the outsides of the wire almost flush with the etch faces. With the assembly complete, go on to ream out the larger hole to suit a length of 1.6mm O.D. bar. Use the same method of locating the Handbrake Lever parts (64 – 66) together and ream out the larger hole to suit the shaft, as above.

Cut a length of 1.6m bar to about 35mm long, to represent the brakeshaft. Push this through the frames at location 'K' and through the steambrake and handbrake assemblies, slotting the top ends of each into the locations in the rear spacer. Centralise the brakeshaft in the frames - it should protrude by at least 8mm each side - solder it in place and then solder the lever assemblies to the shaft, and into the spacer, so they sit vertical and parallel with the frames.

Setting up the chassis

Temporarily fit the driving wheels, including any washers that may be necessary to eliminate sideplay. As a starting point, try full etched washers on the outer axles on half-etched on the centre. Try pushing the chassis around your curves, to see how much sideplay you actually need - this applies to both rigid and compensated chassis.

In OO and EM gauges, we've allowed brake clearance of up to 0.5mm sideplay (total 1mm) on the middle axle. For P4, the sideplay should be no more than 0.3mm either side. If the chassis still won't go around your curves, allow a small amount of sideplay at the outer axles.

For a rigid chassis, the ride height and levels shouldn't really need adjusting. If you're building a compensated chassis, then you may need to make some very fine adjustments. You can alter the height at the back of the loco, either by filing the ends of the compensation beam, or by attaching a small amount of packing onto the tops of the hornblock bearings.

The front end of the loco should be fine, but can be raised or lowered, simply by bending the silver steel pivot rod, or adding some shim where it touches the axle. It may be wise to fit the body at this stage, so you can check the overall levels. When the chassis sits level, and at the correct height, trim the compensation beam pivot wire to length (to the same overall width as the chassis) and then fix it into the frame with a small amount of glue at one end only. Make sure the glue doesn't penetrate into the tube.

Brake Hangers
As well as having a different top pivot arrangement, the front brake hanger mounts sit at an angle. Both types of hanger have tabs at the tops ('L' in Fig. 10) which space them the correct distance from the frames. For P4 wheels, which are narrower the OO/EM, these small pieces be filed off both types.

Make the vertical 90 degree bend on the Front Brake Hangers (67 & 68). Use a short length of 0.5mm wire, pushed through the middle holes, to locate the rear layer (69 x2) onto the fronts, solder them together and then trim the wire flush at both sides. If you wish, add the very small (and optional) hanger pivot details (70 & 71) to the tops of the front brake pivots. Repeat this process for both sides, to make a handed pair, and then check the top and bottom holes are free from solder.

For the midway and trailing wheels, take one of the brake hanger front layers (72 x2 & 73 x2) and carefully make the 90 degree bend at the top and, using wires for location, add the Rear Layers (74 x4) as above, so you have two handed pairs. Again, you have the option of attaching the small details (75 x4) to the tops.

Clean out any excess solder, from the rear corners of the footplate supports (31 & 32) so the front hangers will go fully home. You can also file a small chamfer the leading edge of the front hangers' spacer tabs, to allow the hangers to sit hard up against the frames.

Take one of the leading hanger assemblies and slot it onto the brake stretcher wire, using a 30mm length of 0.7mm diameter wire through the bottom hole. Solder the wire in place so about 5mm protrudes, at right angles, from the outside face of the hanger. Take an opposite handed hanger assembly, slot this onto the long end of the 0.7mm wire, then offer this assembly up to the chassis at the front brake location. Slide the loose hanger along the wire, so both hangers move up to the chassis sides and then slot a length of 0.5mm wire through the holes at the tops of the hangers, and through the chassis at the top holes (Figs. 1 & 12). Push the hangers hard up against the wheels, and up to the chassis sides and then, after checking that they are parallel and lying at the same angle, carefully solder the loose hanger assembly to the 0.7mm stretcher wire - do not solder anything to the chassis so that you can remove the assembly by sliding the wire out the top wire. Make sure you remove any burrs from the ends of the wires.

Repeat this process for the rear pair of hangers, this time at the rear location. For the middle pair of hangers, use the rear hanger locations to set the hangers, but this time solder the top wire into the hangers (but not the chassis) then clip the wire just inside the frames. Spring the hangers apart to allow them drop down, ready for use at the middle location. Before you come to fit the middle hangers, use a drill bit to open out the holes in the frames - you may have to drill through the reverser lever at one side, and some way into the rear of the pump to achieve enough depth for a good location.

Brake Rod clearances
With the hanger assemblies in place, you can set the clearances for the brakes. First, slide a length of 0.5mm wire through holes 'M' in the frames. Slot the Pull Rods (76 x2) over the ends this wire, and the stretcher wires at the bottom the all of the brake hangers, then invert the chassis and set the rods so they run parallel to the chassis, as illustrated in Figure 11. Look at the distance between the backs of the rods and the wheel faces and take into account the sideplay on the axles - with the wheels pushed fully over to one side, we suggest an additional 0.3mm clearance, which can be set using a piece of brass wire. When satisfied all is well, solder the pull rods to the stretcher wires. Finnish off by adding the small Pull Rod Details (77 x2) and then trim all the crosswires so they protrude about 0.2mm beyond the rod assemblies.

Refer to Figures 1, 11 and 12. At the rear of the chassis, remove the wire from 'M', and thread the actuators (78 x2) over the ends of the crosshaft. Relocate the wire but include the actuators this time to set their angle. Check the rods are parallel to the frames and then position the actuators on the crosshaft, so they sit up against the back face of the rod ends. Solder the actuators to the crosshaft only then remove the long wire from holes 'M'. The brakegear can now be removed by pulling the top wires from the hangers and springing the hangers from their midway locations.

Trim the brake crosshaft, so the ends are very slightly proud of the actuators' outer faces. With the brakegear off, cut two lengths of 1mm tube, so they fit between the actuators and hole 'M' in the frames. Refit the 0.5mm wire with the tubes in place and solder the tubes and wire in place, so everything is solid. Cut the wire from between the frames and trim the outer ends of the wires at the actuators, so they are 0.7mm proud (the holes at the back of the short outer rods will locate on this) and very slightly proud of the inner faces at 'M'.

When you come to refit the brakegear, slot a long wire through the hangers at the front, then swing the rear of the brakegear up into position, locating the midway hanger pins in their locations and springing the ends of the outer short rods over the pins on the actuators. Finally, fit the rear hangers' top wire.

Invert the loco and slot lengths of 0.4mm wire into the pre-drilled holes in the front sandboxes. Shape the wire so it runs down to the wheels, as illustrated in Figure 15. This will vary depending on the wheel gauge, and study of prototype photographs is recommended. Check the brakegear can be removed without the pipes getting in the way.

When the brakegear is off, remove the wheels and use epoxy to attach the balance weights (79 x4 & 80 x2 see Figure 14). Make sure they lie flat and don't foul the rods and then clean up all the parts ready for painting.

Gearbox assembly

Study Figure 13. Before cutting the gearbox etch (81) from the fret, progressively drill out or ream each of the holes to accommodate the shafts, bushes and wire shown in the diagram. Components should be offered up until they are a tight push-fit in their holes. Once the gearbox is assembled, the shafts are fixed but the gears are free to revolve.

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 1/8in bushes into place with the larger-diameter shoulders on the same side of the etch as bend lines. File the non-shouldered face of the bushes flush with the etch, then cut the etch from the fret with a heavy blade and trim off the tabs.

Bend the gearbox shell to shape, as indicated - a three-sided box with all bend lines on the inside of the gearbox - and then strengthen the inside corners with fillets of solder. Brace the gearbox using a length of 1mm wire, through ‘N’, as shown.

Solder the stage one spacer (82) into its location, using a length of gearshaft to position it and file off the protruding tab flush at the rear, so the motor mounting plate is smooth.

Using a carborundum disc in a mini-drill, cut the 2mm gearshaft, so their lengths equal the overall width of the gearbox. Wear effective eye protection – cutting discs can and do disintegrate if they snag. Remove any burrs with a fine file. Offer up the shafts to their respective holes. Because they are a tight fit, you will only be able to pass them through both sides of the gearbox if it is truly square. If they won't go through, then the gearbox hasn't been folded accurately. Light finger-tweaking should put things right.

De-flux the gearbox by scrubbing with household cleaner, then rinse and allow to dry. Check that the gears themselves are free from any dust or swarf left over from manufacture. Cut a length of insulated wire into two equal lengths and solder to the motor brush tags. Insulate the terminals with tape. For testing, connect the other ends to the output leads of your controller.

The stage 1 double gear will be one of three types - 15/10T (30:1), 20/10T (40:1) or 27/10T (54:1) - depending on the overall reduction ratio of the gearbox. Fit the stage 1 gearshaft and the double gear (according to ratio) – test for free running and then secure the ends of the shaft with a tiny amount of glue.

Slot the two idler gearshafts (cut to length) through the gearbox, slipping on the thin 20Tooth and 18Tooth gears as shown, noting that the larger boss on this gear runs nearest the gearbox side. Include the 2mm Collars as you do so, and don’t forget the Spacers (83 x2). Secure the shaft to the gearbox sides and then fix the collar in place, so the gears sit right up against the side of the box, as shown. Temporarily fit the axle, along with the brass 20T. gear and check that all the gears revolve smoothly.

Some brass worms are fractionally tighter than others and if they aren’t an easy push-fit, they can be gently forced onto the shaft in a vice. Hold the motor by the rear of the shaft and don’t use excessive force or the shaft may bend. Instead, use a broach to ease the fit of the worm and then, if necessary, secure the brass worm with a small drop of Loctite 601 (or Superglue will be fine) at the outer end of the motor shaft.

Fit the worm onto the motor shaft (at the mounting screw end) so it’s mid-point is about 5mm from the motor face (i.e. - so the worm lines up with the stage 1 gearshaft when the motor is fitted into the gearbox). Sight through the opening in the gearbox sides to check the mesh with the worm - there should be daylight between the gear and the worm, but avoid having too much backlash. If necessary, loosen the motor fixing screws, adjust the mesh and then lightly glue the shaft in place at both ends. Now test the gearbox under power and then, when all is well, remove the driven axle and brass gear.

The gears are effectively self-lubricating but a little plastics-compatible grease will do no harm. Do not use general-purpose modelling oil, which attracts dust and grit. Metal-on-metal contact areas (motor bearings, axle bushes) should be lubricated with a tiny amount of ultra-adhesive oil. Avoid WD 40 as this attacks plastic.

Final Assembly
If the boiler isn't already fitted then clip it into its locations. Position the motor/gearbox unit so the motor sits in the boiler space and, as you slot the driven axle through the frames and gearbox, slip on the final drive gear, but do not tighten the grubscrew yet.

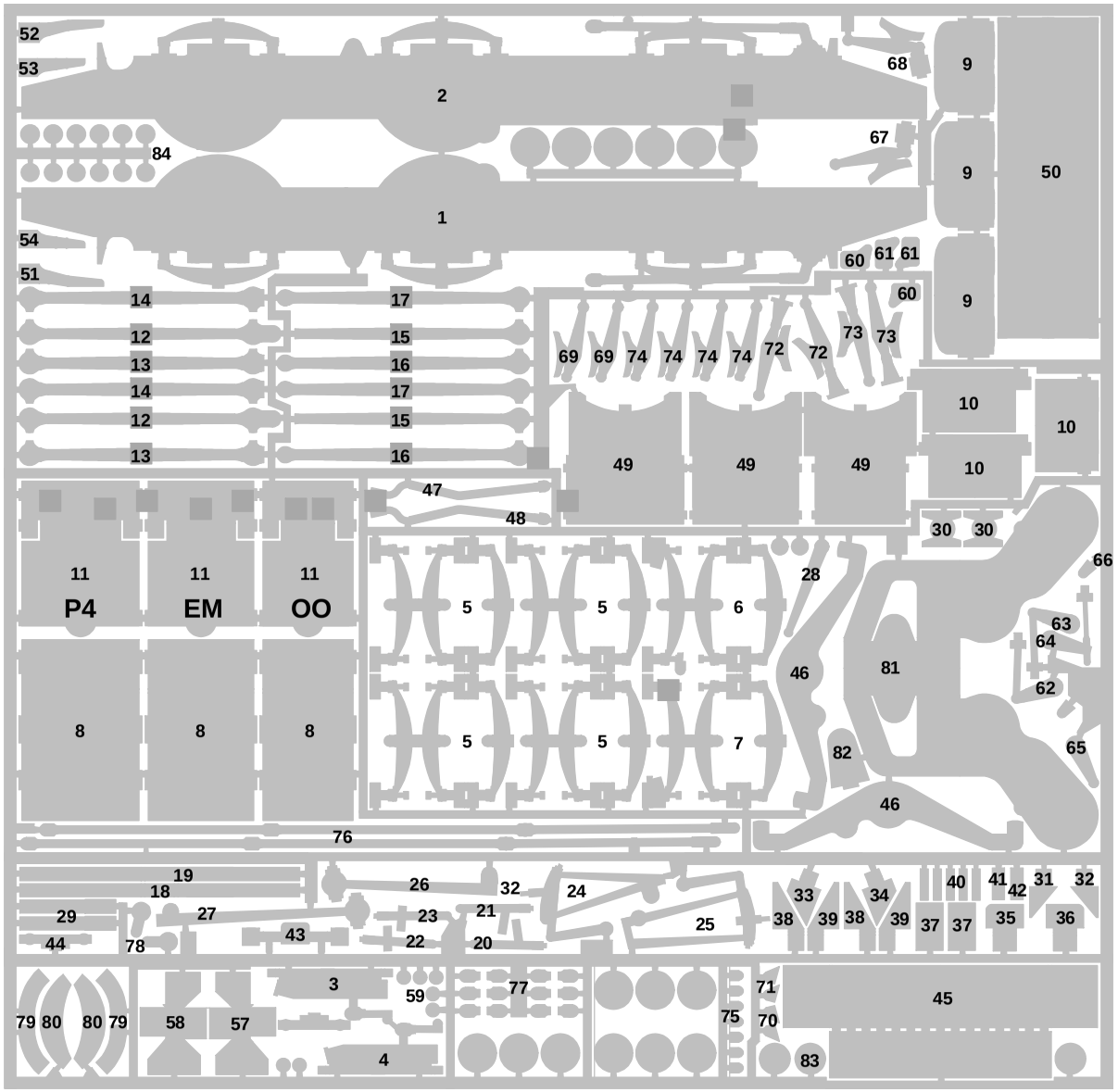
The kit includes axle washers of varying thicknesses, which can be used to limit axle sideplay. Fit all the wheelsets, complete with crankpins, and quarter the wheels, - the right hand cranks lead by 90 degrees. Now add the bushes to the crankpins, followed by the coupling rods, and check for free running before fitting the securing nuts. Optional crankpin spacer washers (84 x6) are provided, but these only need to be fitted if the siderods catch the brake hangers.

Centralise the rear axle and the gearbox in the chassis, tighten up the grubscrew in the brass gear and then test the chassis under power. When the chassis is running smoothly, fit the body, fasten it in place and test run the completed loco.

For all types, try the body in place. As the wheels rotate, you may notice that the bosses on the coupling rods come close to the underside of the footplate. There should be clearance if the chassis is central, but you can always gain a bit extra by careful grinding if there’s a problem.

When you're happy all is well remove the body and refit the brakegear, as described previously, then fit the body for the final time and secure with the original fixing bolts. Once the body is fitted, there's very little room for the motor to move about. You may wish to fit a very small amount of packing (perhaps a blob of bath sealant or Blue-tack) above the foremost end of the motor, which will prevent the unit from lifting when power is applied. You'll need to get the thickness of this material just right - if it's too tight the movement of the rear axle will be restricted and, on a compensated chassis, will prevent the unit from floating freely with the axle.

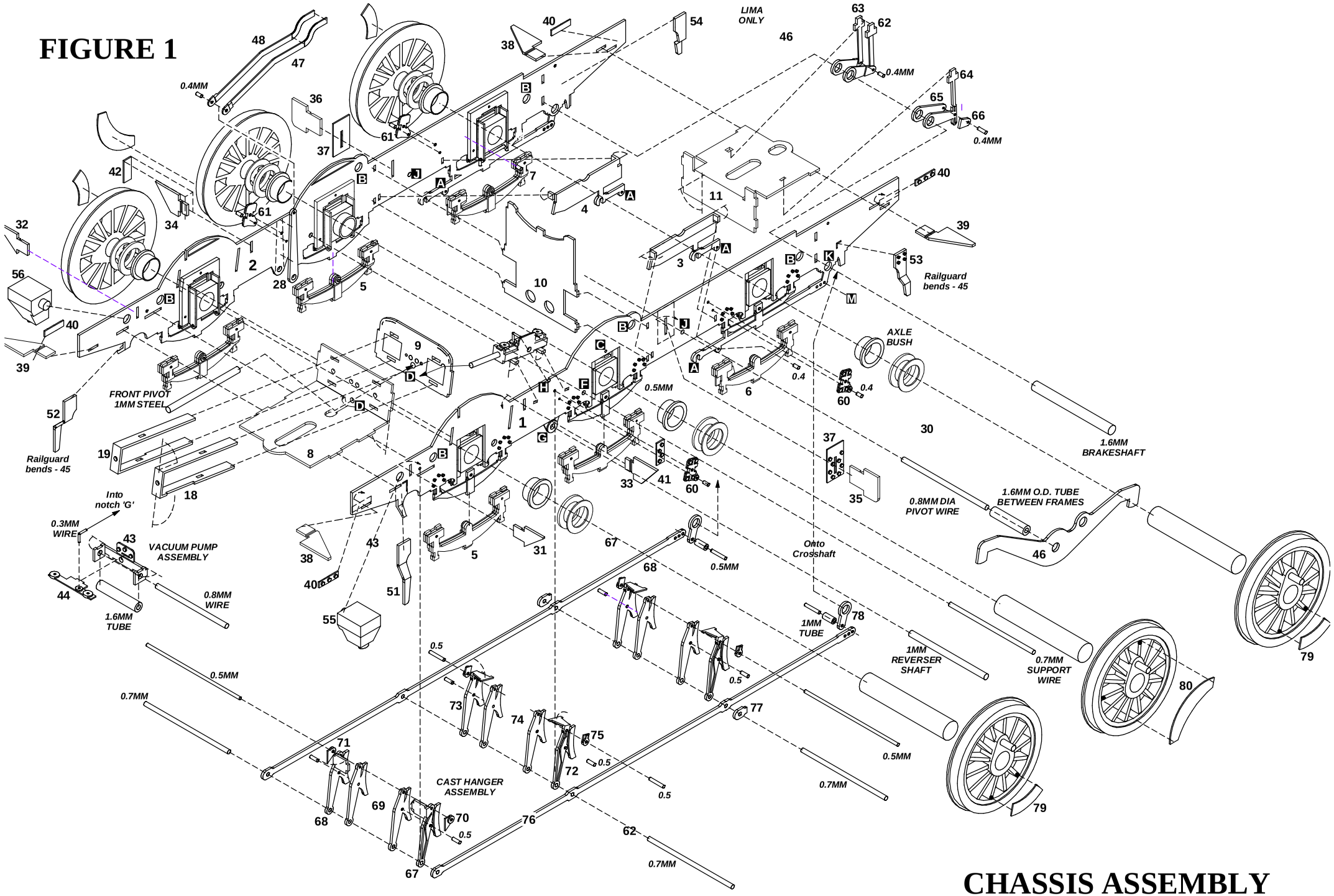
CHASSIS KIT FOR 94XX



PARTS LIST

1. Frame - LHS
2. Frame – RHS
3. Firebox Side - LHS
4. Firebox Side – RHS
5. Front/mid Spring (x4)
6. Rear Spring LHS
7. Rear Spring RHS
8. Front Spacer
9. Motion Bracket Spacer
10. Firebox Spacer
11. Rear Spacer
12. Front Coupling Rod, Middle Layer (x2)
13. Front Coupling Rod, Inner R, Outer L (x2)
14. Front Coupling Rod, Inner L, Outer R (x2)
15. Rear Coupling Rod, Middle Layer (x2)
16. Rear Coupling Rod, Inner R, Outer L (x2)
17. Rear Coupling Rod, Inner L, Outer R (x2)
18. Slidebars - LHS
19. Slidebars - RHS
20. Droplink - LHS outer
21. Droplink - LHS inner
22. Droplink - RHS outer
23. Droplink - RHS inner
24. Radius Arm - LHS
25. Radius Arm - RHS
26. Conn rod - LHS
27. Conn Rod – RHS
28. Reverser Lever
29. Slidebar top layers (x2)
30. Crosshead Details (x2)
31. Front, Left, Footplate Support
32. Front, Right, Footplate Support
33. Mid, Left, Footplate Support
34. Mid, Right, Footplate Support
35. Rear, Left, Footplate Support
36. Rear, Right, Footplate Support
37. Rear Footplate Support Detail (x2)
38. Front L, Rear R, Bufferbeam Brace (x2)
39. Front R, Rear L Bufferbeam Brace (x2)
40. Brace Detail (x4)
41. Mid Rivet Details - LHS
42. Mid Rivet Detail - RHS
43. Vacuum Pump Body
44. Vacuum Pump Top
45. Rear Body Mount
46. Compensation Beams (x2)
47. Reverser Linkage , LHS
48. Reverser Linkage RHS
49. Font Boiler Mount
50. Boiler
51. Railguard - Front LHS
52. Railguard - Front RHS
53. Railguard - Rear LHS
54. Railguard - Rear RHS
55. Front Sandbox - LHS
56. Front Sandbox - RHS
57. Rear Sandbox LHS
58. Rear Sandbox RHS
59. Sandbox Lids (x2)
60. Hanger Bracket LHS (x2)
61. Hanger Bracket RHS (x2)
62. Steambrake Lever Half - LHS
63. Steambrake Lever Half - RHS
64. Handbrake Lever
65. Handbrake Lever Detail
66. Handbrake Fork Detail
67. Front Brake Hanger LHS
68. Front Brake Hanger RHS
69. Front Hanger, Rear Layer (x2)
70. Front Brake Detail LHS
71. Front Brake Detail RHS
72. Mid/trailing Hanger LHS (x2)
73. Mid/trailing Hanger RHS (x2)
74. Mid/trailing Hanger, Rear Layer (x4)
75. Mid/trailing Hanger Detail (x4)
76. Pull Rod (x2)
77. Pull Rod Details (x2)
78. Actuators (x2)
79. Balance Weights, Front, Rear (x4)
80. Balance Weights, Middle (x2)
81. Gearbox
82. Gearbox Spacer
83. Idler Shaft Spacer (x2)
84. Crankpin Spacer Washers (x6)

FIGURE 1



CHASSIS ASSEMBLY

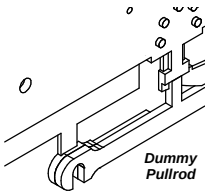
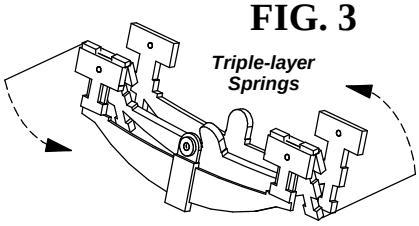


FIG. 2

FIG. 3



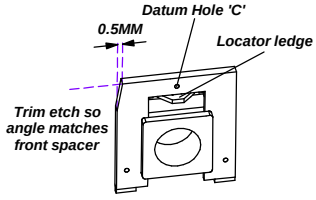


FIG. 5

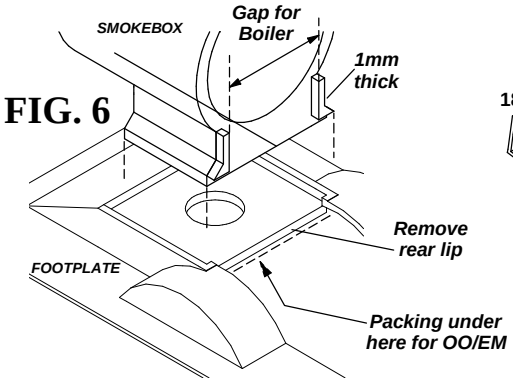


FIG. 6

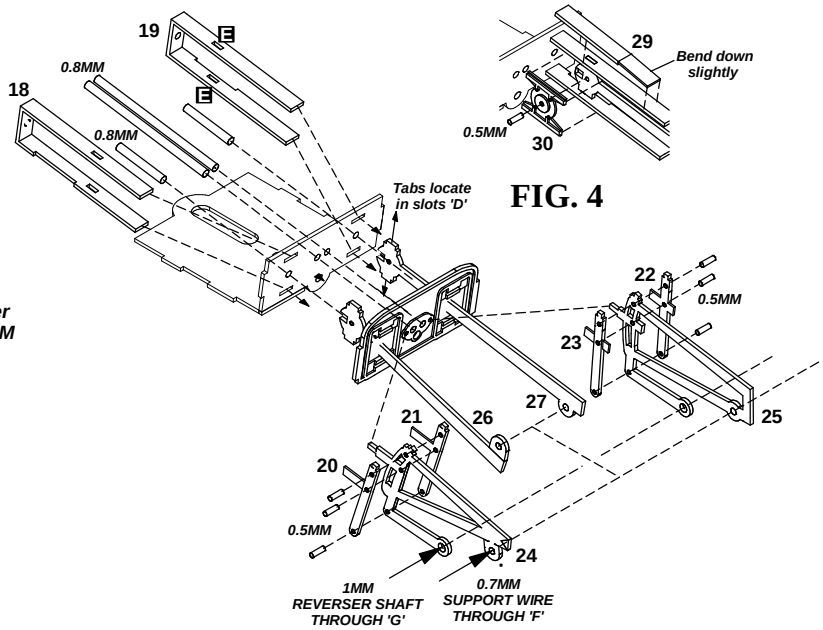


FIG. 4

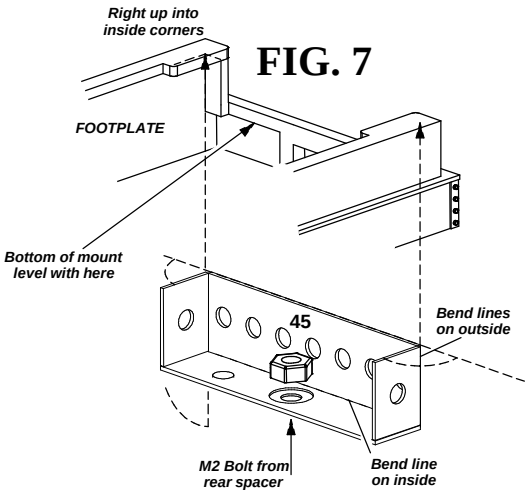
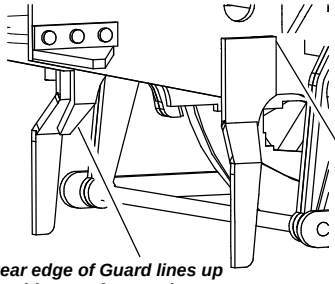


FIG. 7

FIG. 8



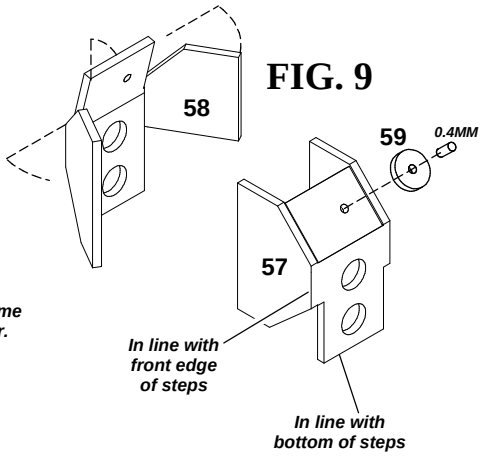


FIG. 9

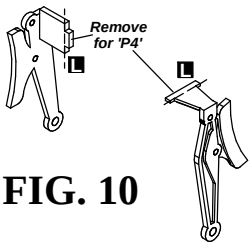


FIG. 10

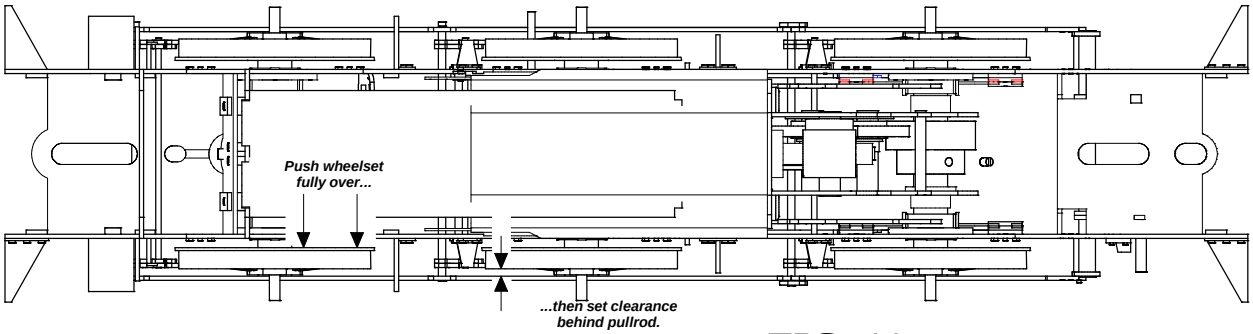


FIG. 11

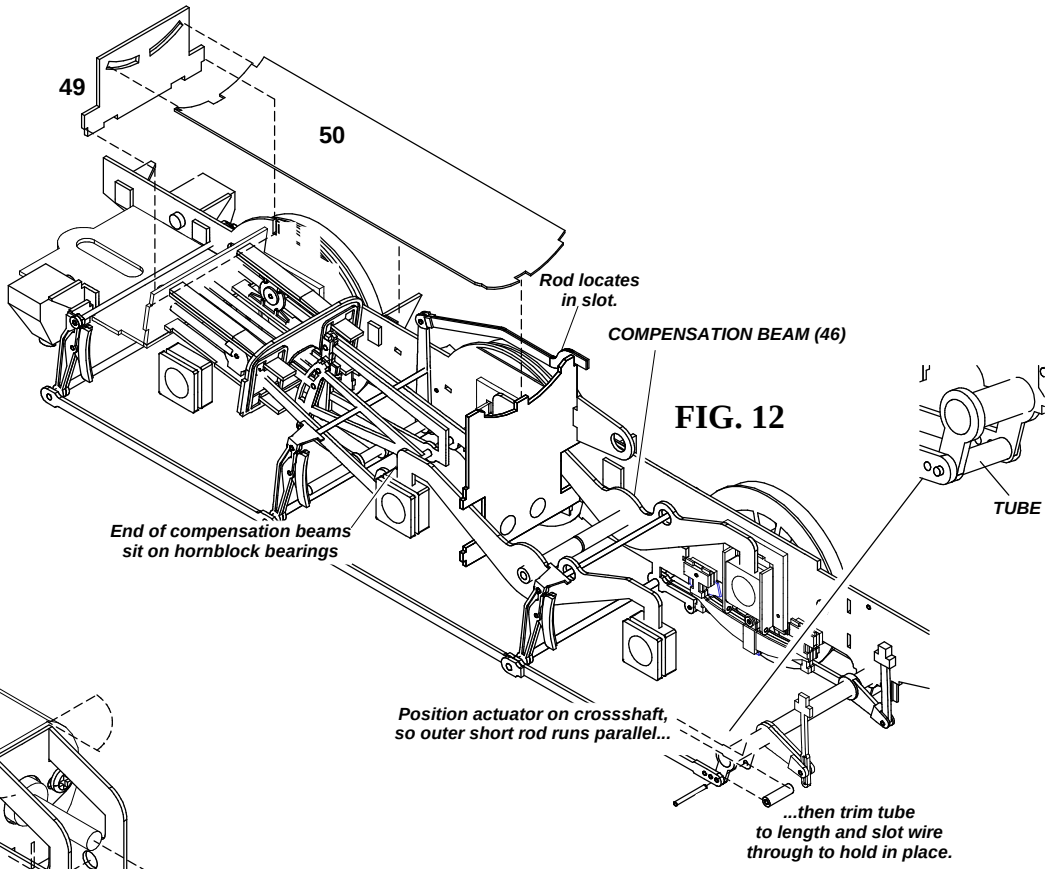


FIG. 12

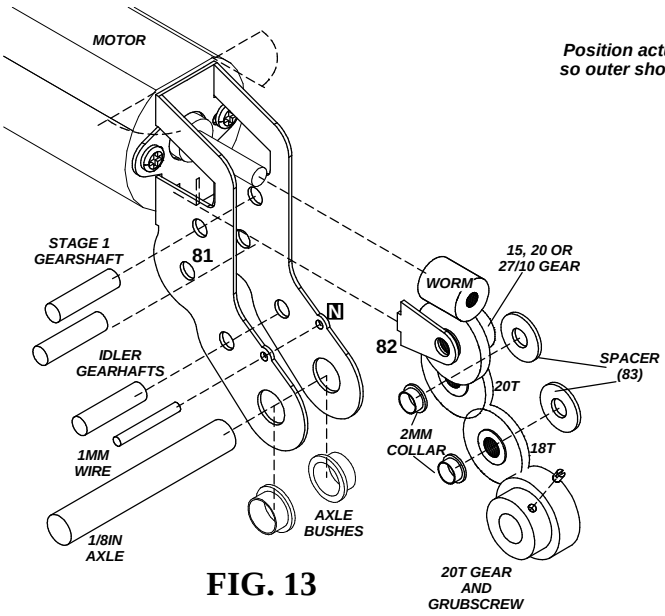


FIG. 13

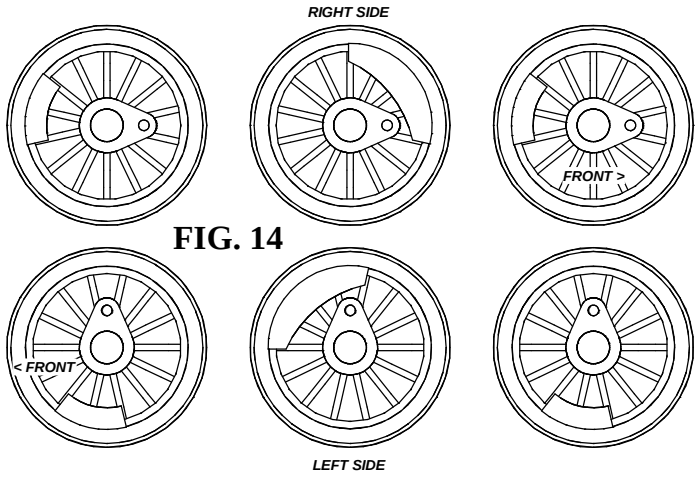


FIG. 14

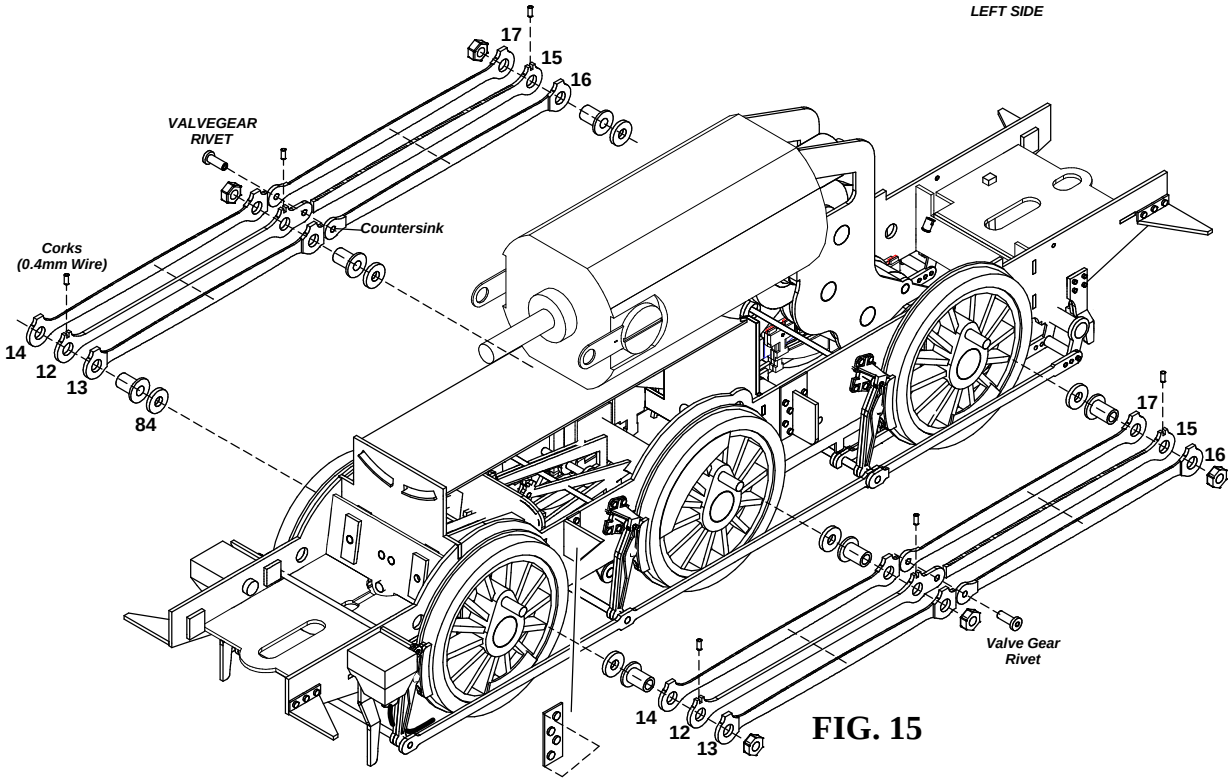


FIG. 15