Stafford Kit Build assembly instructions

Items Needed to Complete Construction - these are included in the relevant kits

- General Multi-Purpose grease
- Loctite 243
- cylinder oil
- General Purpose Black Silicone Sealant

Tools required - you will need to provide these:

- 5/16 Whitworth spanner
- 1/2'' Whitworth spanner
- 3/8 A/F spanner.
- 7/16 A/F spanner
- 9/16 A/F spanner
- Peg spanner
- Metric spanners
- Metric allen keys
- Brass Punch
- Emery paper (600 grade)

General information

- Throughout this manual we refer to the front and back, left and right of the engine. front is the smokebox end, back is the footplate end. left is the left as seen by a (small) man standing on the footplate of the finished engine. Remember, if the chassis is being worked

on upside down, left and right will be transposed.

- In places Loctite is specified for thread-locking purposes. Before applying, thoroughly clean the components and/or fasteners to remove any residual oil or grease left from the machining process. Apply sufficient to form a continous ring of adhesive around the fastener, when screwing in, back off half a turn before final tightening to ensure that the Loctite has wetted right around the thread.

- Torque settings for fasteners are given in the text - whilst not essential, a torque wrench is a good investment and will let you tighten fasteners to the same settings we use on factory-built engines.

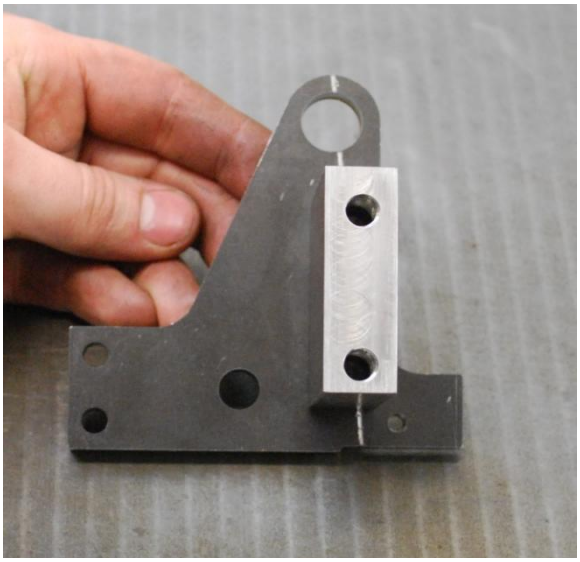
Stage 1

Qty	Description	Part Number
1	chassis	10002
2	motion block	10452
2	motion bracket rear plate	10042
2	motion bracket inner	10049
2	motion bracket outer	10043
1	drag beam	10011
1	buffer beam	10010
1	Coupling	

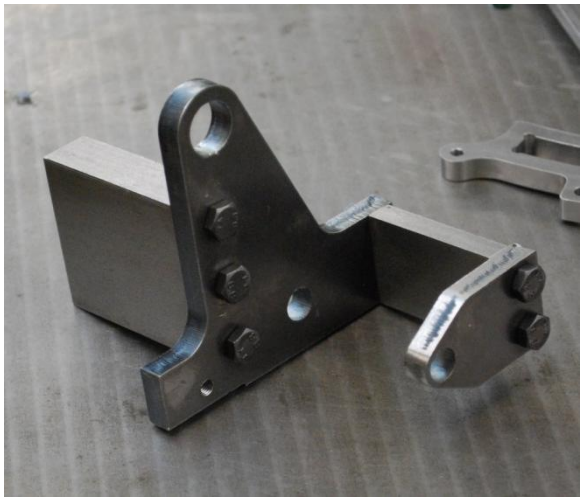
Qty	Description
62	M6 x 16mm hex head bolt
6	M6 x 20mm hex head bolt
12	M6 x 25mm hex head bolt
4	M8 x 20mm hex head bolt

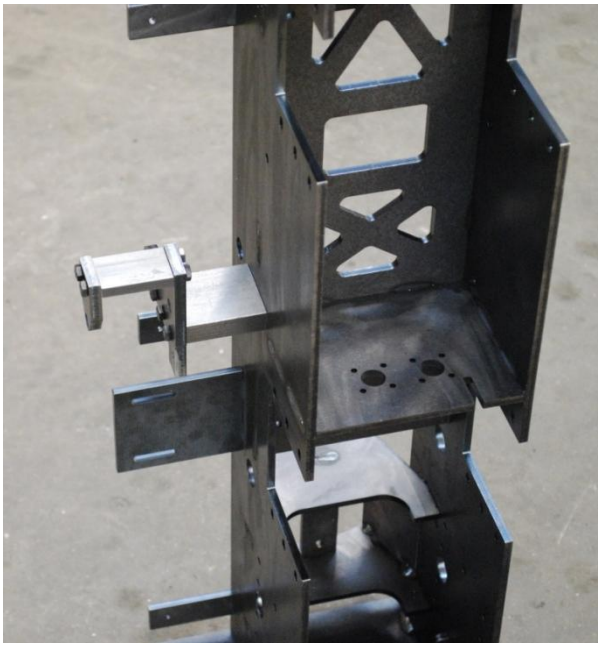
1. Start by assembling the left and right hand motion brackets - photograph shows the left hand bracket. Attach the motion bracket inner (10049) to the motion block (10452) using three M6 x 20 hex head bolts as shown. To make the right hand bracket, the motion block is fixed to the opposite side of the plate.

   Note that the holes in the motion block are asymmetric - the bottom hole is closer to the bottom edge than the top hole is to the top edge. It's important to put it on this way round - double check now, it will save you time later.



2. Complete assembly of the motion bracket by bolting the motion bracket rear plate (10042) and motion bracket outer (10043) to the previously assembled parts using four M6 x 16 bolts. You should end up with a left hand bracket looking like the one in the picture and a right hand one which is its mirror image.





3. The motion brackets are mounted on the chassis using M8 hex head bolts fitted to the pair of holes above and immediately behind the front horn opening - picture shows the left hand bracket fixed. Fully tighten the bolts at this stage - once the engine is on its wheels it is difficult to get at the bolts with a spanner.

4. Time to paint the chassis - we wipe it down with cellulose thinners to clean off any oil, then spray three coats of Hammerite self-priming smooth finish black paint. While you've got black paint in the spray gun, do the backs of the buffer beam and drag beam (ie: the sides fitted against the frames) - the buffer beam fits either way round so you can spray either side black and call it the back. The drag beam has an 11.8mm hole for a vacuum brake connector if fitted - this hole goes on the right hand side which determines which side of the drag beam is the back.

5. The chassis wants a couple of days for the paint to harden off - during this time, wash out the spray gun and mix up some red to do the buffer beams and their fixing bolts.

   There are two approaches to painting the buffer beams. We spray them before fitting, placing them flat on a piece of newspaper, held just clear of it using lolly sticks. Spray red - again we use Hammerite, they need a couple of coats. The M6 x 16 hex head fixing bolts we spray separately - you can push them into a piece of cardboard or foam (we use a wooden block with a few hundred holes drilled in it to spray big batches of bolts at once). Once everything is dry, fit the buffer beam to the chassis using the bolts, you need to be careful not to damage the paint on the bolts, although it's not as tricky as it sounds.

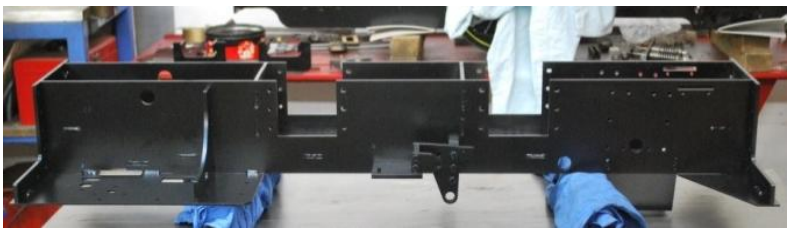
   The alternative is to fit the unpainted buffer beams, then mask everything up and spray red in the relevant places.

6. END OF STAGE 1

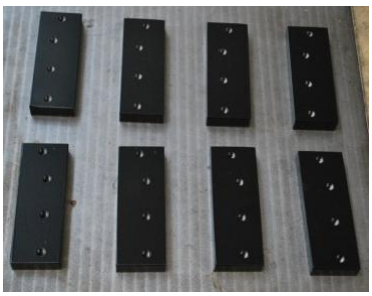
Stage 2

Qty	Description	Part Number
8	hornblock	10033
4	top rear spring platform	10524
4	top front spring platform	10525
4	bottom rear spring platform	10032
4	bottom front spring platform	10045
8	springs	standard part
2	wheel set assembly	10413
4	hornstay	10034
2	coupling rod	10064
2	coupling rod retainer	10066

Qty	Description
32	M6 x 16mm hex head



1. The chassis is supplied as a ready-welded assembly, comprising main frames, all stretchers, smokebox saddle and footplates.



2. Turn chassis upside down (so that the location for the axle boxes are facing upwards) and place on wooden blocks to prevent damage to the smokebox saddle.

3. Lay out the eight hornblocks - note that there are three threaded holes used to fasten them to the chassis, and one further threaded hole offset from the others which is used for the hornstays. We paint these on five of the six sides - all except the face bolted to the frames. Notice that they are fitted left and right hand, so if painting at this stage, lay four hornblocks out with the hornstay bolt hole facing to the right, four with it facing to the left, as shown above.

4. Fasten the hornblocks to the frames as shown, three M6 x 16mm bolts each, don't tighten them at this stage. Hornstay holes face uppermost and towards the axlebox openings as shown.

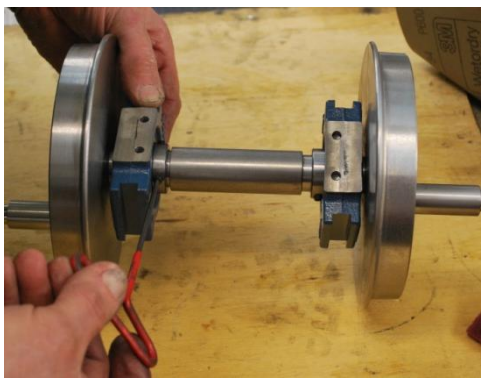
5. Tighten the rear hornblock mounting bolts (13Nm) - rear hornblocks are the pair nearest the footplate, they match up with round bolt holes in the frames, all the other mounting holes are slotted to allow adjustment.

6. Insert top spring platforms (the ones with domed heads) into the two outer holes of the set of three in the horizontal stretcher beneath the axle box openings - domed bit goes in the hole, thicker platforms goes on the rear axle, thinner on the front - shown top and bottom of the picture opposite respectively.

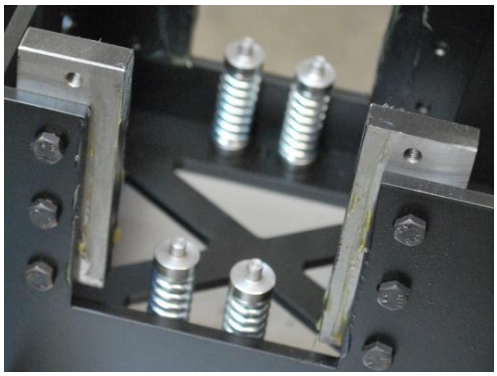
7. Place springs on the platforms as shown.

8. Fit bottom spring platforms onto the springs - again the thick ones go on the rear axle, thin ones on the front.

9. Using a 3mm Allen key, loosen off the two Allen screws on each axle bearing, so that the bearings will move up and down freely.



10. Grease the working faces of the hornblocks where they work in the axlebox slots.

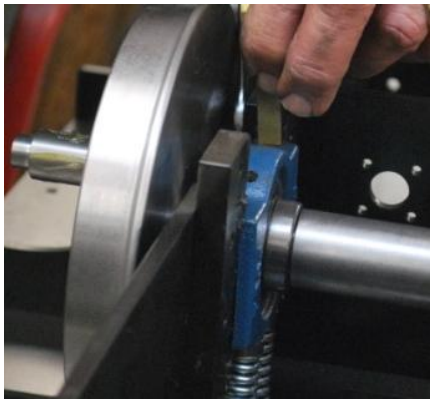


11. Fit the wheelsets to the chassis. The rear wheels have long crankpins, front ones have short crankpins. The axleboxes are machined on their top face and have a pair of holes to engage the spring platforms.

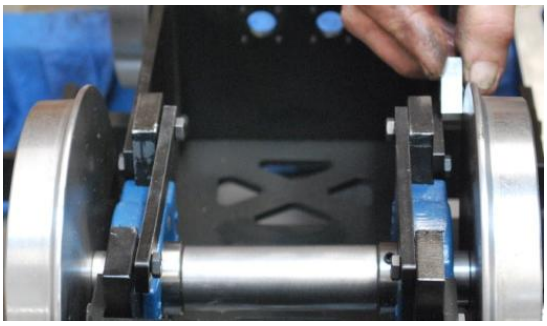
    The wheelsets are quite heavy, a second pair of hands is quite useful at this point as you need to fiddle them into the hornblocks and make sure the spring platforms engage in their holes. Once done, the axles will sit supported on the springs as shown in the picture.

12. Loosely bolt the hornstays across the four pairs of hornblocks using M6 x 16mm hex heads, slotted hole faces the front of the engine.

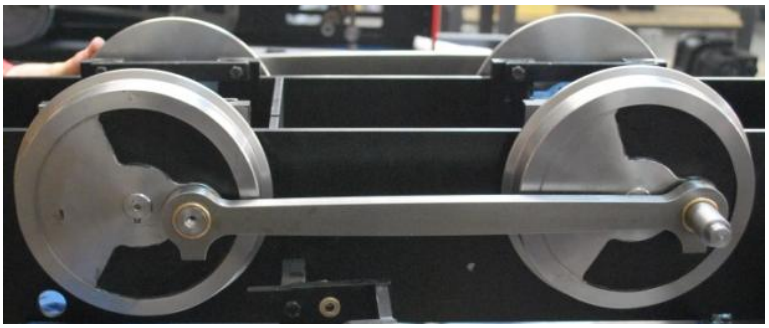
13. Set the rear axle in its correct position by pushing it hard up against the rear hornblocks - this is the pair that have previously been fully tightened. Push the front hornblocks back against the rear axleboxes and tighten up both sides - check that the axleboxes slide freely up and down the full length of the hornblocks.



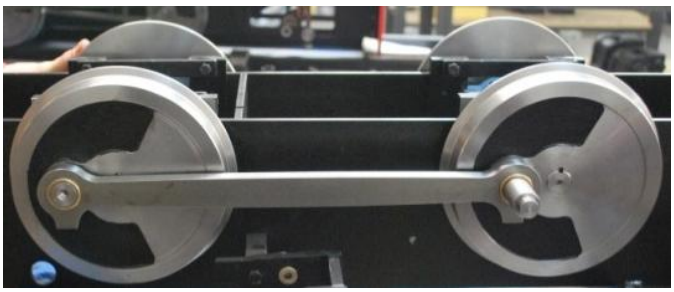
14. Centralise the axle in the chassis by setting the gap between the back of one wheel and the frame to 10mm - we use a slip gauge, but the shank of a 10mm drill will do just as well, at a pinch you can even just measure it with a steel rule. Lightly nip up the grub screws securing the axle in the axleboxes.



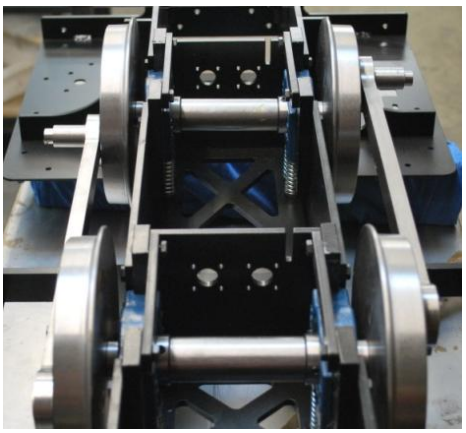
15. Grease all four crankpins. Turn the wheels so that the crankpins all face to the rear as shown, then fit the left hand coupling rod - flange of its bush faces the wheel, oil wells face downwards.



16. Turn the wheels so that the crankpins are at the front dead centre position as shown. Using a square, set the front axle's front hornblock square with the bottom edge of the frames and tighten its three securing bolts with the hornblock lightly pushed up against the axlebox. Turn the wheels to back dead centre, push the rear hornblock up against the axlebox and tighten its fixing bolts.

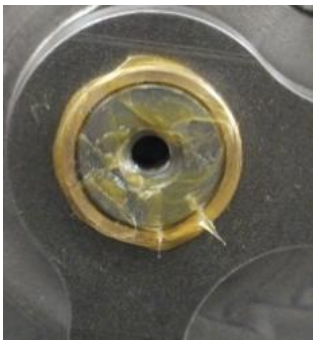


17. Add the right hand coupling rod and repeat step 16 for that side. Check that wheels revolve freely without binding, then tighten the hornstay bolts (13 Nm).



18. Remove the axlebox grub screws and reassemble using Loctite 243 - tighten down onto the axle, taking care not to upset the lateral location you set earlier.

19. Apply grease to the front face of the front crankpins, taking care to keep it away from the threaded hole in the centre. Apply Loctite 243 to the coupling rod retainers, fit and tighten with a peg spanner.



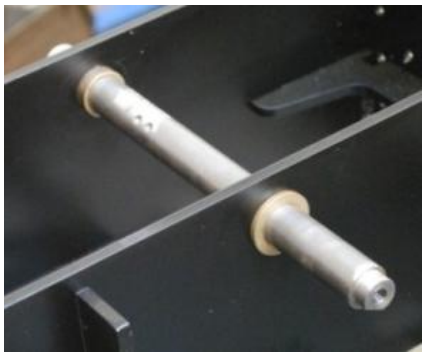
20. END OF STAGE 2

Stage 3

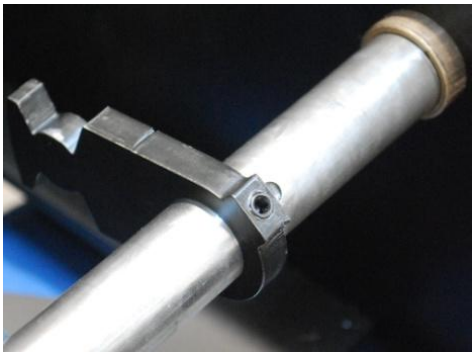
Qty	Description	Part Number
1	brake shaft	10015
1	brake link centre	10044
1	brake pull bar	10470
1	brake cross bar	10024
2	brake hanger	10019
2	brake hanger spacer	10483
2	brake block	10017
1	Brake Barrel Pivet	10485
1	rear brake lever	10029

Qty	Description
1	M6 x 10mm grub screw
2	M6 x 20mm CSK
2	M6 x 45mm hex head
2	M6 nut
2	M6 nyloc nut
1	M8 x 25mm hex head
1	M8 x 20mm hex head
1	M8 nut
1	M8 washer

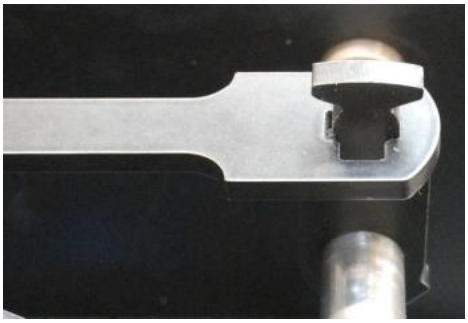
21. Insert brake shaft into the 20mm bushes at the rear of the chassis, threading the brake link centre onto it on the way through - fit he shaft so that the end with the threaded hole comes out the left hand side of the chassis. If tight, tap gently in the centre of the rod with a brass drift and hammer to align the bushes.



22. Fix the brake link centre to the shaft with an M6 x 10mm grub screw, fitted with Loctite 243 - ensure that the screw engages with the dimple drilled in the shaft.

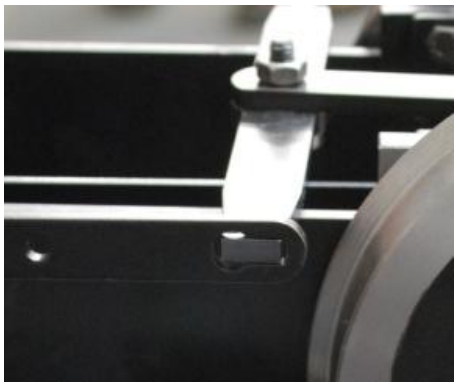


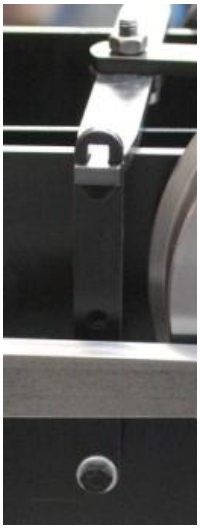
23. Attach the brake pull bar to the brake link centre via its elongated slot and the clasp at the top of the brake link centre. Rotate the brake cross bar so that the two components are linked together. The shaft of the brake pull bar should be left pointing towards the front of the chassis.



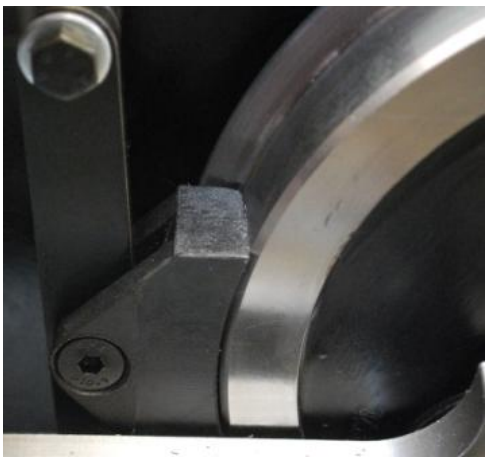
24. Place the brake cross bar under the brake pull bar with holes lining up. grease the brake barrel pivot and insert from underneath - secure with an M8 x 25mm hex head bolt fitted from underside.

25. Fit the two brake hangers to either ends of the brake cross shaft - fit horizontally, then let them rotate to hang down as shown. Fasten to the chassis with M6 x 45mm bolt, washer under the head and nut on the inside of the frames. Tighten.





26. Attach a brake shoe to each brake hanger using an M6 x 20mm CSK bolt and nyloc nut as shown.



27. Attach the rear brake lever to the allocated slot on the side of the brake rod in the alignment that means it does not rotate in parallel with the brake link centre. If fitting is tight use an M8 bolt and several washers, gradually tighten to draw into place then remove and fix with an M8 x 20 bolt and washer.

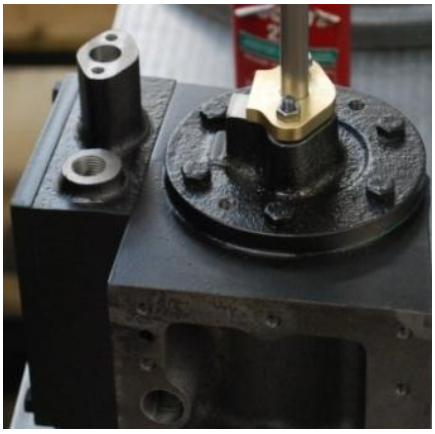
28. END OF STAGE 3

Stage 4

Qty	Description	Part Number
2	cylinder block	10050
2	valve chest	10051
2	valve chest cover	10052
2	piston rod	10078
2	piston rod gland	10079
1	right hand crosshead	10068
1	left hand crosshead	10069
2	exhaust stub	10222

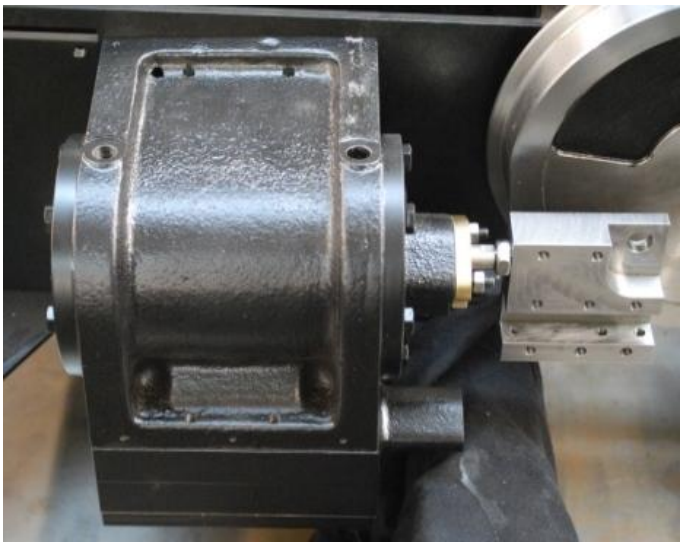
Qty	Description
4	M5 x 25mm stud
20	M6x55 Hex Head
2	M5 nut
4	M5 Nyloc Nut
20	M6 x 16mm hex head
2	M8 half nut
1	15mm equal tee
20	M6x55 Hex Head

29. Fix the two M5 x 25mm piston rod gland studs to the rear cylinder cover using Loctite 243 - the 8.5mm long thread goes into the cover.

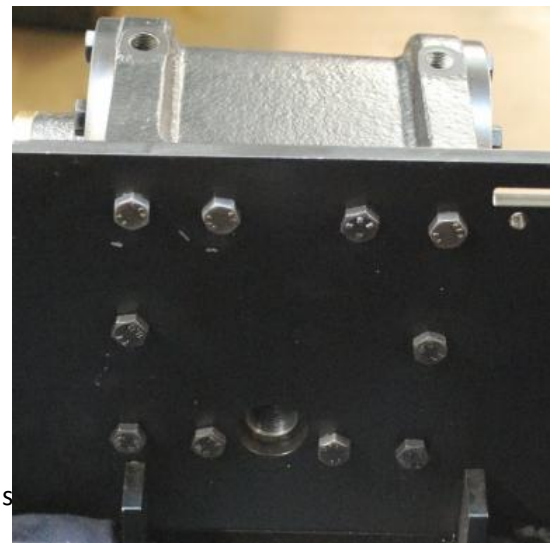


30. Fit a piston rod gland over the piston rod and locate on studs, fastening with two M5 nyloc nuts.

31. Run an M8 half nut down the piston rod, then fit the right hand crosshead - don't tighten the nut at this stage.

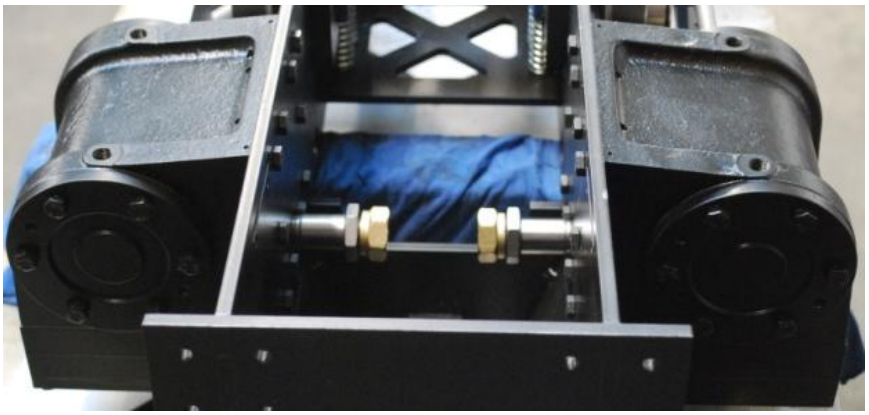


32. Fasten the complete cylinder assembly to the chassis using ten M6 x 16mm hex head bolts (13Nm). Valve chests face downwards at this stage, remember the cylinders are handed, the pistons rods face towards the back of the engine.



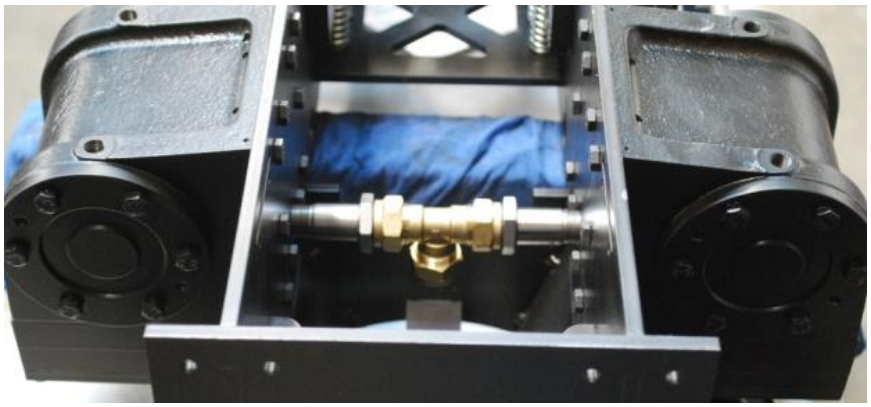
33. Repeat the same process with the left hand cylinder and corresponding left hand crosshead.

34. Fit the exhaust stubs to the cylinders - they pass through holes in the frames as shown opposite, screw them in as far as they will go by hand.



35. Unscrew the union nuts and compression olives from the supplied 15mm equal Tee fitting and fit them to the stubs, along with the brass olives - nut on first, followed by the olive.

36. Fit the Tee piece by unscrewing the exhaust stubs from the cylinders until they enter the Tee. Check to make sure that the centre of the Tee, where the blast pipe will be fitted later, is in line with the hole in the smokebox saddle stretcher as shown opposite. When its correctly positioned, tighten both nuts up fully which will crush the olives onto the exhaust stubs, making a steam-tight connection.



37. END OF STAGE 4

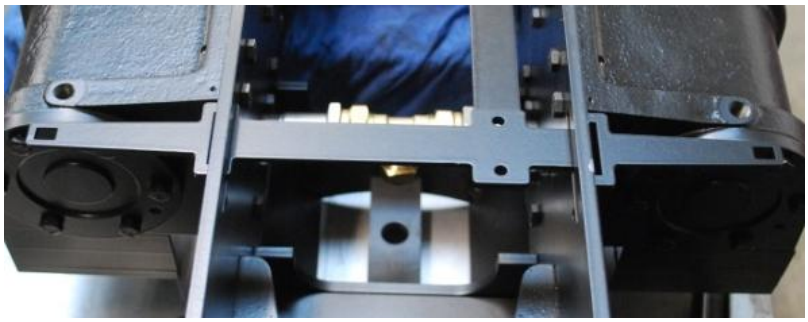
Stage 5

Qty	Description	Part Number
1	drain cock operating rod	10185
1	drain cock cross shaft	10184
2	drain cock retainer bar	10460
4	drain cock body	10439
1	drain cock operating rod bush	
2	drain cock operating bar	10440

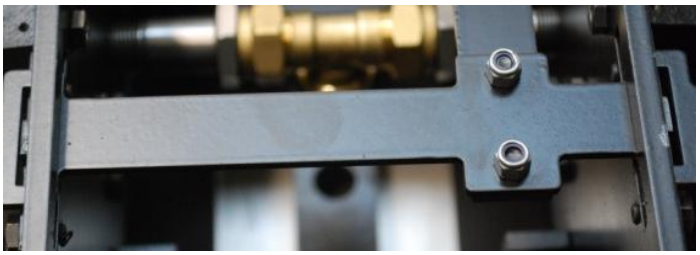
Qty	Description
4	M3 x 12mm cap head
2	M5 x 12mm hex head
2	M5 nyloc nut
4	M6 x 10mm hex head
4	3mm dowel
4	spring
4	5mm ball bearing
4	1/8 BSP nut

38. Place the drain cock operating rod in the slots on the right hand side of the chassis - one end has two 5mm holes in it, this goes at the front.

39. Slide the drain cock cross shaft through the slots in frames just in front of the cylinders as shown.



40. Fasten the cross shaft in place with two retaining plates, positioned outside the frames and secured with two M6 x 10mm hex head bolts each. Note that the "tongue" of the retainer engages in a slot in the cross shaft.

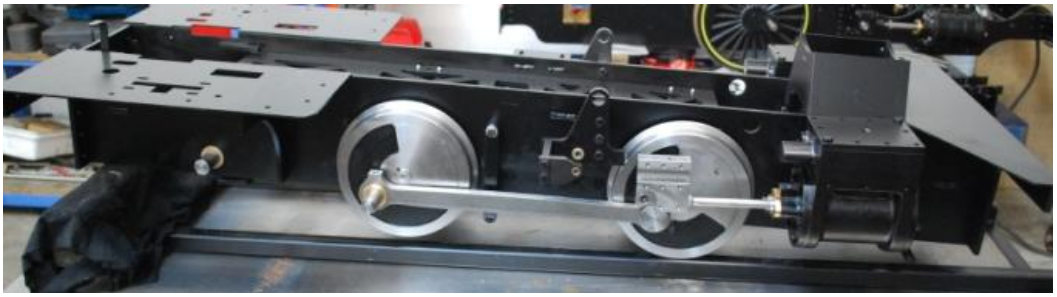


41. Bolt drain cock cross shaft to the operating lever using two M5 x 12mm hex head bolts and nyloc nuts.

42. Assemble the drain cocks by putting an M3 x 12 cap head screw into the threaded cross hole at the bottom - head goes in the counterbored location. Turn the draincock over and drop in a 3mm dowel, followed by ball and spring as shown. Finally fit a locknut.

43. **CAUTION - HEAVY PARTS**, you will need a second pair of hands for this step

    Turn chassis over onto its wheels - ideally on a piece of track.



44. The rear end of the drain cock operating rod is fastened to the right hand frame with an M6 x 10 hex head bolt and top hat bush as shown. grease before assembly - when tightened down, the drain cock operating rod should move smoothly and freely.

45. The drain cocks and drain cock operating bars are not assembled till later in the process, however if you loosely screw them into the cylinders now, it will ensure that the balls, springs and dowels don't get lost.

46. END OF STAGE 5

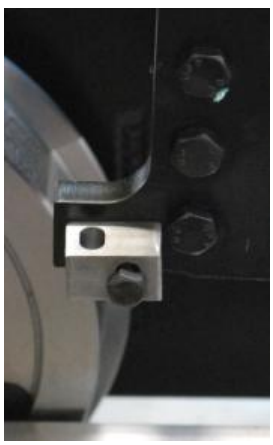
Stage 6

Qty	Description	Part Number
2	guide bar mounting block	10083
2	guide bar	10082
2	crosshead slipper	10072
2	gudgeon pin	10067
1	left hand crosshead cover plate	10070
1	right hand crosshead cover plate	10070
2	drop link outer	10472
2	drop link inner (spacer)	10471
2	nylon coupling rod spacer	10431
2	connecting rod	10061
2	return crank	10103
4	valve chest gasket	10286
2	valve gland	10075
2	valve spindle	10074
2	valve spindle clevis	10073
2	slide valve	10058
4	slide valve lock nut	10118
2	slide valve drive block	10059

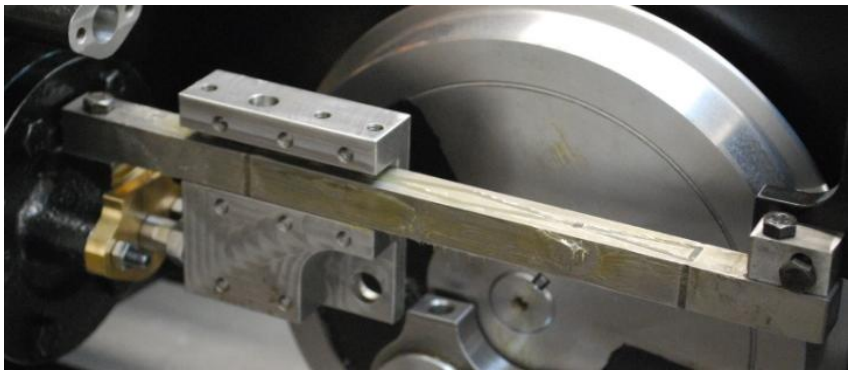
Qty	Description
2	M4 x 30mm cap head
2	M8 Nut
2	M4 nyloc nut
2	M8 half nut
6	M5 x 12mm hex head
8	M5 x 20mm hex head
8	M5 x 10mm CSK
6	M5 x 15mm grub screw
4	M5 x 25mm stud
8	M5 nut
4	M5 Nyloc nut

47. Rub crosshead slippers on wet and dry emery paper (P600) on a flat surface to make sure there are no high spots.

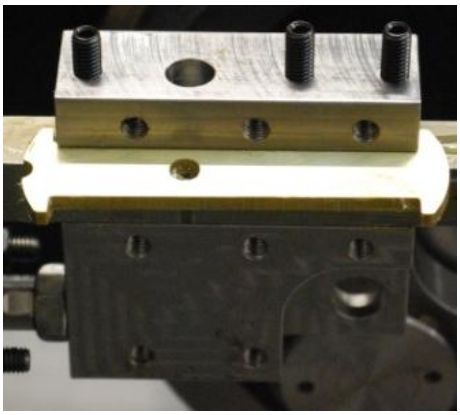
48. Attach a guide bar mounting block to the left hand motion bracket using a M5 x 20mm hex head bolt. Vertical slot goes towards rear, horizontal to front.



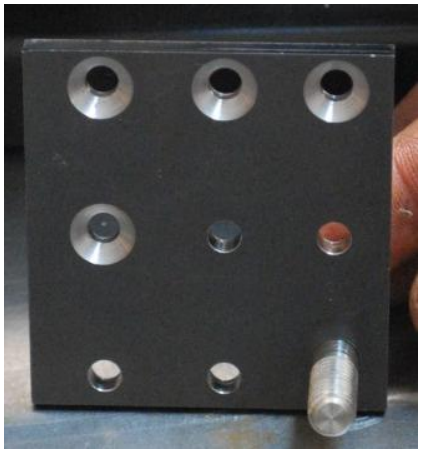
49. Grease all faces of the guide bar and place in the crosshead slot. Milled oilways face upwards, slotted mounting hole to front, thread mounting hole to rear. Fix to cylinder rear cover and mounting block with two M5 x 20 hex head bolts - don't tighten at this stage.

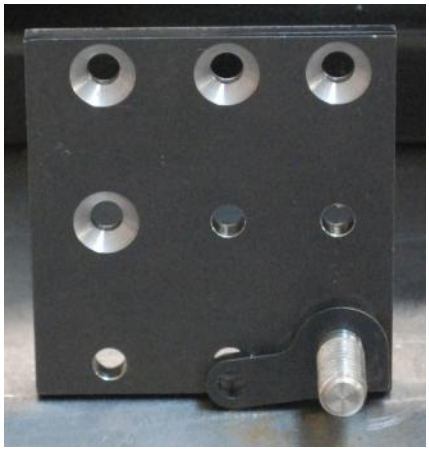


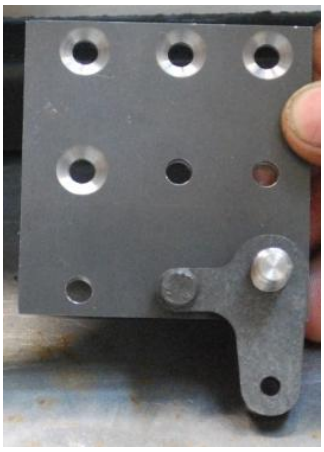
50. Position the brass slipper above the guide bar - front is marked with a notch, which ensures that the oil holes line up when assembled.



51. Crosshead cover plates are handed - select the left hand one, shown below, and put the gudgeon pin through its hole in the bottom corner. Place a drop link spacer and drop link over the gudgeon pin, and temporarily put an M5 bolt in the centre hole as shown to align the parts as shown.



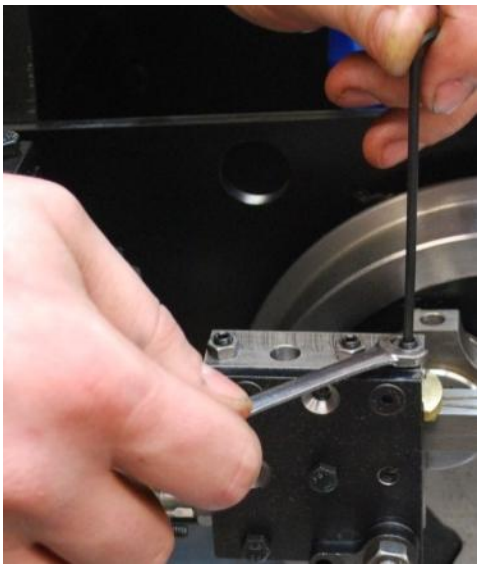




52. Fix the gudgeon pin tightly in place with an M8 nut and M8 half nut used as a locking device. The pin will try to turn whilst tightening the nut - to stop it we catch hold of it in the three jaw chuck of a lathe. Failing that, a drill chuck makes a good substitute, alternatively use soft jaws in a vice. Do not hold it in the unprotected steel jaws of a vice or use Mole Grips - they will mark the bearing surface.

53. Fit a couple of screws to hold the cover plate to the crosshead body temporarily.

54. Fit three M5 x 15 grub screws into the top of the crosshead and wind down until each screw is just clamping down the slipper. Undo each screw half a turn, fit an M5 nut and tighten whilst holding the grub screw with an Allen key to stop it turning.



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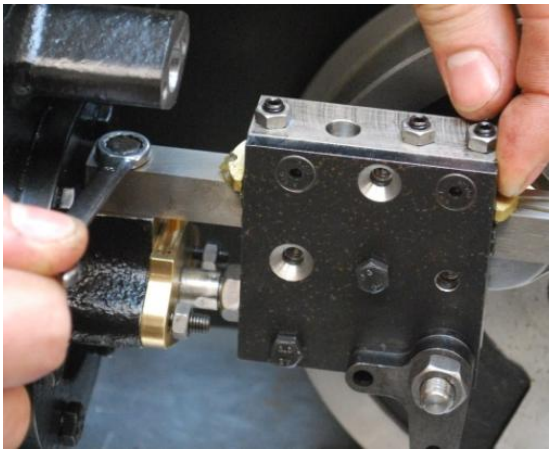
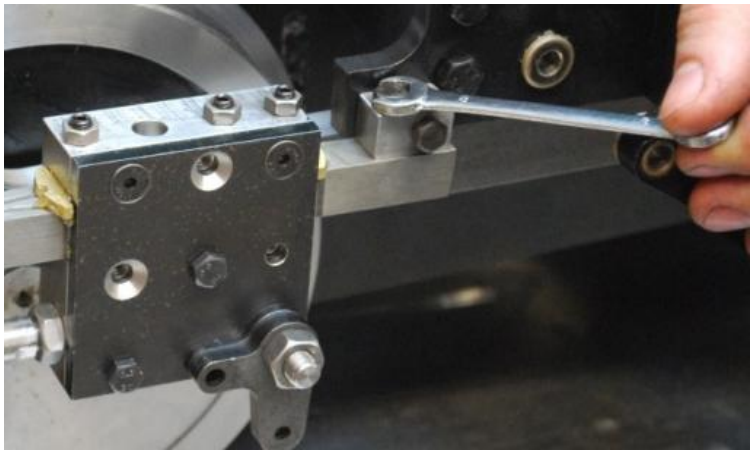
55. Slide the crosshead up to the cylinder rear cover and lightly nip up the M5 hex head bolt attaching the guide bar to the cover. Slide the crosshead to the opposite end of its stroke and repeat for the mounting bolt at that end as shown. Slide back and forth to make sure the crosshead slides freely on the guide bar, then fully tighten the fixings.

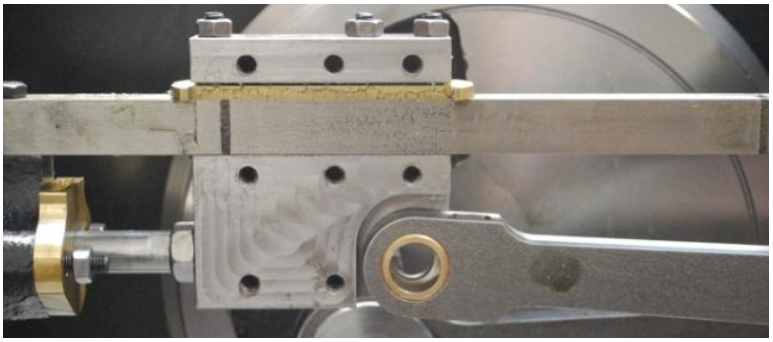




56. Repeat all steps above to fit the crosshead and guide bar to the right hand side of the engine.

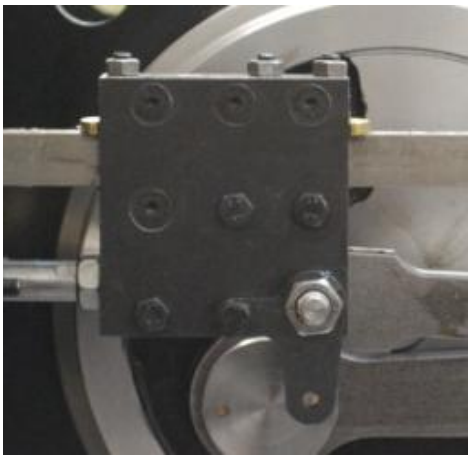
57. Grease the rear crank pin and fit a nylon spacer in front of the coupling rod, as shown.

58. Fit the connecting rod, flange of the big end bush faces outwards, oil well at the crosshead end faces upwards as shown.

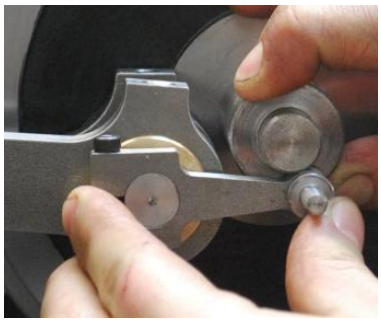
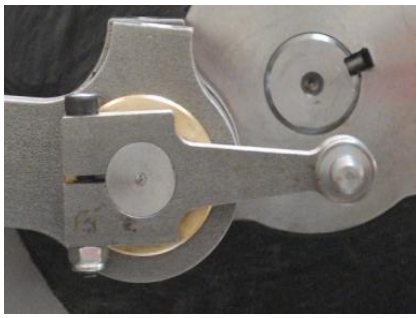


59. Remove crosshead cover plate, grease the gudgeon pin, then refit the cover, ensuring that the gudgeon pin slides easily through the connecting rod bush.

60. Attach the cover plate back to the crosshead by sliding the gudgeon pin through the connecting rod and crosshead and Attaching four M5 x 10mm CSK bolts to the four counter sunk holes situated at the top of the cover plate, using a 3mm allen key. Attach one M5 x 20mm hex head to the bottom middle hole and three M5 x 12mm hex heads to the remaining holes.

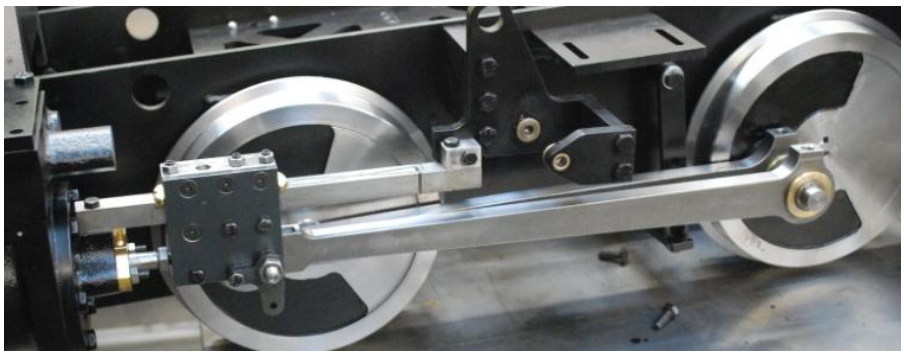


61. Repeat steps to attach the right hand connecting rod. Once this is completed the chassis should be able to roll freely.

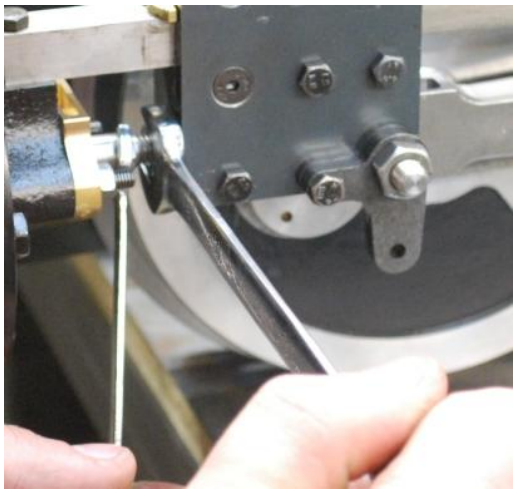
62. Fit the return cranks to the ends of the rear crank pins - ensure that their seating is clean and free of grease. They have been marked at our works to show the correct position, line up the centre dots on crankpin and return crank, then secure with an M4 x 30 cap head screw and nyloc nut.

63. Roll the chassis along so that the left hand crosshead is at its furthest forward point.

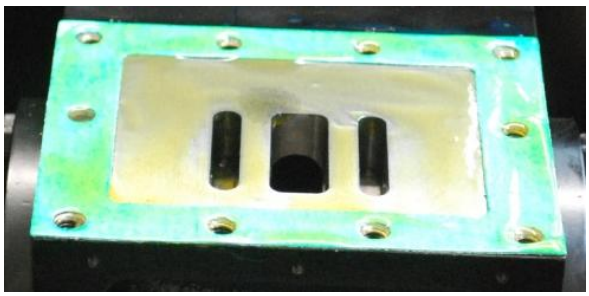


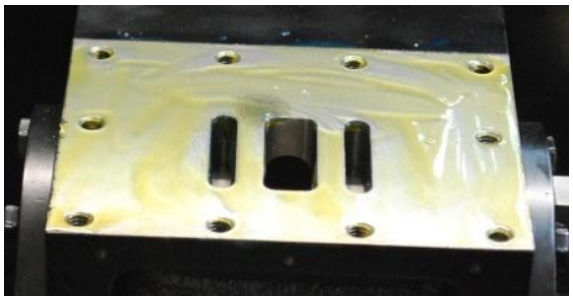
64. Check that the piston is 6.5mm from the end face of the cylinder – a vernier caliper or steel rule can be used. To adjust, loosen off the piston rod locknut at the crosshead and turn the piston rod – it has machined flats for a 9mm spanner. When the piston is in the correct position, tighten the locknut.

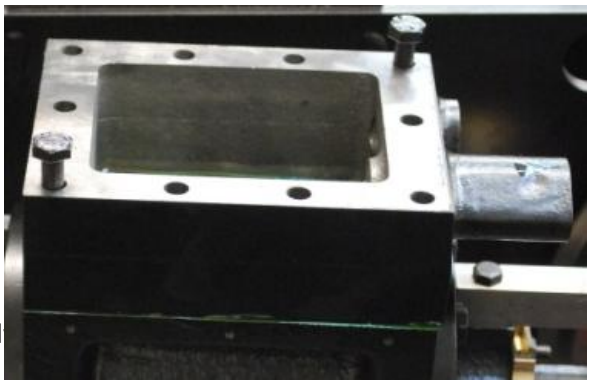

65. When satisfied with the figure tighten the position of the piston rod and the crosshead by applying Loctite 243 and tightening the M8 nut using a 13mm spanner whilst holding the piston rod In place using a 9mm spanner. Then reattach the cylinder cover. Repeat process on the right hand cylinder being sure to move the right hand side wheels to front dead centre before commencing.



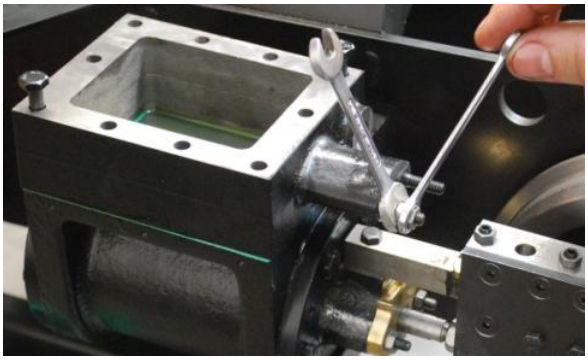
66. Remove the valve chest and cover. Coat the valve face with cylinder oil. Apply a valve chest gasket (green side up) to the valve Face, ensuring all holes line up. Apply more cylinder oil to the top of the gasket and replace valve chest – circular steam pipe boss goes towards the centre.



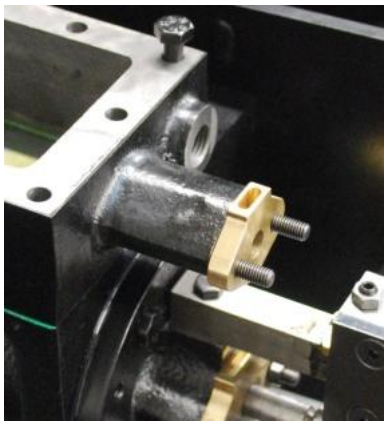




67. Fit two M5 x 25 studs to the valve rod gland boss on the valve chest cover. Use Loctite 243, tighten the stud by locking two M5 nuts together on its threaded end, then winding it in. When tight, use a pair of spanners to turn the nuts in opposite directions, after which they can be removed leaving the stud in place.

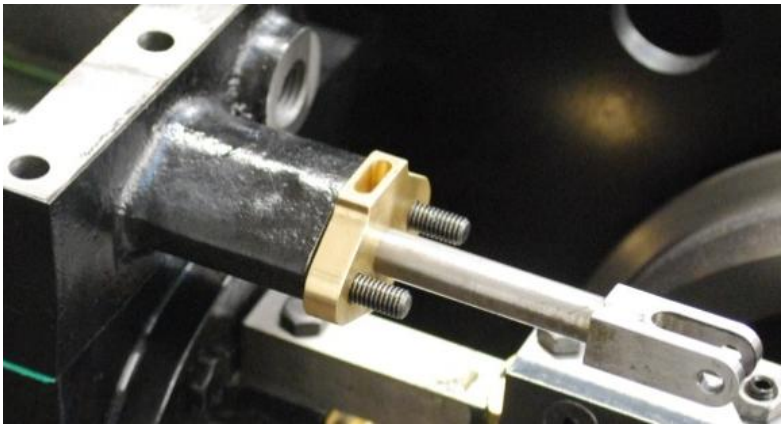


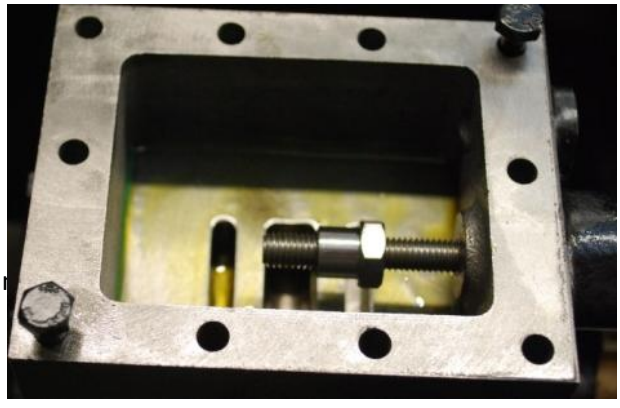
68. Attach valve gland to the valve chest boss ensuring the profile of the gland matches that of the boss, in that the oil well is facing upwards. Fix M5 Nyloc nut on each valve gland studding.



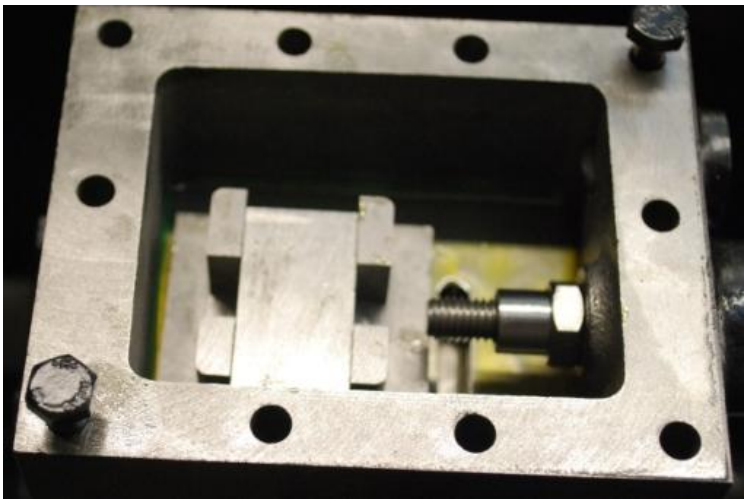
69. Fit the valve rod, complete with clevis, passing the threaded end through the gland and into the valve chest. Run a slide valve locknut onto the end, hexagonal head nearest the boss as shown.

    Give the port face a good coating of cylinder oil before fitting the slide valve.

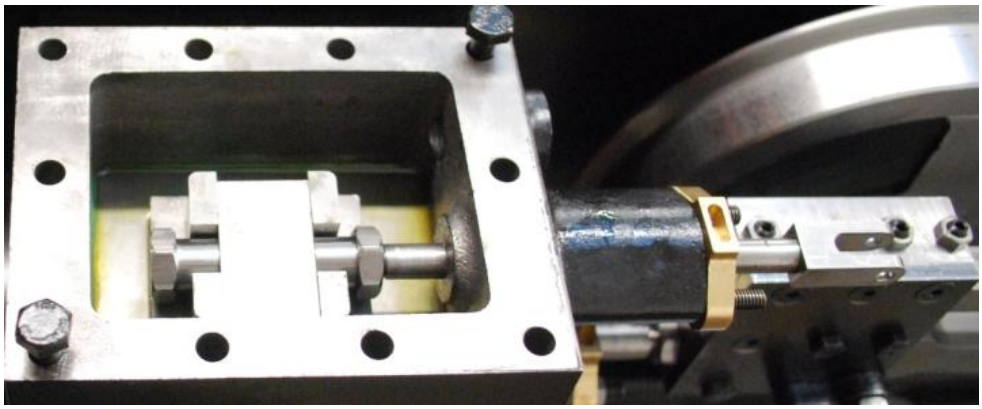




70. Fit the slide valve into the valve chest – narrow legs face outwards, wide legs towards frames. Place the slide valve drive block into the slide valve as shown.



71. Push the valve rod, through the drive block and lightly clamp in place with the other lock nut.



72. Repeat on the right hand side of the engine.

73. Temporarily fit the valve chest covers with a couple of bolts to stop dirt getting into the valve chests.

74. END OF STAGE 6

Stage 7

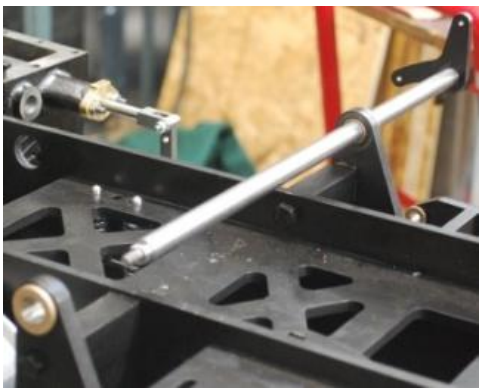
Qty	Description	Part Number
1	weighshaft	10095
1	reach rod lift arm	10451
1	radius rod lift arm	10099
2	combination lever	10109
2	union link	10108
2	lifting link	10100
2	expansion link	10101
2	die blocks	10102
2	radius rod	10106
2	inner Trunnion block	10119
2	outer Trunnion block	10113
4	expansion link trunnion pin	10114
2	Eccentric rod	

Qty	Description
14	M4 x 20mm motion pin
14	M4 locknut
2	M6 locknut
2	M6 washer
4	M5x35 Hex Head

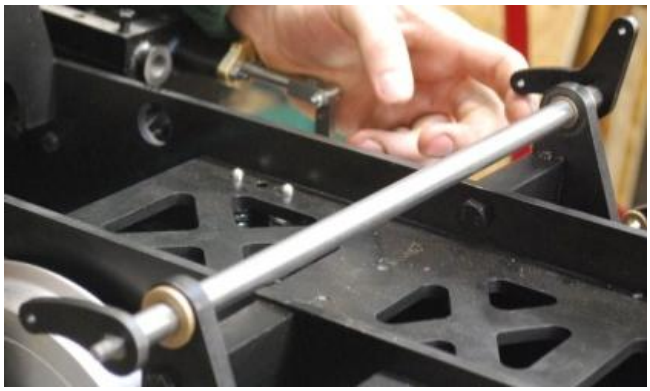
IMPORTANT - The valve gear is assembled using machined motion pins, secured with nyloc nuts. When fitting them, lightly oil the plain shank on assembly, tighten the locknut then back off half a turn - the pins are used as bearing journals, not to clamp parts together, if tightened fully they will cause excessive friction in the valve gear.

75. Attach the reach rod lift arm to the weighshaft as shown - it engages with a D-shaped hole to ensure correct positioning, fix with washer and M6 nyloc nut.

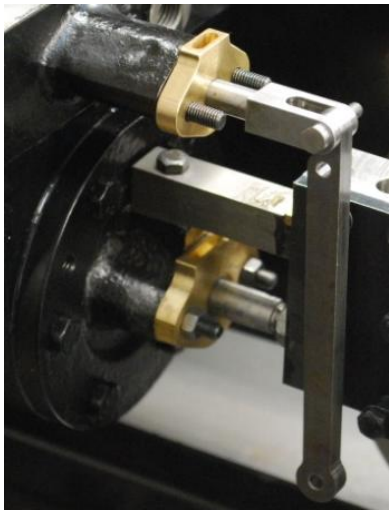
Insert the weighshaft through the bushes in the motion brackets - reach rod lift arm goes on the right hand side of the chassis.



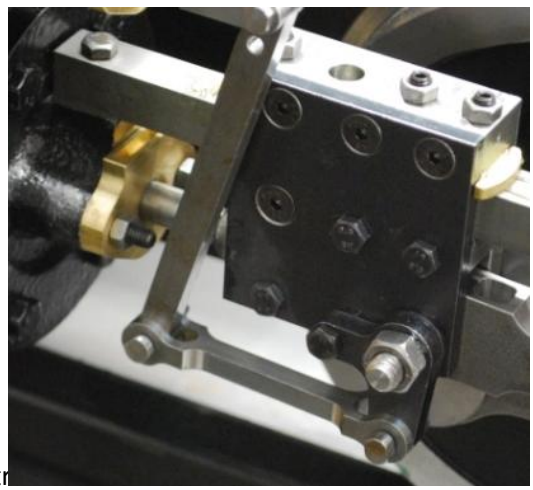
76. Attach radius rod lift arm to the left hand side of the weighshaft, making sure the lifting arms line up on either side as shown. Fix with a washer and M6 locknut.



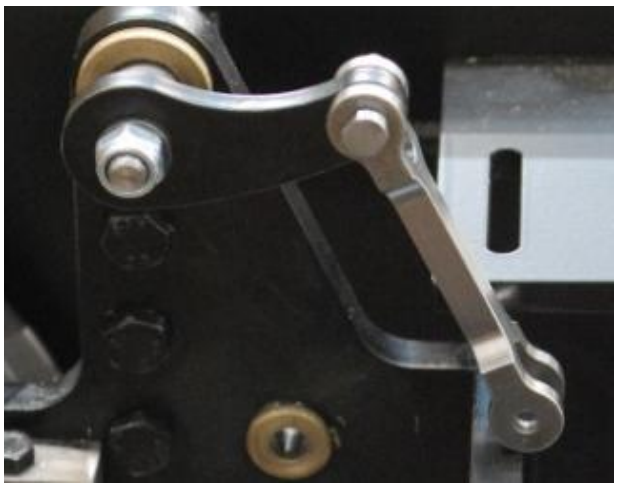
77. Fit combination lever to the valve spindle clevis using an M4 x 20 motion pin and nyloc nut. The combination lever has three holes in it, the two closest together are at the top - the machined notch between these holes faces the front of the engine.



78. Fit the union link with two M4 x 20 motion pins and nyloc nuts, connecting the combination lever and drop link.



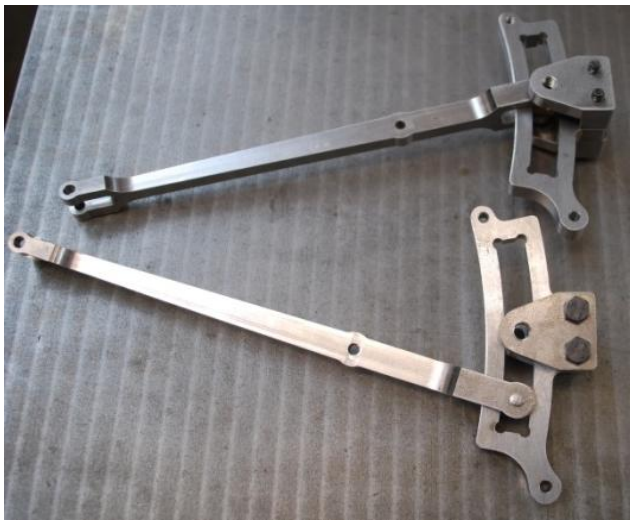
79. Attach lifting link to the radius rod lifting arm with an M4 x 20 motion pin as shown.



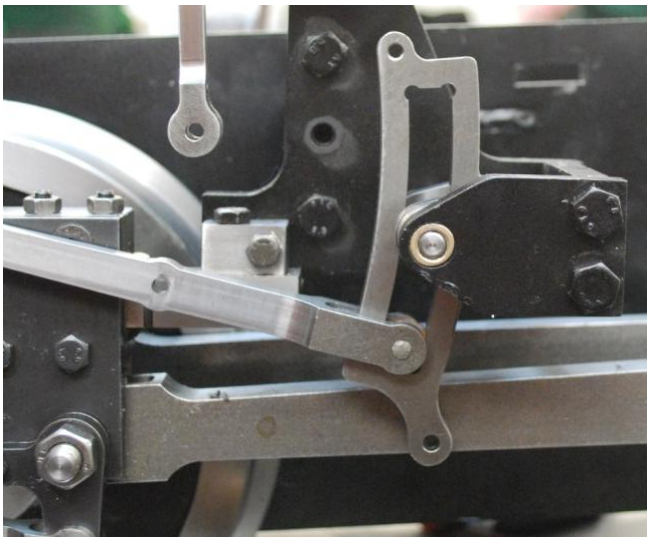
80. Lay out the left hand expansion link and radius rod assembly as shown. Position the inner trunnion block beneath the expansion link and the outer trunnion block above, fix all three components into a "sandwich" using two M5 x 35mm hex head bolts fitted with Loctite 243.

81. Fix the expansion link trunnion pins as shown using Loctite 243 - hold in a drill or lathe chuck to tighten.

82. Repeat for the right hand expansion link, this time fitting the trunnion blocks in mirror image to end up with a pair of assemblies that look like the ones in the picture - left hand at the top, right hand at the bottom.

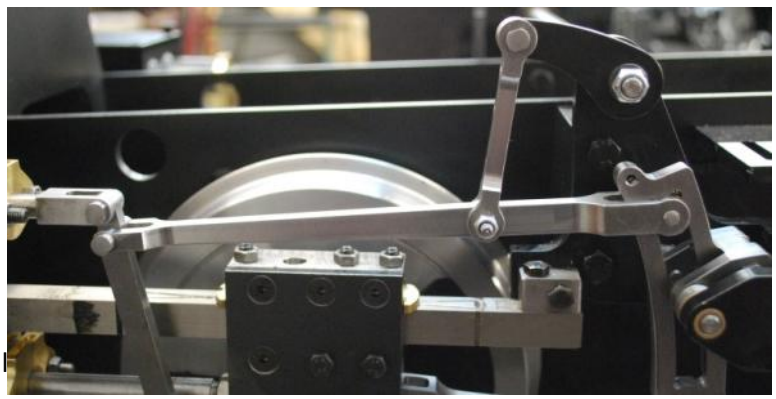


83. Remove the motion bracket outer plate. Lightly oil the expansion link trunnion pins and fit as shown - refit outer plate and tighten the bolts. Make sure that the expansion link can swing freely.

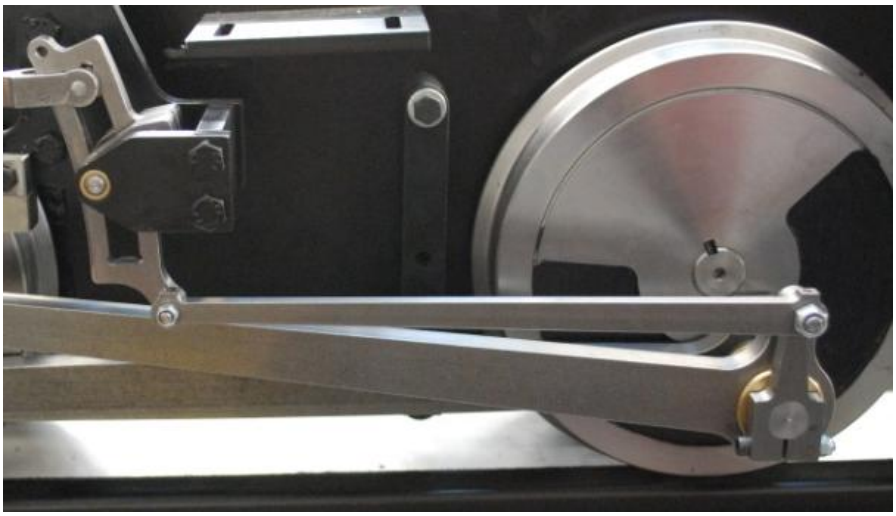


84. Attach the front end of the radius rod to the combination lever using an M4 x 20 motion pin as shown.

85. Connect the lifting link to the radius rod using an M4 x 20 motion pin and nyloc nut as shown.



86. Roll the chassis until the rear crankpin is at the bottom. Oil the return crankpin and an M4 x 20 motion pin, fix the eccentric rod as shown, large boss to the rear and oil wells facing upwards. The eccentric rod lies in front of the expansion link. Fit an M4 nyloc nut to the motion pin and M6 nyloc to the return crank pin, tighten both then back off half a turn to provide running clearance.



If you move the lifting arms up and down, the die nuts should now move up and down in the expansion links, setting forward or reverse gear.

87. END OF STAGE 7

Stage 8

Qty	Description	Part Number
1	reverser lever	10084
1	reverser trigger	10120
1	reversing lever trigger link	10486
1	reverser latch lifting link	10087
2	reverser lever latch	10088
1	reverser latch spring	N/A
1	reverser stand	10091
1	reverser quadrant	10092
2	reverser quadrant spacer	10093
1	reach rod	10094
1	reach rod spacer	
1	reverser lever spacer	10591
2	1/8" BSP flanged plug (doping plug)	N/A
1	lubricator tank	10529
1	lubricator link	10661

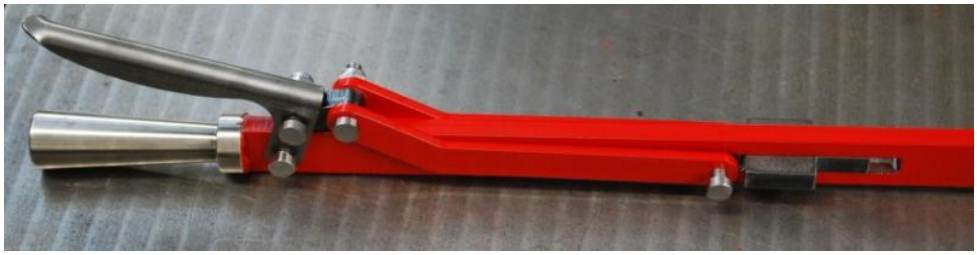
Qty	Description
2	M4 x 15mm motion pin
3	M4 x 20mm motion pin
6	M4 nyloc nut
1	M5 x 10mm hex head
2	M5 x 12mm hex head
4	M6 x 12mm hex head
1	M6 x 16mm cap head
1	M6 x 20mm hex head
3	M6 x 25mm hex head
3	M6 nyloc nut
5	M6 washer
4	250mm graphite yarn

88. Attach the reverser latch to the lever using an M4 x 15 motion pin and nyloc nut, as shown. grease on assembly.

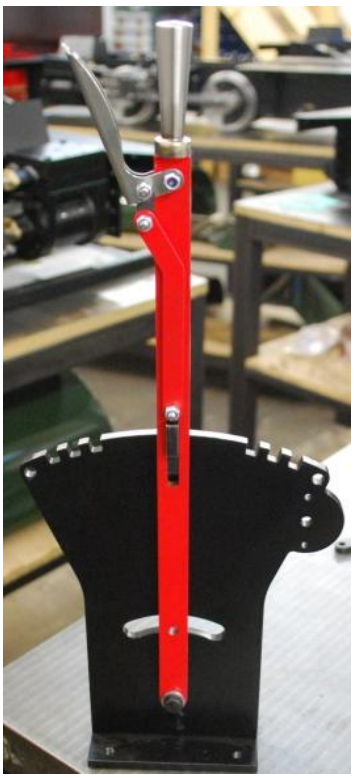
89. Attach the reversing lever trigger link using an M4 x 15mm motion pin as shown. grease on assembly.

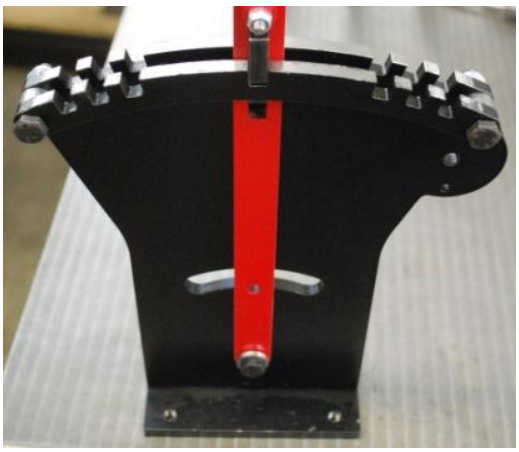
90. Attach the reverser latch lifting links to either side of the reverser lever latch using M4 x 20 motion pins as shown, ensure that the holes used in the reverser latch lifting links are the ones at the end of the shorter shafts so that the remainder of the part can situated so that it is parallel with the Reversing lever, attach via a M4 x 20mm motion pin, from the front and nyloc nut.

91. Insert a reverser latch spring into the slot in the Reversing lever and cover the slot using both reverser latch lifting links. Hold Reversing latch Lift links into place and insert the trigger catch (ensuring the end with the hole in it is inserted towards the top of the lever and that its hole will correlate with those in the Reversing latch Lift links) into the slot in the Reversing lever beneath the spring, push the trigger catch up so that the spring becomes constricted and locate the hole at the bottom of the reverser latch lifting links and the trigger catch. Insert a M4 x 20mm motion pin through all three components, from the front (the same side as the preceding motion pins) and attach via a M4 locknut.



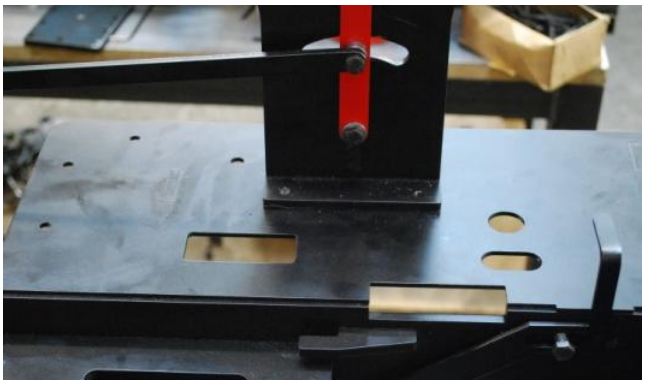
92. Fix reversing lever to the reverser stand using an M6 x 25mm hex head and nyloc nut - tighten up then back off quarter of a turn to allow sliding clearance. Sandwich the two spacers between reverser quadrant and reverser stand as shown, fix with two M6 x 30 hex head bolts and nuts - ensure that the reversing lever can move freely backwards and forwards.





93. Grease the reverser lever spacer and push it through the large hole in the reach rod. Fix to the reversing lever as shown using an M6 x 30 hex head bolt and nyloc nut - the nut runs in the slot in the stand, bolt

head on the other side as shown. Large diameter of the spacer is next to the reversing lever.



94. Fasten reverser assembly to the right hand footplate as shown with four M6 x 12 hex head bolts and washer inserted from underneath - the reverser stand itself is threaded. Don't tighten the bolts fully at this stage.

95. Attach the reach rod to the lifting arm as shown using an M4 x 20mm motion pin, from the outside of the chassis, and secure with a locknut - remember to grease on assembly, tighten, then back off slightly to give running clearance.

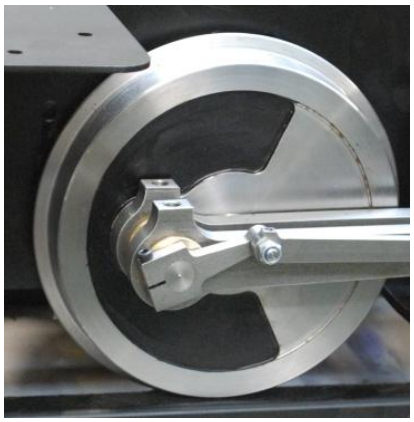
96. Set reverser into full forward gear and observe the position of the die block in the expansion link (it will be towards the bottom). Now set it into full reverse and again check the die block - it will be near the top. The aim is to end up with an equal gap top and bottom in reverser and forward gear respectively - to adjust, slide the complete reverser stand backwards or forwards along the footplate. When set correctly, tighten the four mounting bolts fully.

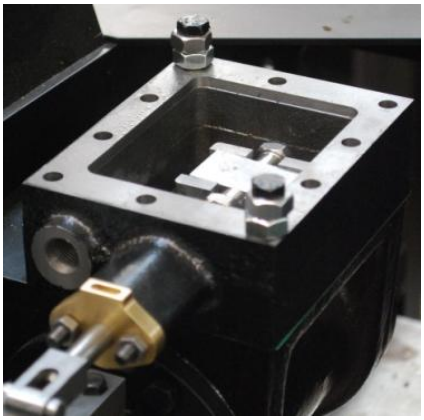
SETTING THE VALVES

This next stage shows you how to set the valves. This is an important part of the build, read through the instructions carefully before starting. Time spent getting this right will be amply

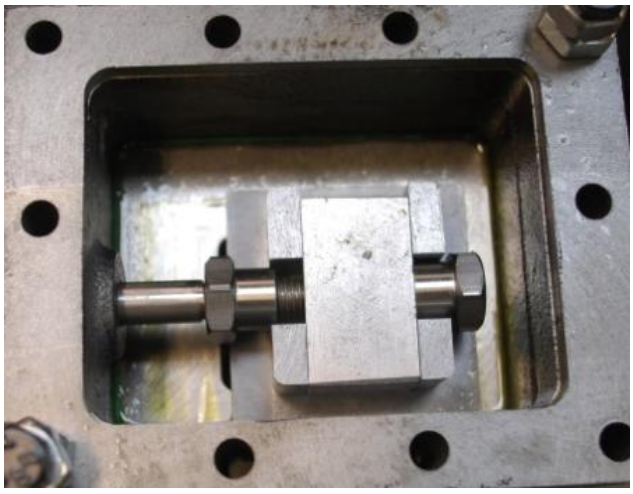
repaid, giving an engine that will run well in both directions, with square exhaust beats.

97. Move reverser to full forward gear, set the right hand wheel set to back dead centre as shown. Remove the valve chest cover on the right hand valve chest. Using a couple of M8 nuts as spacers use two of the M6 x 55mm valve chest bolts to hold the valve chest in place as shown.

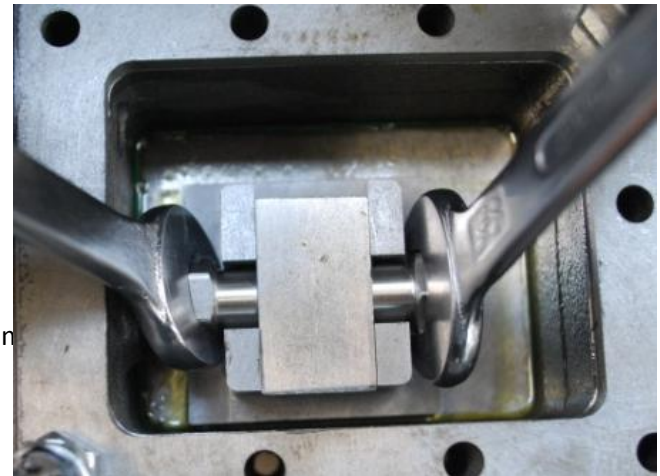




98. Set the slide valve using the adjuster nuts so that its back edge is just opening the rear port - there should be a tiny crack of a black line showing as the valve uncovers the port with the wheels set at back centre.



99. Roll the engine forwards to front dead centre and check that the front edge of the slide valve is just opening the front port.

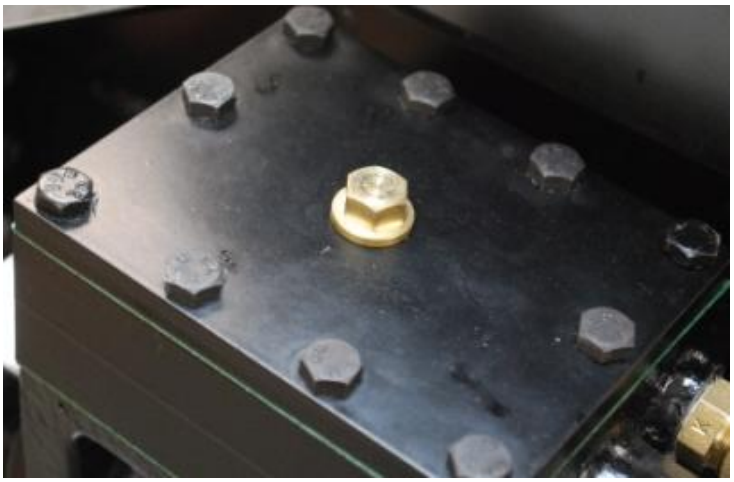


Adjust the valve so that the amount of port showing is equal for front and back dead centres.

100. Repeat for the left hand slide valve.

101. Attach remaining M6 x 12mm hex heads to the underside of the reverser.

102. Attach valve chest cover to the top of the valve chest and attach via ten M6 x 55mm hex heads and insert doping plugs into the top middle holes of the two valve chest covers.



103. **Packing the glands**

The piston and valve rods pass through the cylinder and valve chest castings respectively - there is steam on the inside which has an inclination to escape through little gaps such as is found between the rod and the hole it runs in.

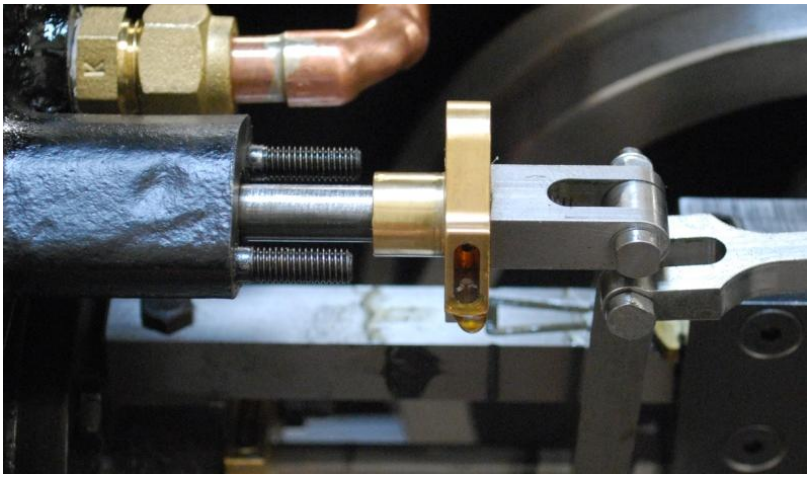
To stop this happening, we wrap graphited yarn around the rod, then compress is into a bored housing called the stuffing box - by tightening down the gland, the yarn can be compressed against the rod, producing a steam tight seal.

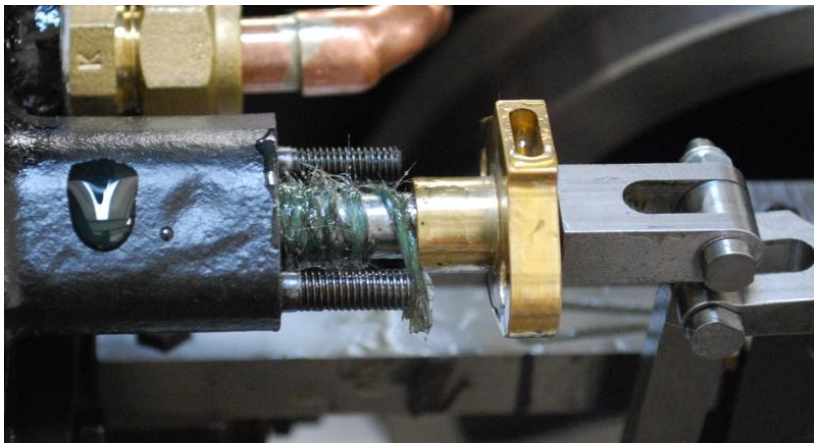
It's not difficult to pack glands, and it is part of the regular maintenance for any steam engine. As the packing wears, the gland can be tightened down further - however eventually it will need to be removed and new packing put in.

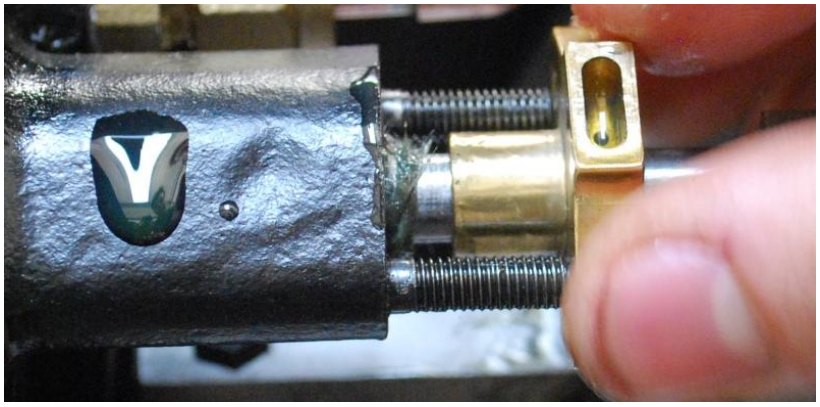
Here's how you do it:

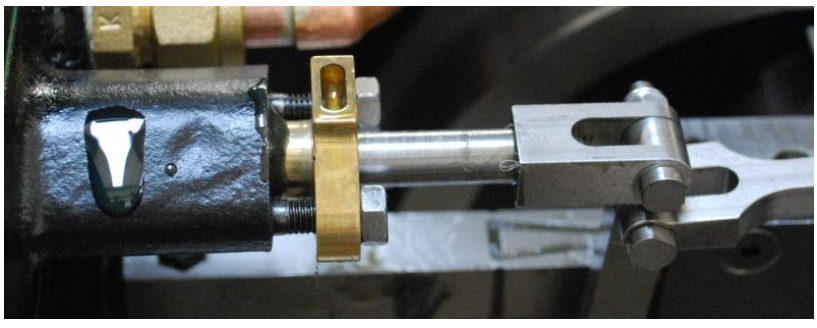
104. Cut four lengths of graphited yarn - two at 250mm long for the valve rods, two at 325mm for the piston rods. Smear with cylinder oil.

105. Roll the chassis to a position where you have clearance to pull the valve rod gland from its stuffing box as shown. Wind the length of yarn around the rod as shown and gently push it back in with the gland - a small screwdriver or scriber is useful here. Fasten with two M5 nuts, don't attempt to crush it down too tightly.

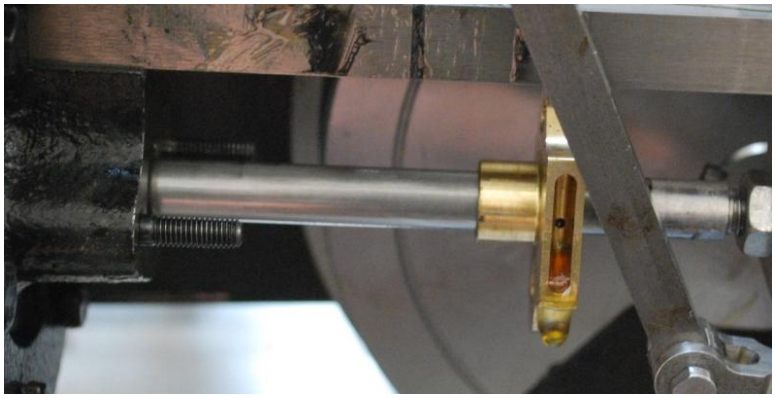


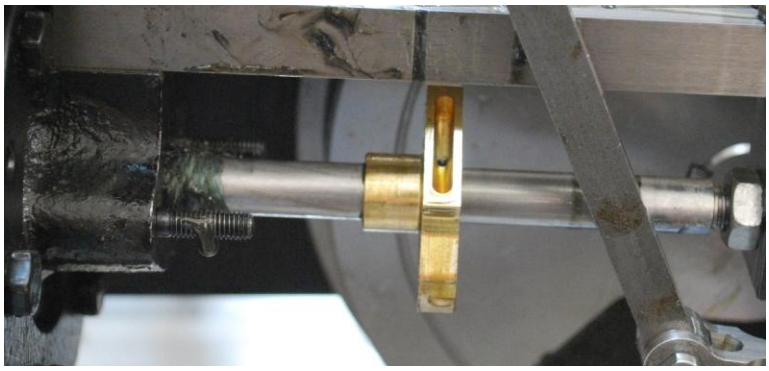


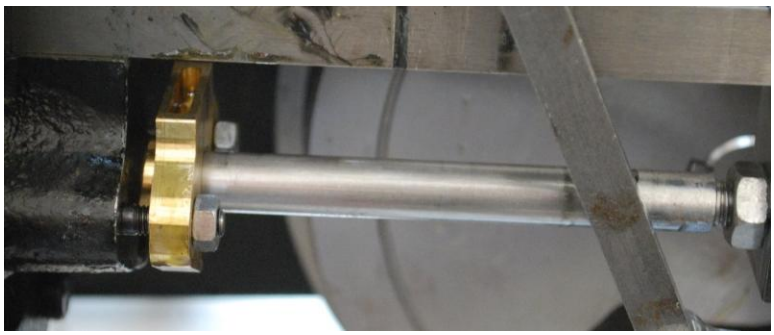




106. Using the lengths of yarn, pack the piston rod glands the same way.





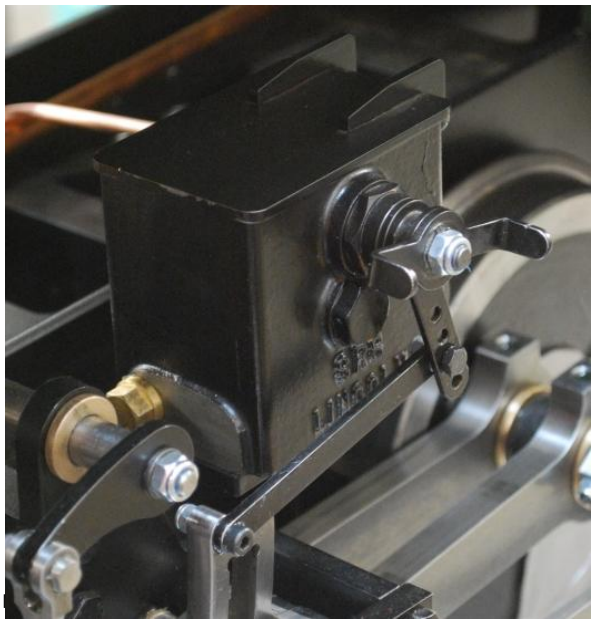


107. Repeat for the right hand side piston and valve rods.

108. Fasten the mechanical lubricator onto its platform on the right hand side of the chassis, just behind the weighshaft. Oil connection union faces to the rear, “SRS LINCOLN” should face outwards as shown.

Fix with two M5 x 12mm hex head bolts and washers from underneath – don't tighten at this stage.

Attach the lubricator link to the expansion link and operating arm on the lubricator. Expansion link end needs an M4 x 16mm cap head screw



with nyloc nut - tighten, then back off a quarter turn to give running clearance before nipping up the locknut. Lubricator end is fixed with an M5 x 10 hex head bolt, head on the outside and a washer between link and operating arm. Again, fix with a nyloc nut, nip up then back off a quarter turn.

Check that the lubricator operating arm and expansion link line up when viewed from above, the link should be parallel to the frames. Tighten the two M5 bolts securing the lubricator to its platform.

109. END OF STAGE 8

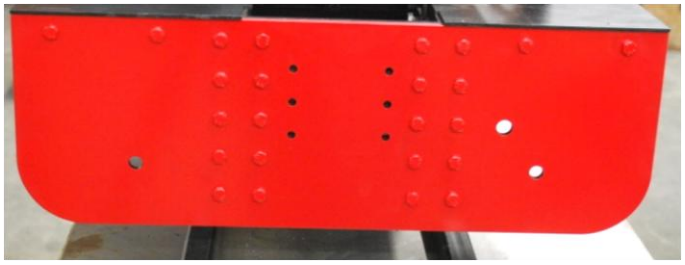
Stage 9

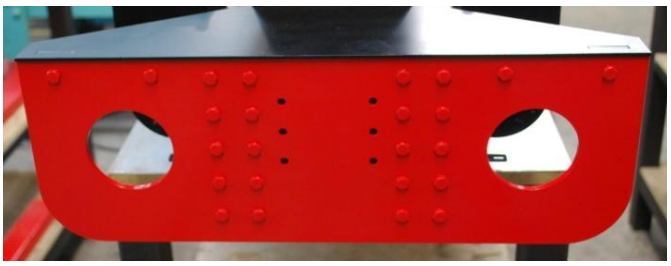
Qty	Description	Part Number
1	boiler	10170
1	blast pipe	10236
1	blast pipe nozzle	10223
1	smokebox blower fitting 5/16 x 32	10234
1	blower pipe	N/A
1	smokebox locking bar	10228
1	smokebox door handle dart	10227
1	smokebox door handle assembly	10522

vacuum brakes		
Qty	**Description**	**Part Number**
1	vacuum fitting 3/8 x 32	standard part

Qty	Description
1	M3 x 5mm button head
6	M6 x 25mm hex head
1	M8 x 30mm hex head
1	M8 x 20mm hex head
1	M8 nut

- **General Purpose Black Silicone Sealant will be required for this section.**
- **Two people are required to lift the boiler onto the chassis due to its weight and size.**
- **When tightening compression fittings use a spanner until the nut tightens on the olive, then nip the fitting another half turn to compress the olive, making the joint. This can be done on a vice first if preferred.**





110. If not previously assembled, attach drag beam and buffer beam to the chassis. The buffer beam has two large holes in it to allow removal of the pistons for maintenance. Attach using 24 off M6 x 16mm hex head bolts, fit to all the holes except the six coupling mounting holes shown in the middle of the Beam. Attach the drag beam in the same way using 24 off M6 x 16mm hex heads to the twenty four holes except from the six inner holes.

111. Attach couplings to the drag beam (and buffer beam if applicable - a front coupling is optional, if not fitted then blank holes with M6 x 16 hex head bolts). using six M6 x 25mm hex heads bolts.

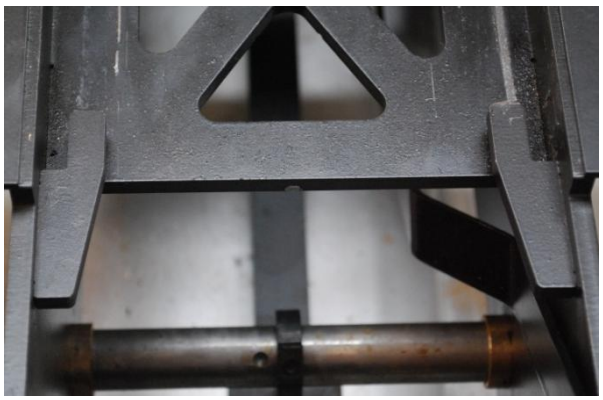
112. Mounting the boiler

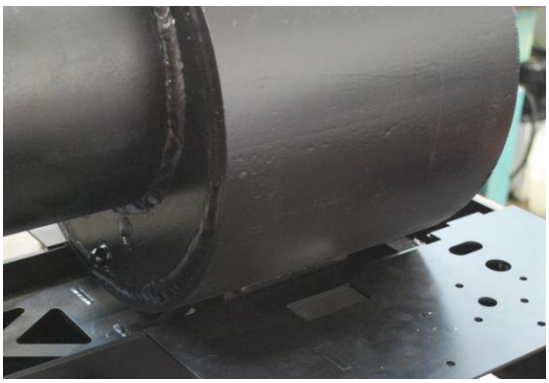
A steam engine boiler expands when it gets hot and contracts when it gets cold - not by a huge amount (it's a bit under 2mm for Stafford) but sufficient to cause serious problems if both ends are bolted down tightly (the boiler is rather less flexible than the chassis, so it would tend to be the frames that went a funny shape).

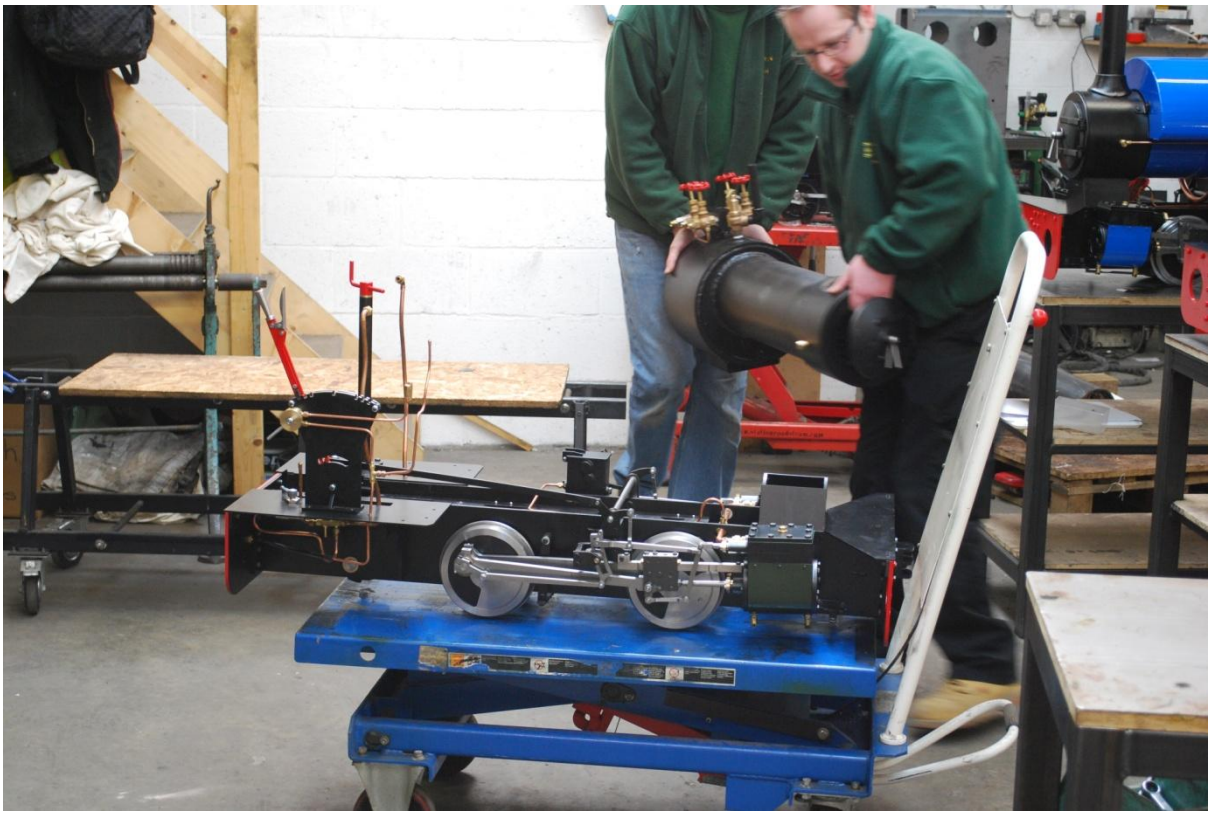
To avoid distortion locomotives use a system whereby the boiler is bolted down at one end and allowed to slide back and forth at the other as it heats up and cools. Stafford's boiler is bolted down at the smokebox end, the back end has a U-shaped bracket underneath the firebox which engages in a pair of tabs welded into the chassis - they stop the boiler falling off if the engine turns upside down, but more importantly allow it to slide back and forth as it expands and contracts.

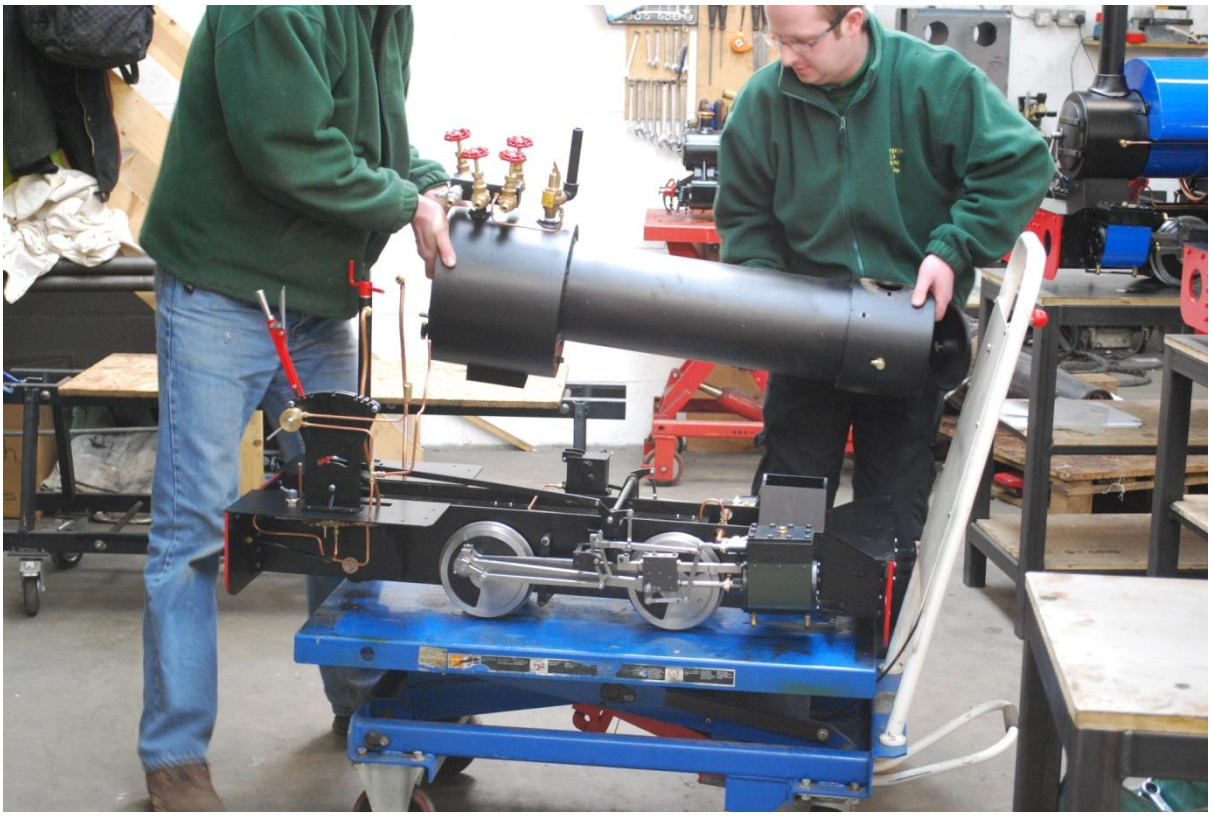
113. The boiler is too heavy to lift on your own - you will either need a hoist or a strong friend. The strong friend route is illustrated below.

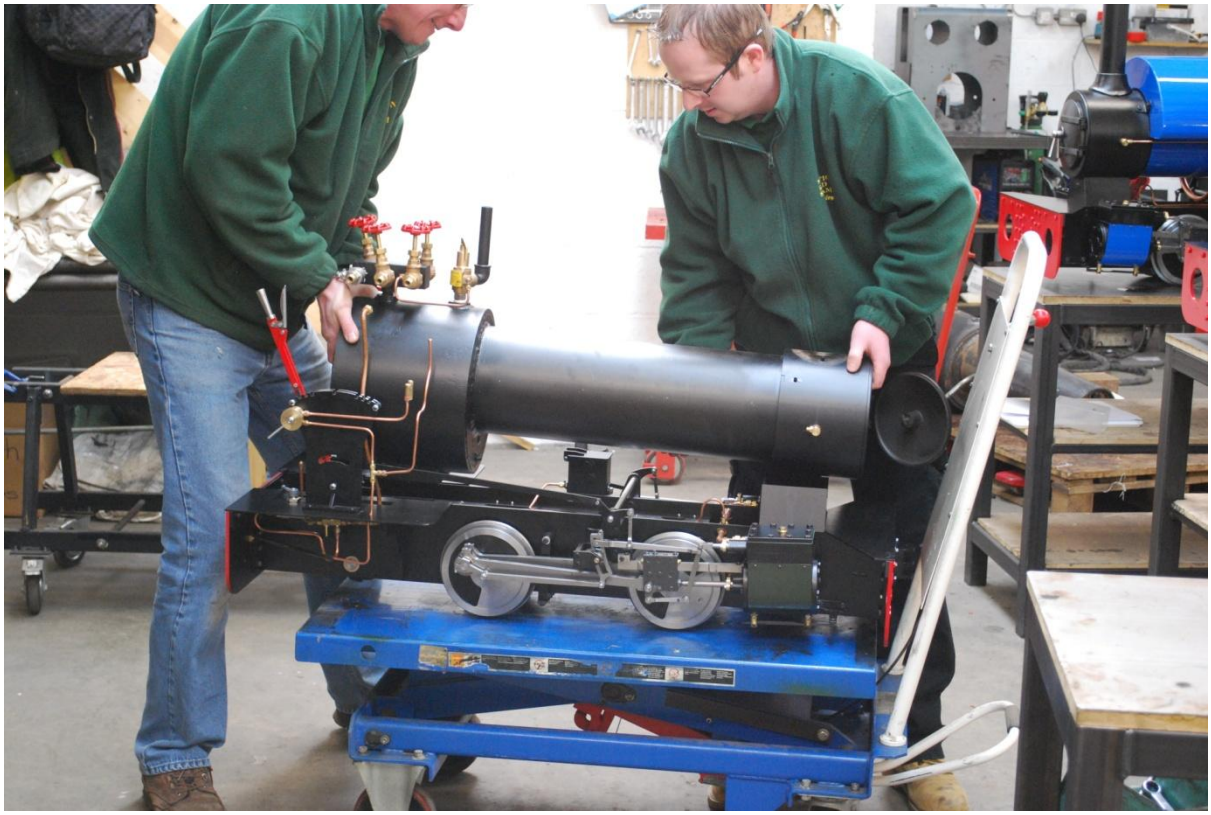
Start by sliding the U-shaped bracket beneath the firebox between the frames in front of the boiler lugs.

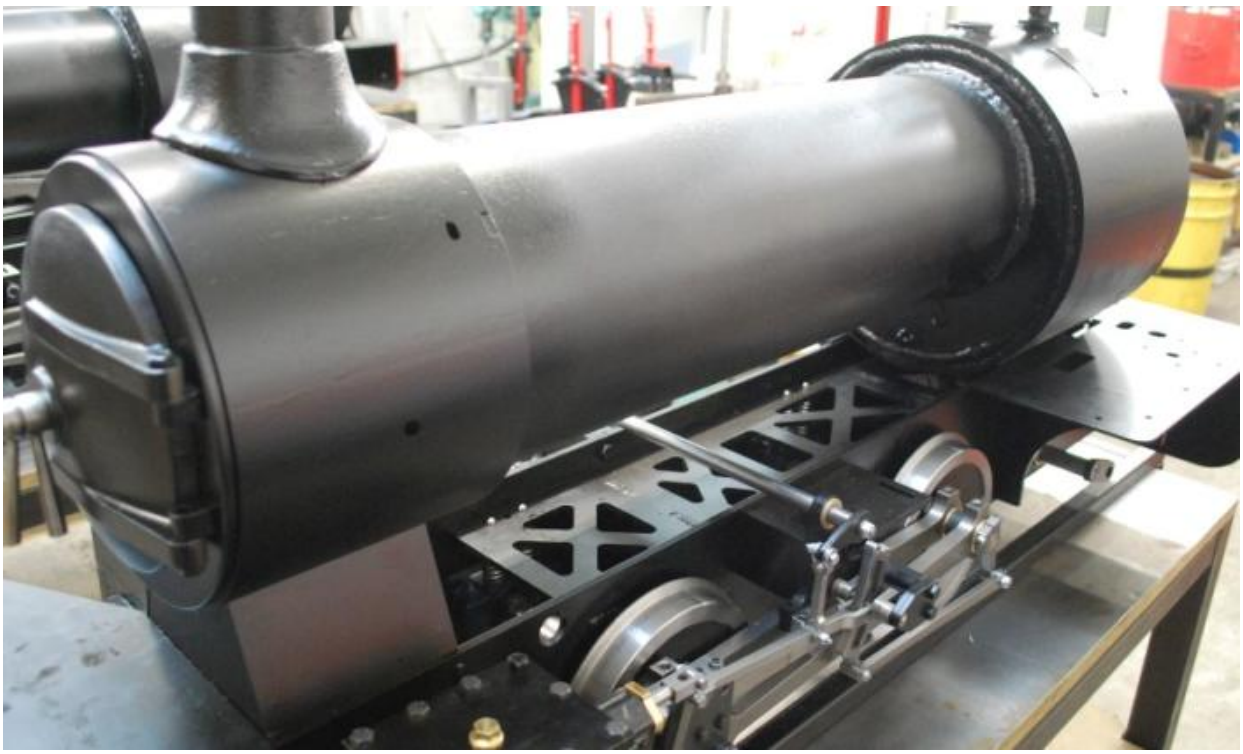




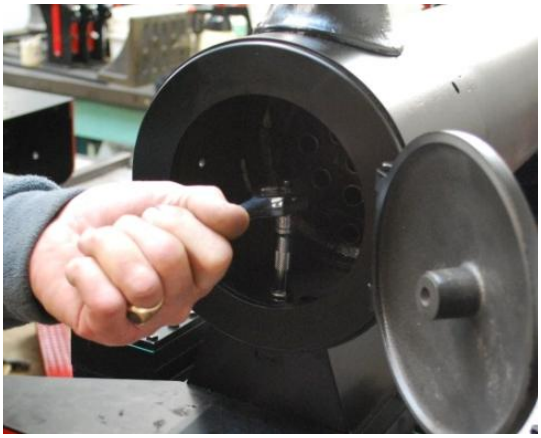






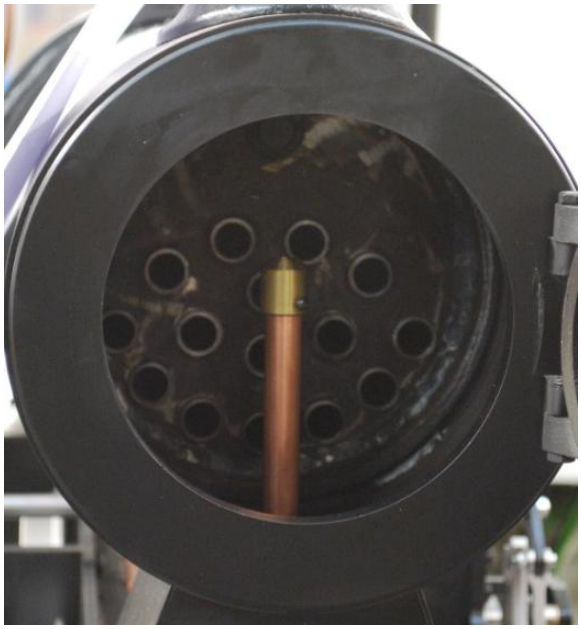


114. The boiler is fixed in position using an M8 x 30 hex head bolt bolted through the hole in the bottom of the smokebox and into a threaded hole in the saddle stretcher below.



115. Push the blast pipe through hole in bottom of the smokebox and fit into the exhaust tee.

116. Fit the blast nozzle to the top of the blast pipe and secure with an M3 x 5mm button head screw.



117. It's important that the blast pipe is fitted centrally in the chimney - look down from the top and make sure it's in the middle. If not, move it by adjusting the exhaust stubs where they screw into the cylinders - this will move the bottom of the blast pipe.

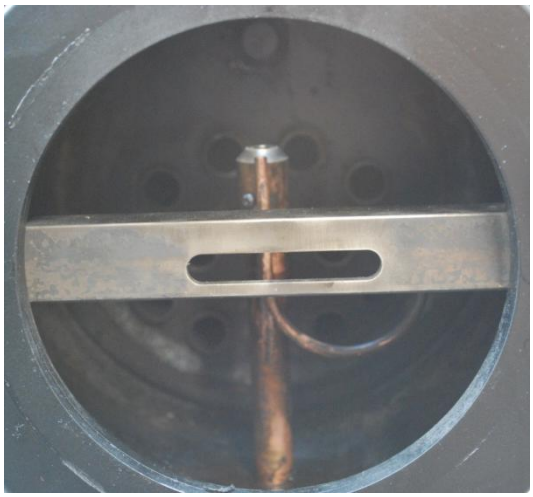
Fully tighten all three compression nuts on the equal tee using a 1/2'' Whitworth spanner, whilst holding the equal tee in place using an adjustable spanner. This will crush the brass olives onto the two exhaust stubs and blast pipe, making a steam tight seal.

118. The smokebox must be airtight when its door is closed - the blast from the exhaust creates a vacuum which draws the fire, air leaks in the smokebox will destroy this vacuum and the engine won't make steam.

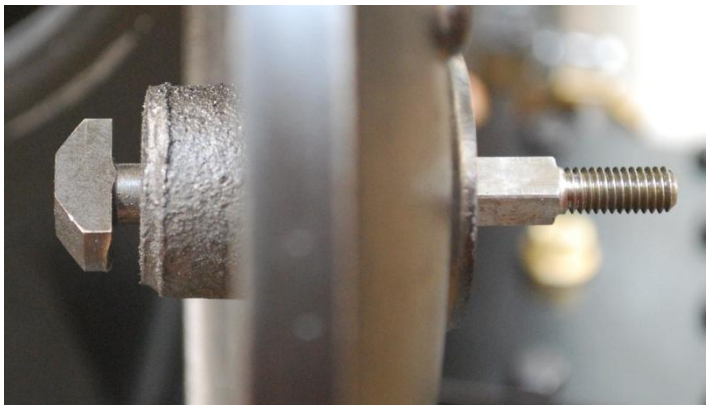
Seal all around the boiler to smokebox joint and base of the blast pipe with black silicone sealant - wear a pair of nitrile gloves to protect your skin whilst doing this, using a finger to smear a good fillet of sealant into the joint. Remove any excess with a rag.

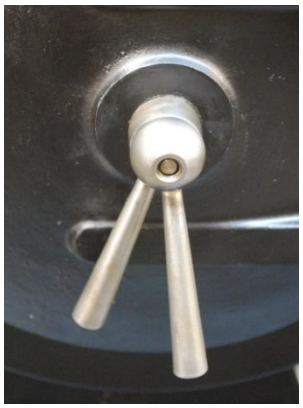
119. Fit the smokebox blower fitting (5/16 x 32 thread) to the left hand side of the smokebox - fitting on the outside with pipe connection facing rearwards, nut on the inside. Connect the blower pipe as shown, with its end alongside the blast pipe, facing up the chimney.

120. Drop the smokebox handle locking bar into its two lugs in the smokebox as shown.

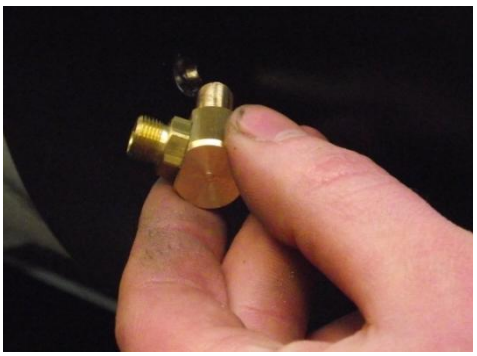


121. Push the smokebox dart through the door as shown, slide an inner handle over the square shaft and screw on the outer handle - don't tighten it up at this stage.





122. If fitting vacuum brakes, put the ejector exhaust fitting into the hole in the right hand side of the smokebox, pipe fitting facing rearwards and secure with an M8 nut on the inside. If not, then blank off the hole with an M8 x 20mm hex head bolt.



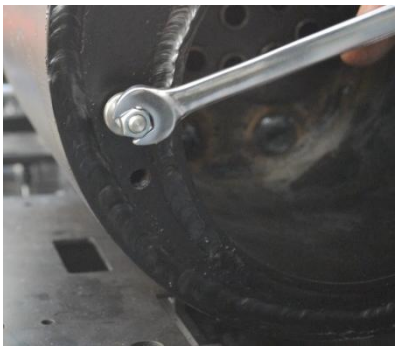
Stage 10

Qty	Description	Part Number
1	fusible plug	10173
2	back head stud	10216
2	clack valves	
2	clack valve feed pipe (injector Delivery pipe)	10446
1	back head	10209
2	fire hole door hinge block	10435
1	grate	10218
1	fire hole door catch	10317
1	fire hole door	10310
1	fire hole door latch	10312
1	baffle	10302
2	back head stud knob	10214

Qty	Description
4	M5 x 25mm cap head
1	M5 x 50mm hex head
2	M5 nut
4	M5 washer
4	M6 x 20mm hex head
1	15mm snap head rivet

123. Fit the fusible plug into its bush in the top of the firebox - wrap a few turns of PTFE tape around the thread to seal it and tighten using a socket as shown.

124. Fit the two stainless steel backhead studs to the back of the boiler, either side of the firebox. There are two threaded holes - you want the top one, tapped M8. Use Loctite 243 to seal the threads before assembly, short end goes into the boiler. Easiest way to fit them is to run a pair of M8 nuts down the thread, lock them together and then wind the stud in using a spanner. When tight, use wind the nuts in opposite directions to break the lock, then remove.



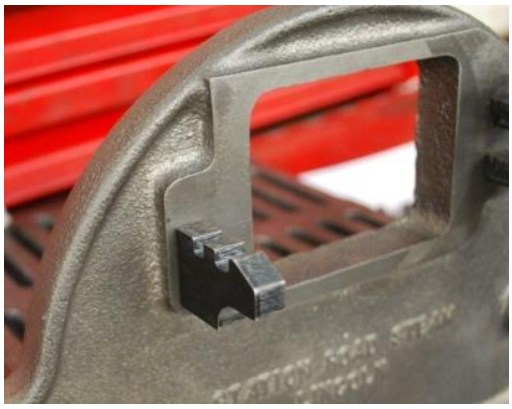
125. Fit the pair of injector clack valves as shown, using Loctite 243 to seal the threads. Make sure the pipe unions face downwards.

126. Fit the injector delivery pipes to the clack valves as shown, one each side.

127. Bolt the fire hole door hinge blocks to the front of the back head (the face with Station Road steam cast into it) using two M5 x 25mm cap head bolts with washers under the heads. The holes in the hinge block need to line up, so drop a long M5 bolt in them while tightening up.

128. Fasten the grate to the backhead as shown with a pair of M6 x 25 bolts. Slots in the grate are tapered top to bottom, wide side goes downwards, narrow side has the coal on it.

129. Bolt the fire hole door catch onto the back head as shown, using a pair of M5 x 20mm cap head bolts with washers under their heads.



130. Insert the fire hole door latch through the slot on the fire hole door as shown, drop a snap head rivet through the holes and peen over with a hammer as shown. You don't need to hit it very hard - lots of little taps with spread out the rivet and stop it falling out, whilst still allowing the latch to move up and down freely. In the pictures, we're supporting the head of the rivet with a rivet snap (it's just a bit of a steel with a hemispherical dent in it to support the rivet head) but it's not vital - you can sit the rivet head on a block in the vice given the gentle knocking down we're giving it - just hit it gently so you don't flatten it (which wouldn't make a jot of difference to its function, but would look a bit crudely done).

Attach the fire hole door to the back head by fire hole door hinge blocks between the fire hole door hinges and secure using an M5 x 50mm hex head from the top side of the back head, and a nut from below, which should allow the door to open and close on its hinges with ease.

This is quite a good time to paint the Backhead - it's the one part of the whole engine that gets seriously hot and needs some very high temperature paint to have any chance of staying on. We use barbecue paint in an aerosol.

131. We fit a stainless steel baffle at the back of the grate - this has two functions, supporting the grate at the rear of the firebox and also deflecting flames up and over the baffle, maximising the heating transfer in the top of the firebox and stopping pieces of coal racing off down the tubes.

    Attach baffle to the grate as shown, using a pair of M6 x 20 bolts - cut off bit goes to the top, round bit to the bottom.

132. Fit the back head, grate and baffle combination into the fire box in the rear of the boiler and secure with the pair of stainless steel backhead knobs as shown.

Stage 11

Qty	Description	Part Number
1	Fountain	
2	Injectors	
3	steam valve	N/A
1	regulator valve	N/A
1	safety valve	N/A
1	safety valve chimney	10152
2	water valve	N/A
2	water valve to injector pipe	N/A
1	main steam pipe	10443
1	left hand steam pipe	N/A
1	right hand steam pipe	N/A
2	steam feed to injector pipe	N/A
1	lubricator feed pipe	10441
1	blow down valve	N/A
1	upper water gauge	N/A
1	lower water gauge	N/A
1	water gauge glass	N/A
4	O ring	N/A
1	water gauge blow down pipe	10447
1	brake column	10025
1	brake bush	10018
1	brake handle	10028
1	brake stop collar	10047
1	brake Screw Boss	10020
1	brake barrel pivot washer	N/A
1	10mm equal tee (with compression fittings)	N/A

Qty	Description
1	½'' BSP ferrule
5	¼ BSP union
3	¼ BSP plug
7	8mm union (with compression fittings)
3	10mm union (with compression fittings)
3	10mm compression fitting
1	3/16'' x 32mm pressure gauge union
1	M10 nyloc nut

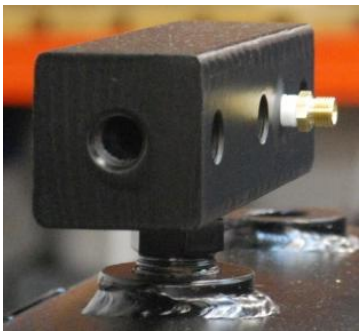
Whistle	
Qty	**Description**
1	¼ BSP threaded 8mm compression union

vacuum brakes	
Qty	**Description**
1	¼ BSP union
1	8mm union
1	8mm compression fitting

Qty	Description	Part Number
1	steam valve	N/A

This section deals with fitting up the fountain - this is where all steam from the boiler is taken off to the various places it's needed - regulator, injectors, pressure gauge etc. All joints will need a few turns of PTFE tape to seal the threads, four or five turns is usually about right.

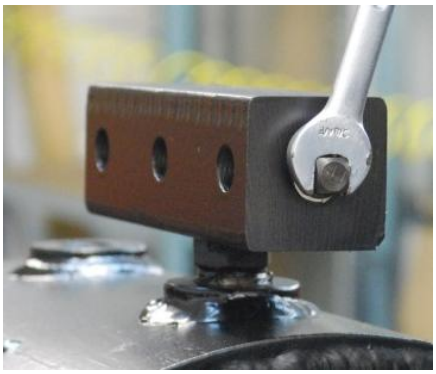
133. Fit the pressure gauge union to the fountain using a few turns of PTFE tape to seal the threads. There's only one hole it can fit in (the smallest one). Tighten using a 3/8 A/F spanner.

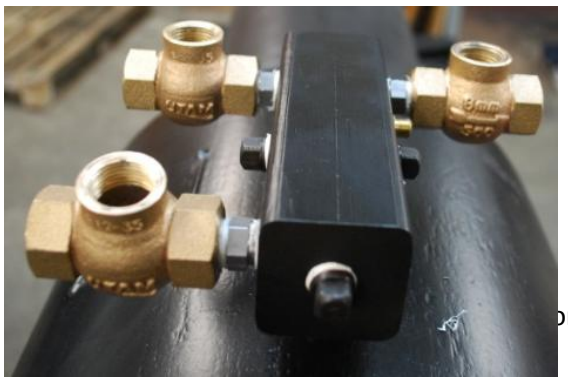


134. Fit a ¼ BSP blanking plug to the hole at the front of the fountain using PTFE tape, tighten.

135. The standard specification engine has three steam valves - one for each injector and one for the blower. The valves are bronze, fitted with a PTFE working face and rated for use with steam at the temperatures and pressures the engine runs at. They seal well with minimal force and don't need tightening down hard - overtightening reduces the life of the seat and tends to make them leak.

136. Fit three steel adaptor unions to the fountain with PTFE tape as shown - two on the left, one on the right next to the pressure gauge union. Tighten using a 9/16 A/F spanner.

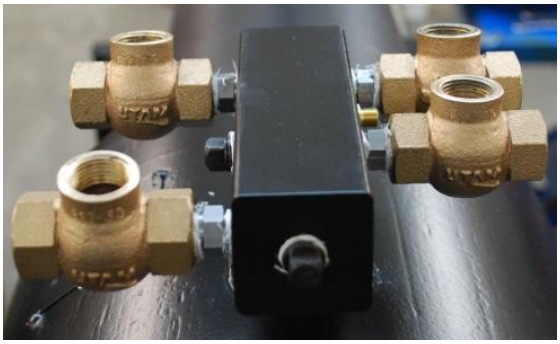




137. The steam valves have to be disassembled to fit them - they are supplied with the tops loosely assembled to the bodies.

    Unscrew the top and fit the bodies to the adaptors already fitted to the fountain as shown - note the arrow cast into the valve body, showing the direction to fit them. Steam flows from the fountain outwards - arrows as shown.

138. If fitting vacuum brakes to the engine you will need a fourth steam valve fitted as shown - if not, fit a ¼ BSP blanking plug.



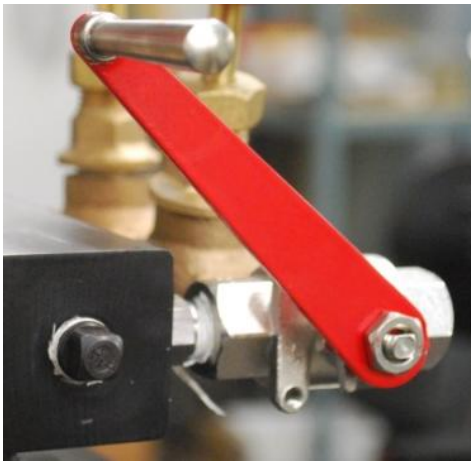
139. If fitting a whistle, put a ¼ BSP threaded 8mm compression union in the middle hole on the left hand side of the fountain - if not, use a ¼ BSP blanking plug instead.

140. Reattach the handles to all steam valves and tighten with a 19mm spanner.

    Before tightening make sure that the valves are open (they open anticlockwise, like a conventional tap).

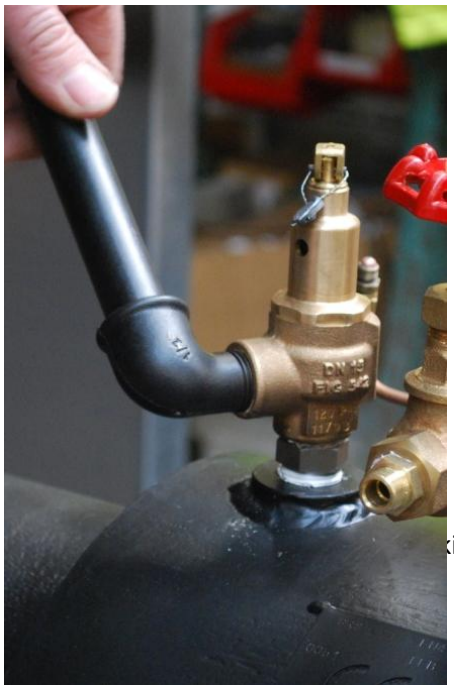
    If you don't, the valve face can be damaged as you tighten the top nut down.

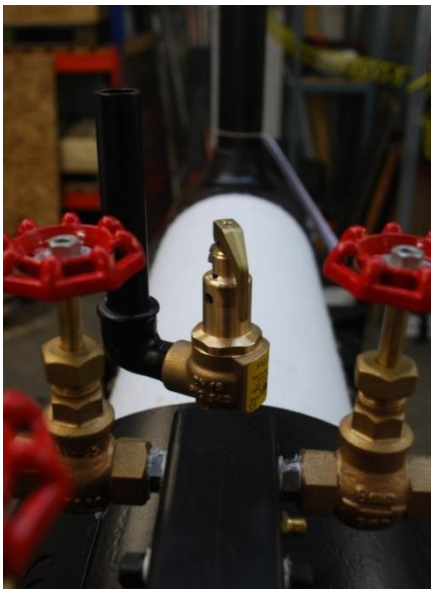
141. Fit the stainless steel regulator valve - same way you fitted the steam valves, steel adaptor ferrule, PTFE tape - making sure the mounting lug with tapped hole goes on the left, towards the fountain as shown. Fit a 10mm compression fitting to the valve using PTFE tape.



142. Fit the regulator handle as shown.

143. Fit the safety valve to the bush at the front of the firebox on top of the boiler. Use a steel adaptor ferrule with PTFE tape - tighten into the boiler with a 22mm spanner, then screw the valve itself onto the ferrule, tighening with a spanner. When viewed from above, the exhaust vent should point to 10 o'clock as shown. Once correctly

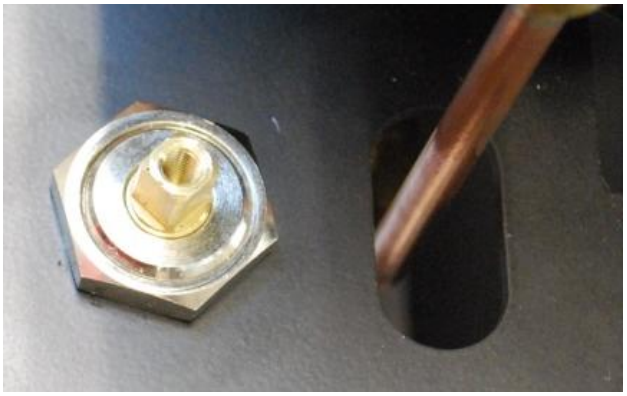




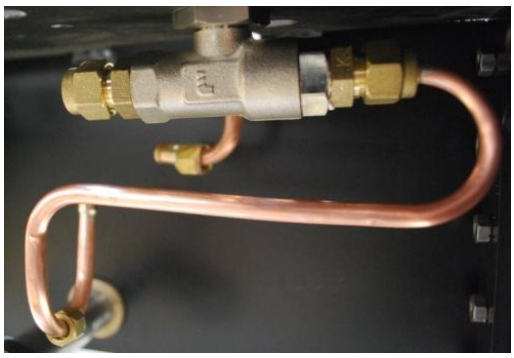
kit b

positioned, fit the chimney as shown.

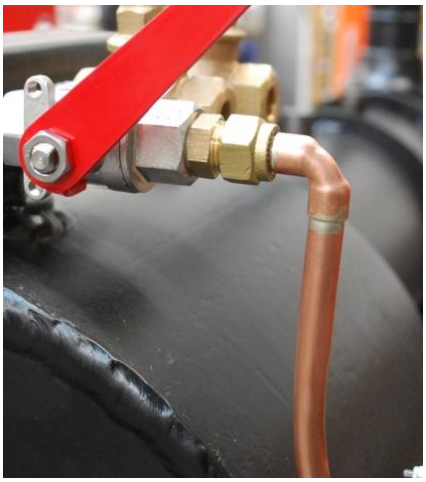
144. Fit 8mm unions to either side of the injector water valves using PTFE tape. Remove the handle and nut from the top of the water valve and insert into the holes in either footplate next to the slot for the injector feed pipe. Position the valve in line with the chassis, larger diameter part towards the rear and tighten up the retaining nut. Replace the handle.

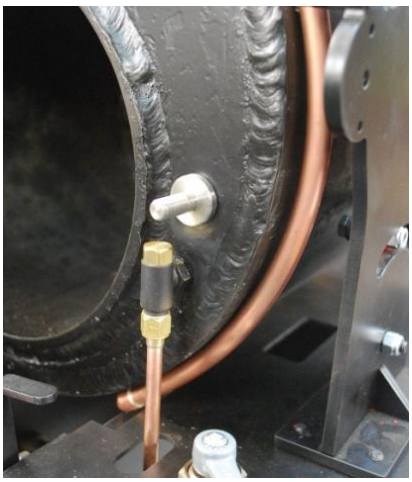


145. Fit the water valve to injector pipe as shown to each water valve.

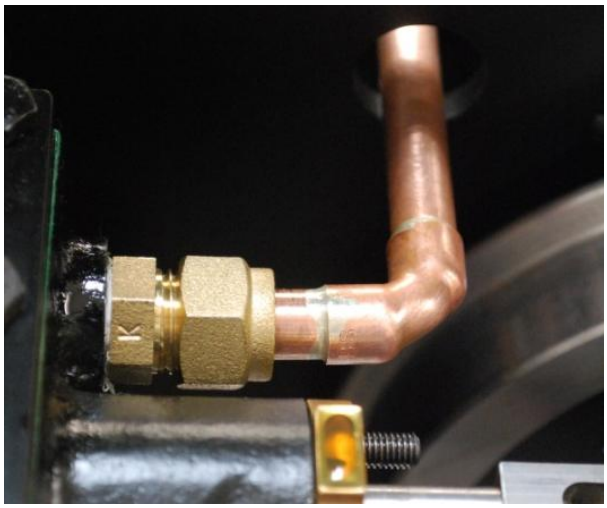


146. Fit the main steam pipe by sliding it through the U-shaped staple welded to the bottom of the boiler - push it through until the front end is near the cylinders, running inside the frames above the horizontal stretcher. The rear part curves around the outer firebox and joins up with the regulator valve at its compression fitting. Nip up this fitting finger tight at this stage to hold the pipe in place.

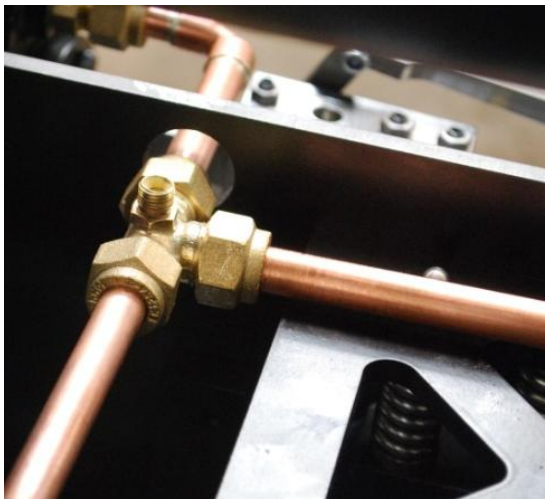




147. Fit 10mm unions to each valve chest using PTFE as shown. Fit the left hand steam pipe (longer one) into its union in the left hand valve chest, right hand (shorter one) to the right hand steam chest.

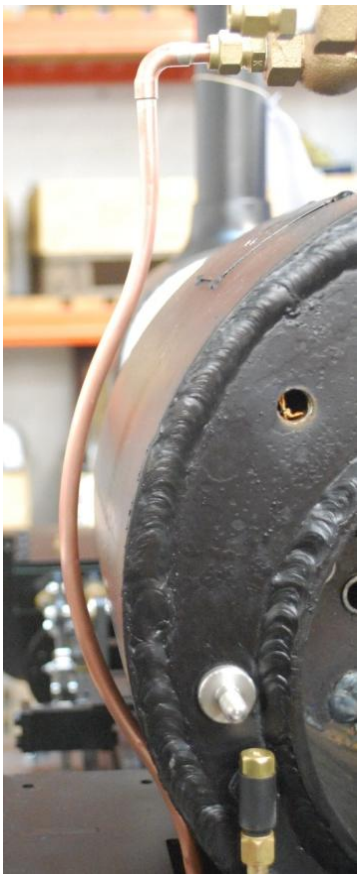


148. Fit the 10mm equal tee to connects all three steam pipes - the threaded lubricator union faces upwards. Once satisfied with the positions of all pipes, tighten all compression fittings using a pair of 18mm spanners.

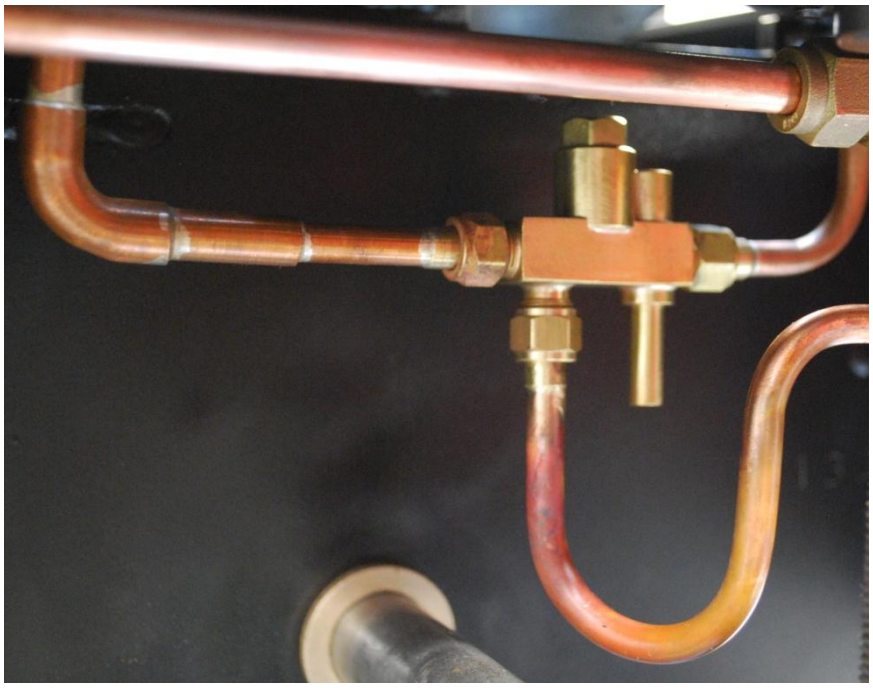


149. Attach an 8mm compression union to each steam valve with PTFE tape.

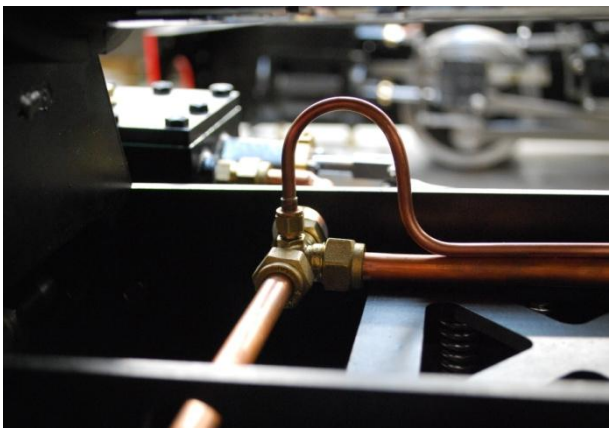
150. Attach the injector steam pipe to its valve on the fountain, threading it through the cutout in the footplate as shown. The end beneath the footplate points rearwards.

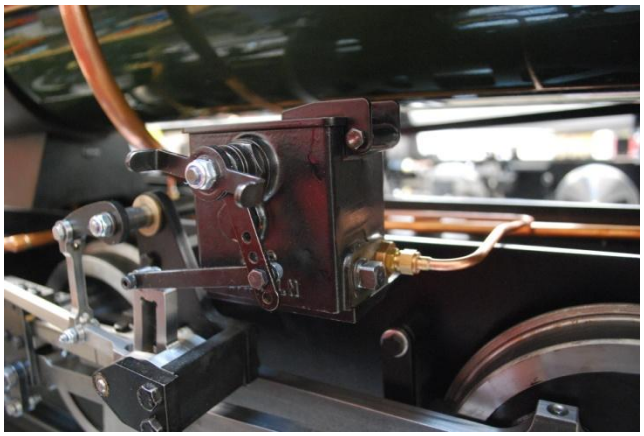


Fit the injector as shown - the one in the picture is the left hand injector, connections are water feed at the bottom, steam feed from the left, water delivery to boiler on the right.

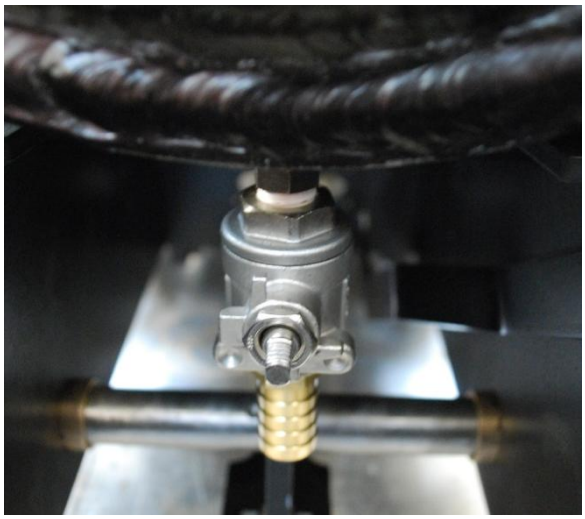


151. Fit the lubricator feed pipe, connecting the lubricator to the steam tee union as shown.





152. Fit a ¼ BSP union using PTFE tape to the blowdown valve bush underneath the boiler as shown. screw on the blowdown valve after first removing its handle and tighten up - ensure that the valve spindle faces rearwards. Refit to the spindle, tighten its nut and fit a 15mm hose adaptor to the bottom of the valve - this allows you to fill the boiler easily without disturbing any of the fittings.



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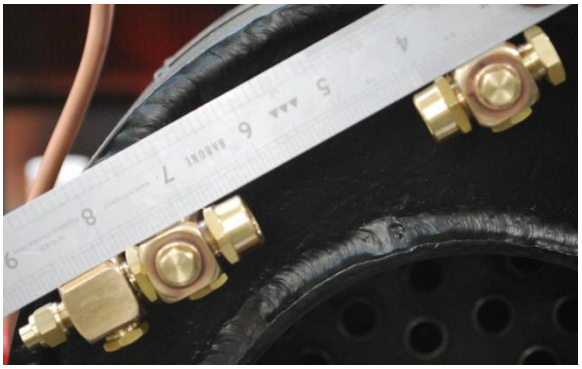
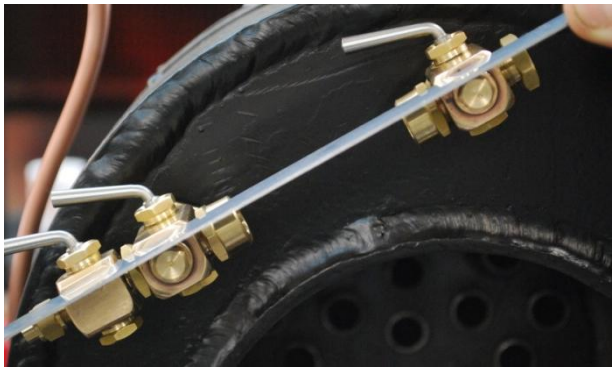
153. Screw the upper water gauge fitting into the backhead as shown using PTFE tape. Repeat for the bottom fitting.

Adjust until both fittings are exactly in line with each other, ensure that both are positioned the same distance from the backhead.

Misalignment here will cause problems with broken gauge glasses later.

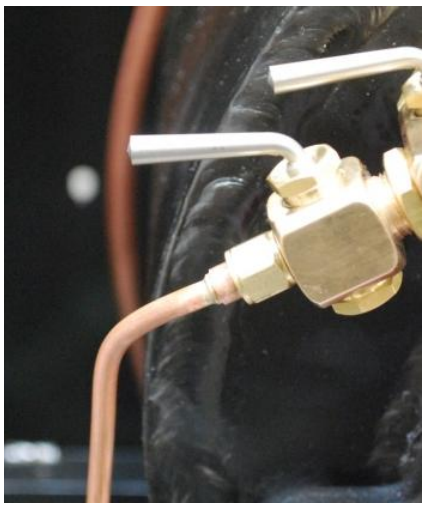
Once satisfied with the position, tighten the locknuts to fix in position.



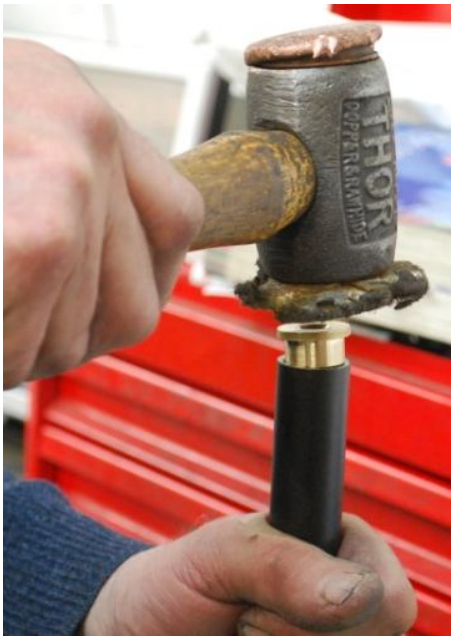


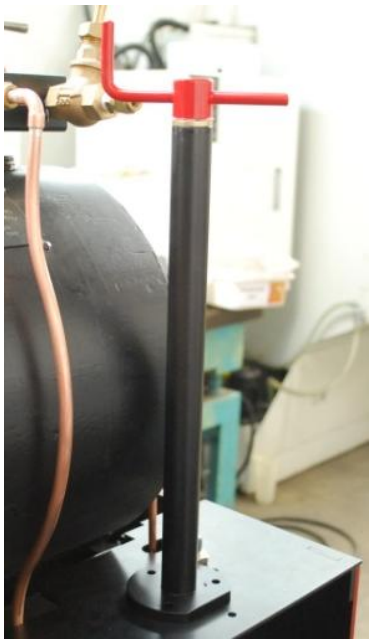
154. Remove the plug from the top gauge fitting and fit gauge glass as shown, using two O-rings each end to seal it in the gland nut. Do up the union nuts hand tight only, over tightening with a spanner will break the glass. Refit the top plug.

155. Fit the water gauge blow down pipe as shown - bottom end goes through a small hole in the left hand footplate, next to the injector water valve.



156. Fit a bush into the top of the brake column as shown - ideally you would press it in, but it can also be tapped in gently with a soft hammer (although preferably not at quite such a jaunty angle as our photographer appears to have captured).



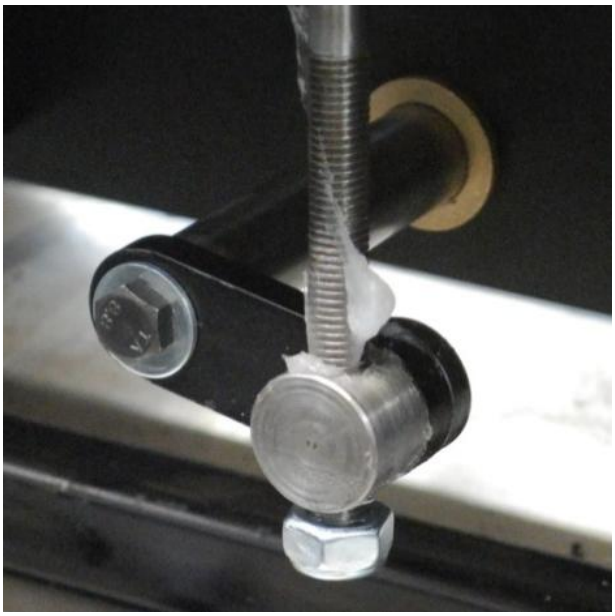


Put a smear of grease on top of the brake screw where it's soldered into the handle and fit it into the bush, wind it round a few times to make sure it runs smoothly and the grease is spread around.

bolt the assembled brake stand to the left hand footplate using three M6 x 20 bolts - flat side of the mounting flange faces outside edge of the footplate as shown.

157. Slide the brake screw retaining collar up the brake screw from beneath, push it up to the footplate and fix with an M6 x 10 grub screw - leave a bit of clearance otherwise the brake will be stiff to operate.

158. Apply a liberal smear of grease to the brake screw as shown and thread into the brake nut far enough so that an M10 nyloc nut can be fitted on the end to stop the brake being unscrewed off its nut in use. Grease the rear face of the brake nut and one face of its thick washer and assemble with an M6 x 12mm bolt. Check that the brake nut can slide in its slot when the retaining bolt is fully tightened.



Vacuum brake equipment (optional)

Instructions for fitting vacuum brake equipment are on the website.

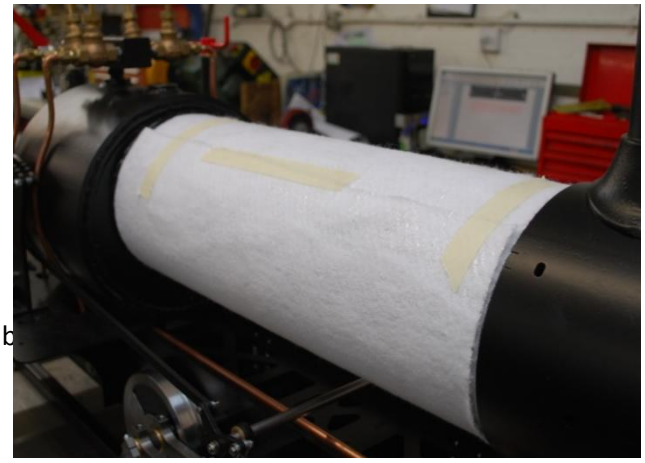
Stage 12

Qty	Description	Part Number
1	boiler lagging 1300mm long	N/A
1	boiler cladding top	10650
1	boiler cladding bottom	10651
2	cylinder cladding	10266
1	left hand cab sheet	10270
1	right hand cab sheet	10269
2	works plate	10271
1	cab sheet brace piece	10458
1	right hand (pressure) gauge bracket	10660
2	angle (mounting) bracket	10562
1	saddle tank	10250
1	saddle tank lid	10417
1	steam to smokebox blower pipe	10217
2	saddle tank to water valve pipe	
1	balance pipe	10442
1	pressure gauge	N/A
1	pressure gauge pipe	10448
1	centre footplate	10664

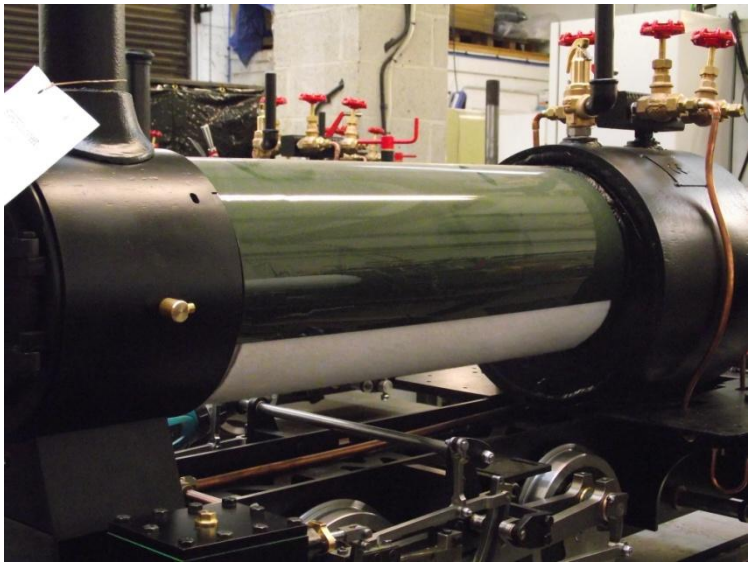
Qty	Description
2	plastic spacer
1	rubber grommet
10	M3 x 5mm button head
4	M3 x 12mm button head
4	M3 nyloc nut
14	M6 x 12mm hex head
4	M6 x 16mm hex head
2	M6 x 20mm hex head
2	M6 nut
19	M6 washer

- **To avoid damaging the paintwork, it's much easier to have a helper when fitting the saddle tank**

159. Wrap lagging material around the boiler - cut it to the correct width, allowing a 10mm gap at each end. We supply a 1300mm length, which will wrap around the boiler completely a couple of times - hold it in place with some masking tape.

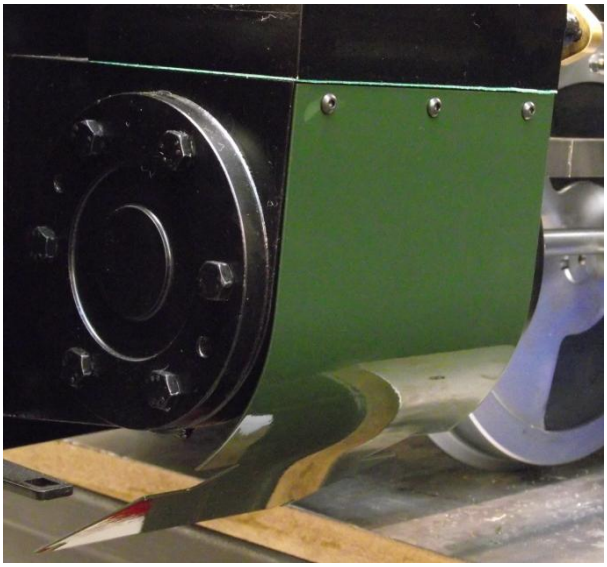


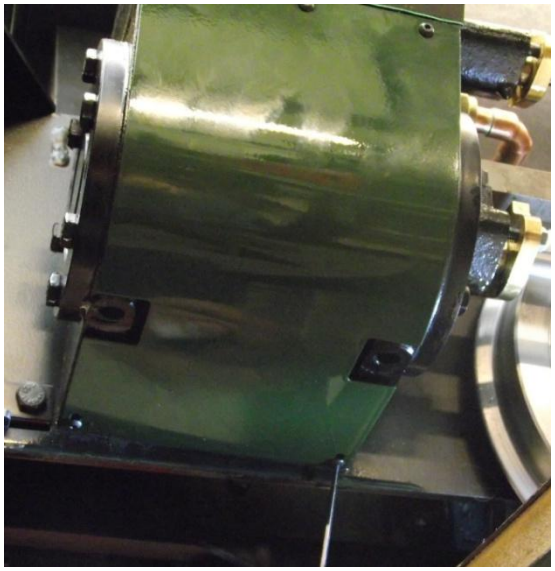
160. Fit the top cladding sheet (without holes) on top of the boiler, bottom cladding sheet (with fastening holes) to the bottom - bottom sheet fits over top sheet on both sides.



161. Temporarily hold the two sheets tightly together, ensuring that the ends of square to the smokebox and tubeplate - you can use ratchet straps to do this, or a helper can hold top and bottom. Drill through the fastening holes in the bottom sheet straight through the top sheet with a 3.2mm drill - **don't drill into the boiler, if in doubt, fix a stop collar on the drill so that it can only penetrate a short distance**. Fix the two cladding sheets together with 4mm self-tapping screws.

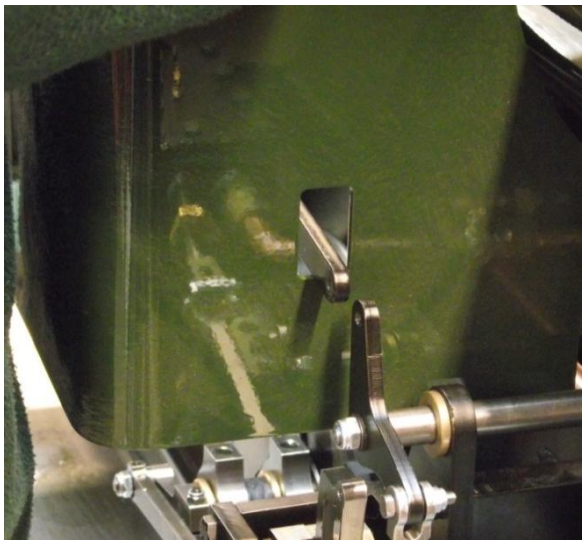
162. Fit the cylinder cladding sheets using M3 x 5mm button head screws, tighten with a 2mm allen key. It's easiest to fix the bottom two screws loosely first, then the three at the top just below the valve chest before tightening all of them.

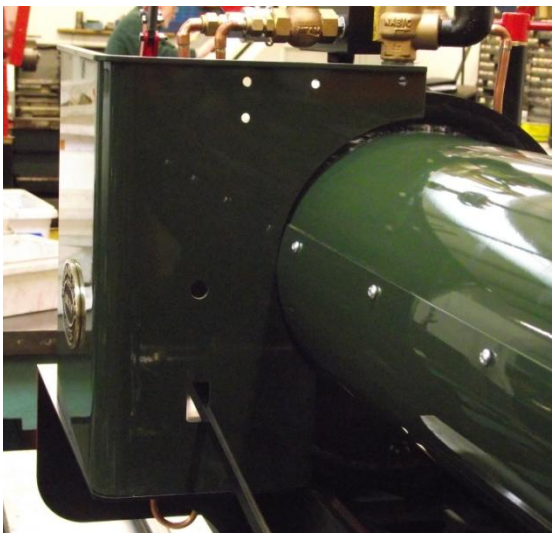


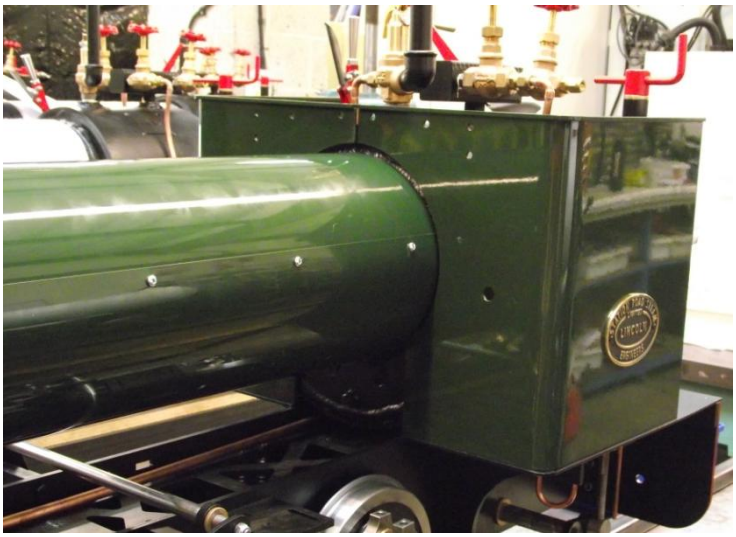


163. Clean up the back of the cast brass works plates with emery paper before fixing to the cab sheets to avoid damaging paintwork. Fix with M3 x 12 button head screws, nyloc nuts on the inside.

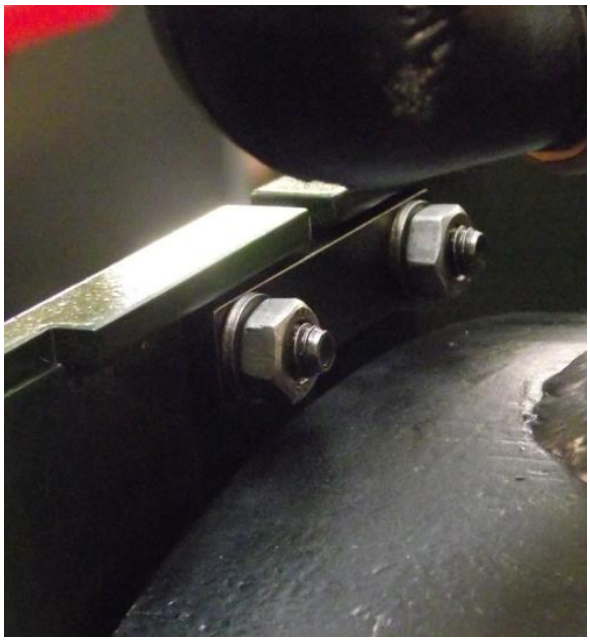
164. Attach left and righ hand cabsheets to their respective footplates using five M6 x 12 bolts with washers fitted from underneath - fit finger tight at this stage. To fit the right hand cab sheet, you will need to remove and refit the reach rod which was temporarily fitted when setting up the valve gear earlier.



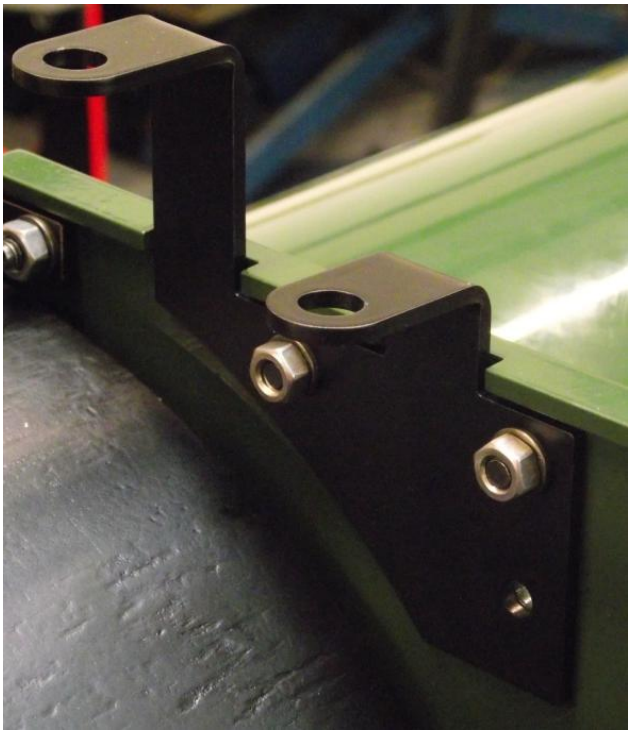




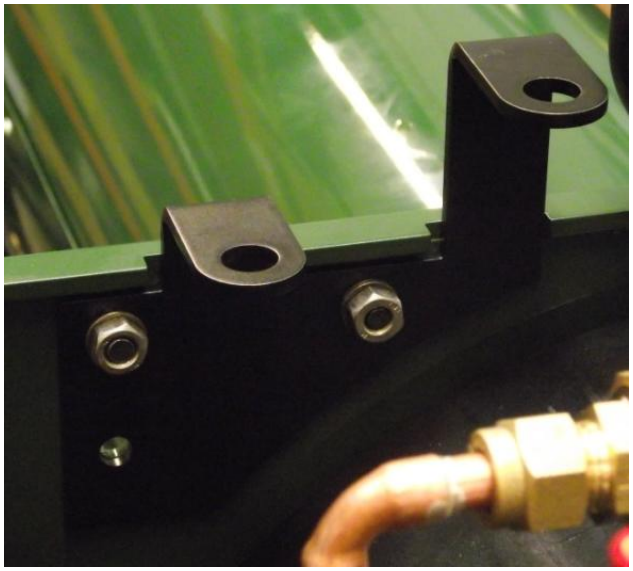
165. Join the two cab sheets with brace piece in front of the safety valve, fix with M6 x 16mm bolts with a washer and nut inside the cab. Tighten nuts and all footplate bolts.



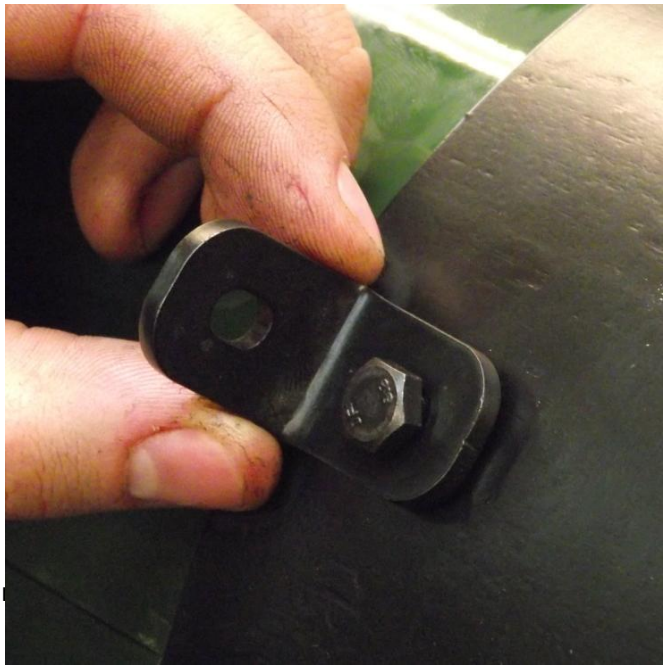
166. Fit the gauge bracket to the right hand side, inside the cab sheet as shown using M6 x 12 bolts, washers and nuts.



167. If fitting a whistle, bolt its bracket to the left hand cab sheet as shown.



168. Fit two saddle tank brackets to the smokebox with M6 a 16 bolts and nuts - don't tighten at this stage.



169. Fit an M6 x 20 bolt through the third (bottom) hole in the gauge bracket on the right hand side and fit a plastic tank spacer as shown, put a plastic tank spacer on the end. Repeat for the left hand cab sheet.

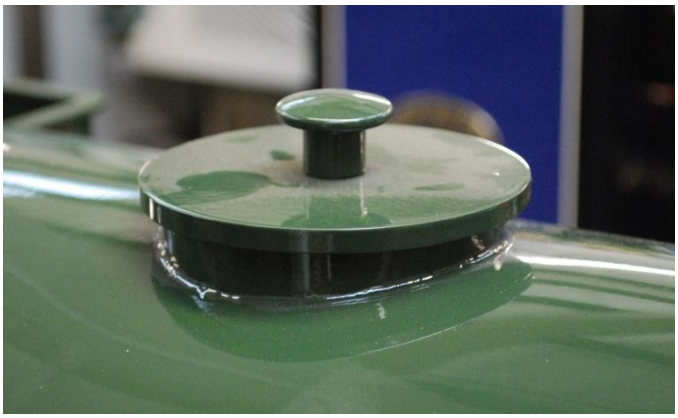
170. The important thing to remember when fitting the saddle tank it to get it the right way around! You can't go wrong, the mounting bushes at each end are at different spacings - find the end that matches the pair of angle brackets already fitted and you've got it.

It's handy to have a helper at this stage to hold the tank while you screw in the rear bolts (making sure the spacers don't fall off), then fitting M6 x 12mm bolts at the front, fixing the angle brackets to the tank - don't tighten at this stage.

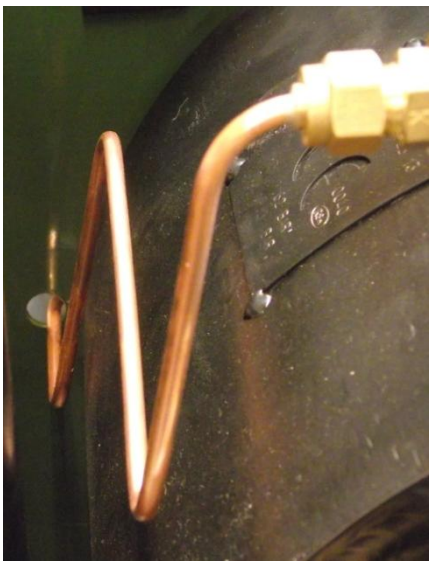
It's important to tighten the bolts in the correct order: make sure angle brackets are sitting flat on the smokebox, then tighten the bolts fixing brackets to tank. Now tighten rear tank bolts, then finally tighten the bolts fixing angle brackets to smokebox.

Notice that the tank is fixed to the smokebox, which is fixed to the chassis - and so are the cab sheets. As the boiler gets hot it will expand (remember we talked about this when fitting the boiler), but by allowing it to slide underneath the saddle tank as it expands backwards, we don't stress the tank itself (and remember, a stressed tank is a leaky tank...).

171. Fit the saddle tank lid as shown. Got to be the easiest bit of the entire build.

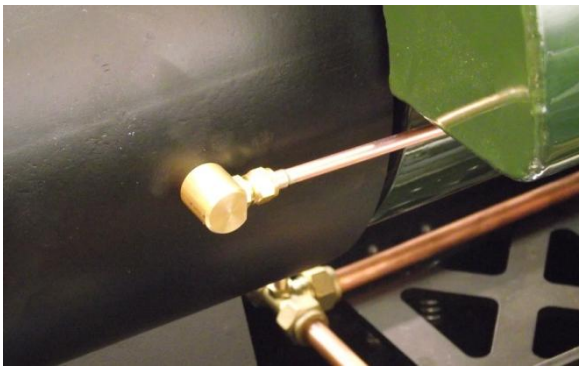


While I'm thinking about it, a quick note on tank lids. We don't normally have a problem with them falling off, however one customer drove home in exuberant style with his new Stafford on a small and rather lively trailer - en-route home the lid flew up in the air before bouncing down the side of the tank, taking a couple of dings out of the paintwork. Ever since, we've always transported engines with the tank lid wrapped in a rag and put down the side of the cab sheet, behind the brake column.

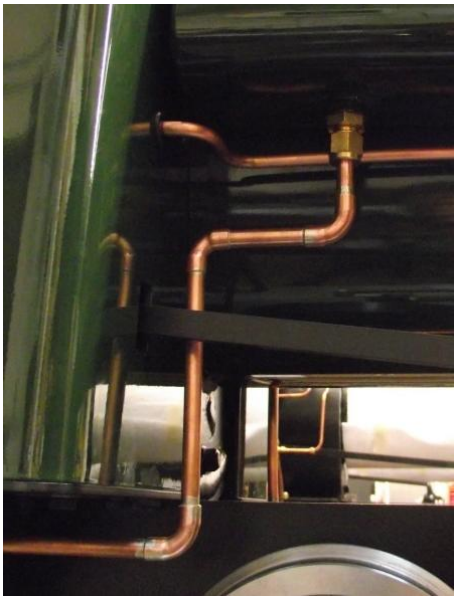


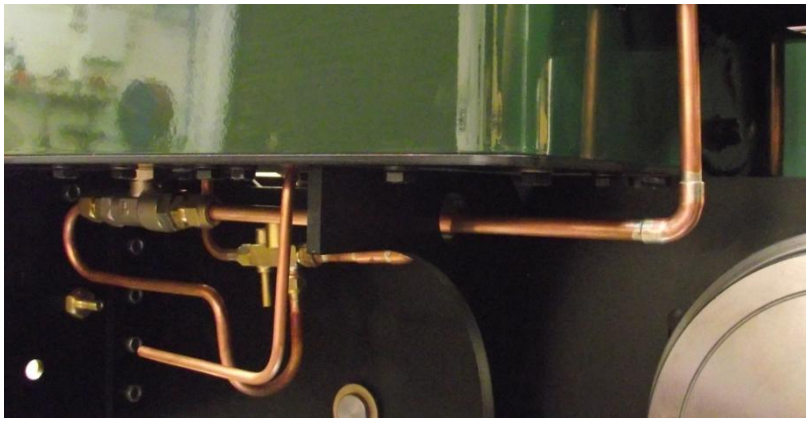
172. Temporarily remove the left hand injector steam pipe - it makes fitting the blower pipe easier. Thread the blower pipe through the hole in the front of the left hand cab sheet and attach one end to the rear steam valve on the left hand side of the fountain, the other end to the fitting already installed in the smokebox. Cut a rubber grommet down the side and fit it around the pipe where it passes through the cab sheet.

Reattach the steam feed to injector pipe to the fountain.

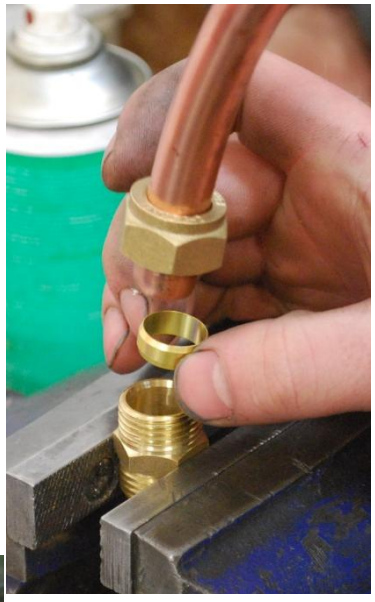


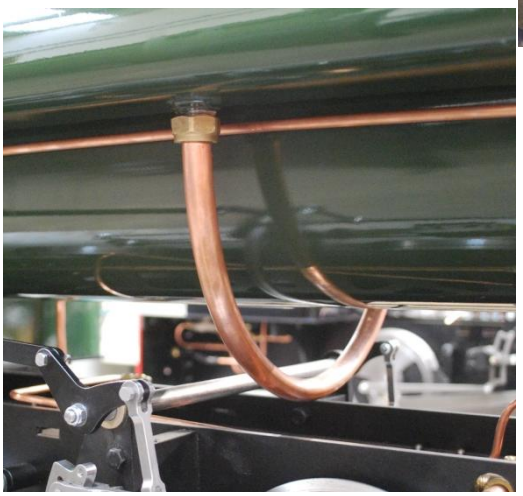
173. Fit the saddle tank to the left hand injector water valve pipe as shown, passing behind the reach rod and through the large hole in the cab support plate. The side of the pipe which should be inserted into the water valve is the end on the longer shaft following the 90 degree bend. Repeat for the right hand side (where there's no reach rod to complicate things).





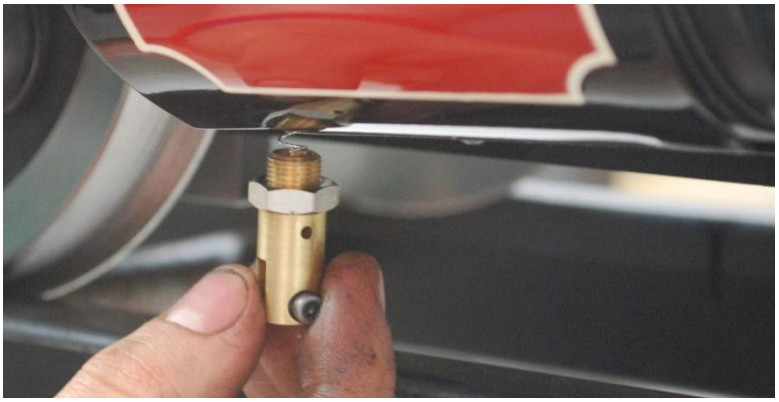
174. Push one end of the saddle tank balance pipe into a straight coupling held in the vice, tighten the union nut which will crush the brass olive making a watertight joint - check that the oilve can't rotate on the pipe, if it can you haven't done it up tight enough. Repeat for the other end, you now have a balance pipe with two permanently fitted union nuts and olives - throw the centre part of the coupling away, it's not needed. Fit the balance pipe to the tank as shown.



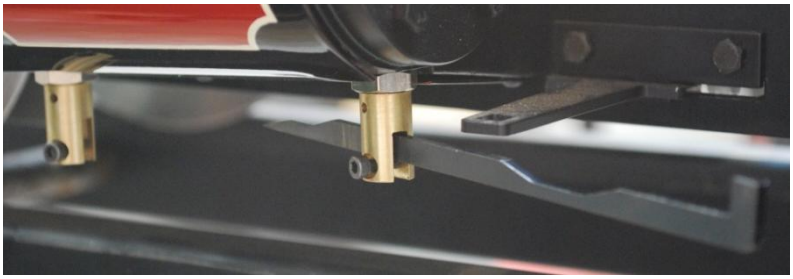


175. Fit the pressure gauge to its bracket and connect to the fountain as shown.

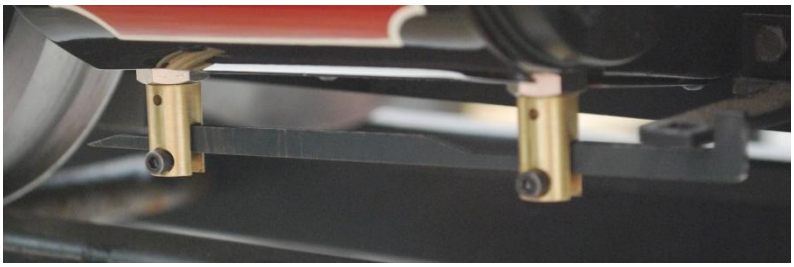
176. **Note that this sequence of pictures show the right hand cylinder.**



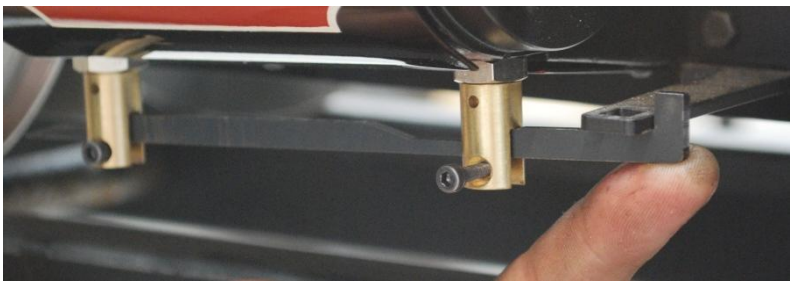
Fit two drain cocks to each cylinder - make sure the dowel, ball and spring are in position - then screw in. Before they are fully tight, make



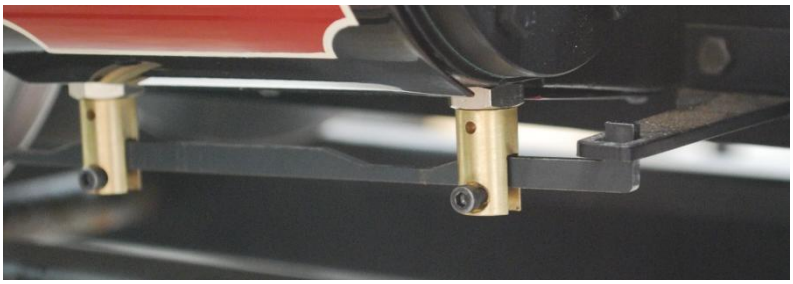
sure that the slots line up between the two and the cap head screws face outwards as shown.

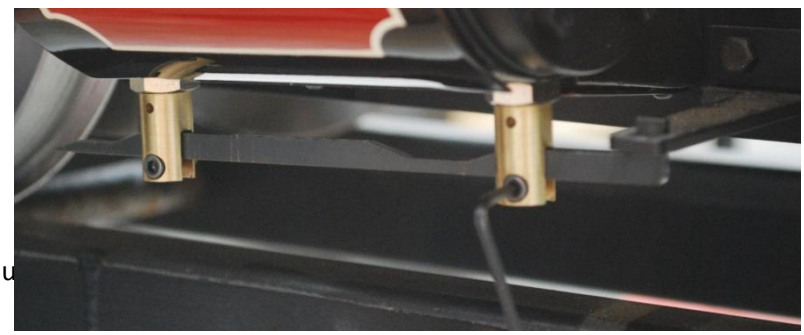


Slide the drain cock operating bar, pointed end first, through the slot in both drain cocks - tag on the end faces upwards to engage with the drain cock cross shaft.



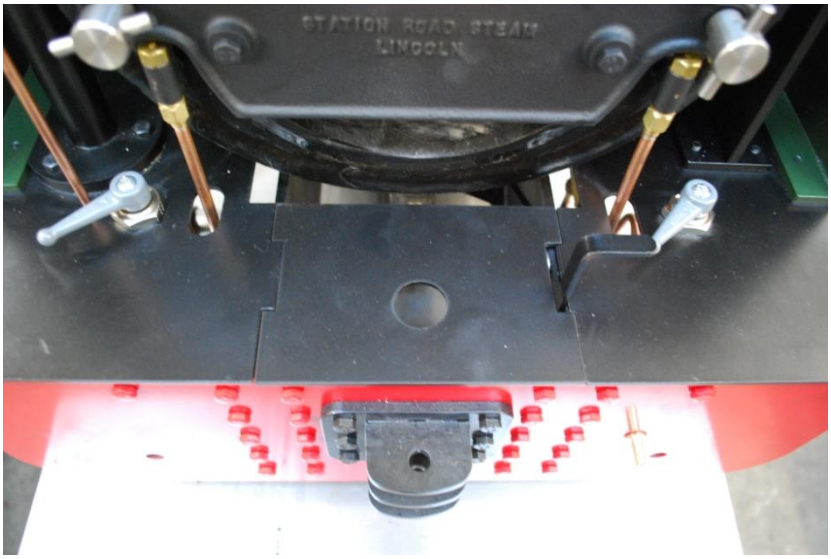
Undo the M3 cap head screw from the front drain cock whilst holding the bar up to stop the dowel dropping out. Let it drop down slightly to enable its tag to fit in the square window in the cross shaft, then refit the M3 screw.





177. Pull the drain cock operating bar away from the chassis to ensure that the drain cocks are held in line and tighten their lock nuts (9/16 A/F spanner) - check that the drain cocks operate freely, they should require next to no force to pull the handle at the footplate end.

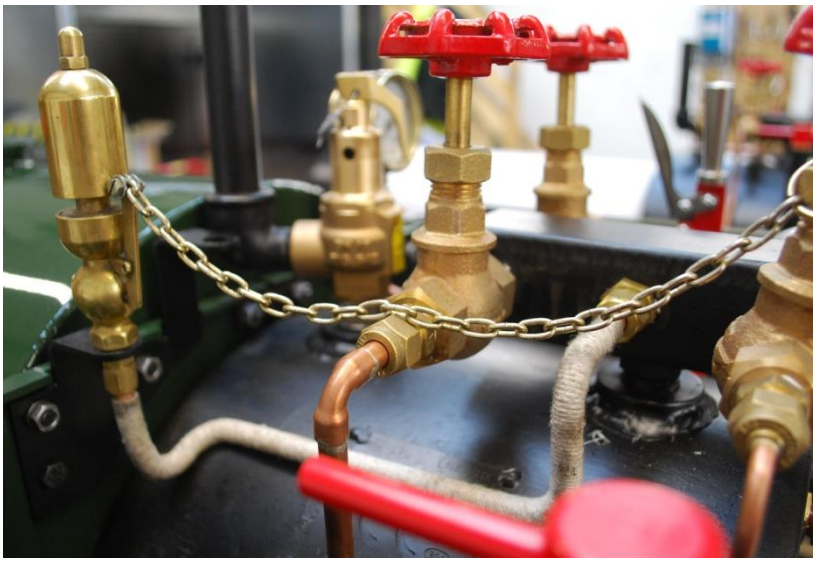
178. Fit the centre footplate, wide slot to the right as shown.



Whistle (optional)

Qty	Description	Part Number
1	Whistle	N/A
1	Whistle to steam pipe	10454

179. Fit the whistle to the left hand arm on the bracket mounted at the front of the left hand cab sheet, connecting it to the fountain as shown.



End of assembly

You should have something that looks like this sitting on the bench now (there will be detail differences, but if you've got more wheels or fewer chimneys, give us a call)

Next steps

- Check that all nuts and bolts are tight (remember the motion pins need a quarter turn of free play, otherwise the motionwork will bind up)

- Check that the engine rolls along freely - if anything binds or locks up, stop at this point an investigate

- Fill the saddle tank and check for water leaks - make sure that injector water valve work and water appears at the injector overflows when they're turned on

- Refer to the operator's handbook for the engine for information on first steaming and driving the engine

Document update log			
Version	**Date**	**Author**	**Revision**
v1.0.0	20-5-2013	SRS	Initial version
v1.0.1	3-6-2013	MP	Format changes
v1.0.2	17-4-2014	MP/JM	Updated contents Revised hornblock setting procedure