S102

ROBERT STEPHENSON & HAWTHORNS
14in 0-4-OST

Some industrial locomotive designs were so successful that they continued in production for decades. This was certainly true of the products of the Forth Banks Works in Newcastle-upon-Tyne. Robert Stephenson & Hawthorns built large numbers of these saddle tanks, which were a direct descendent of the tried and tested 14in 0-4-0ST design introduced by their predecessors, R&W Hawthorn Leslie Ltd, in the early years of the century.

Renowned for their quality and reliability, these powerful engines could be found at power stations, gas works, collieries, quarries, engineering works and many other industrial locations all over Britain. A considerable number were built for export, especially to Commonwealth countries. A livery of light or mid-green, elaborately lined out, seems to have been the most common but there were others. The Hawthorn Leslies at Marston's brewery in Burton-onTrent, for instance, were painted a most attractive navy blue, with straw-and-orange lining and vermilion buffer beams.

The Hawthorn Leslie design had a different cab to that used on the later engines. Otherwise, the main visible differences between the RSH and Hawthorn Leslie versions are the smokebox front, buffers and sandboxes, although early RSH engines were to all intents and purposes Hawthorn Leslies under a different name- There was no exact cut-off point and the modifications were introduced gradualy. Later RSH engines were four inches longer than the original design and had a different arrangement of dome and filler cap, as depicted in the High Level kit. In spite of the large numbers that were built, most of these engines were delivered ex-works with only minor variations in detail, usually in response to customer specification. Owing to their long lifespan and the interchangeability of parts, however, many modifications were made in the course of subsequent repairs and overhauls. Hybrid 'bitzers' (bits of this, bits of that) became commonplace. The study of photographs is recommended to clarify specific points of detail on particular locomotives.

The kit is based on 1954-built RSH 7796 from Stella power station, which is now preserved on the Tanfield Railway in County Durham. It includes alternative Hawthorn Leslie smokebox front, buffers and sandboxes to enable earlier or hybrid versions to be constructed if required. The diagrams, however, show the later RSH design with the appropriate fittings.

AddItional parts requlred
Mashima 1220 or 1224 motor, with flywheel to choice - the 1220 gives a higher maximum speed, the 1224 is more powerful. With 108:1 gearing, the effect of a flywheel is minimal.
Sharman 3ft 6in, 10-spoke wheels (ref S62)
Couplings, pick-ups and hornblocks

GENRAL NOTES ON CONSTRUCTION

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

Leave the parts in the fret until they are required for use. This will protect them and makes identification simpler. Small holes can be drilled more easily while the parts are still attached. Where an accurate hole size is specified, holes are etched undersized so they can be drilled or reamed out to the correct diameter.

Except where you have a visible outside edge, such as on a cab side, it is advisable not to file off the cusp around the edges of components, especially with dimensionally-critical parts such as formers and spacers. The slight alteration to their dimensions could be enough to affect the way they integrate with other parts.

AII fold lines are etched on the inside of the bends. Check all right angles with a square. When soldering parts in place, tack-solder first in one spot only and then check that everything is as it should be before final soldering along the joint. Moving a part that isn’t aligned correctly can be difficult if it has been tack-soldered at more than one point.

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

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

The alternative Hawthorn Leslie-pattern components (smokebox front, buffers and sandboxes) are identified in the instructions but are not numbered separately. Simply substitute these as required for RSH fittings. Some engines had a mixture of different styles (odd sandboxes etc).

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

As always, plan ahead and think through every move before soldering parts together. If you are patient and careful, you will find that building this scale model locomotive becomes an immensely rewarding experience.

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

ASSEMBLING THE BODY

Remove the axle washers from the footplate (1) and store them (the small fold-up tab on the right-hand side of the footplate is for the reverser reach rod and should not be removed). Lightly oil the thread of an M2 bolt and push it through the hole at the front of the footplate. Screw the nut up tight and solder it to the top of the footplate (the oil will stop solder reaching the thread). Remove the bolt. Bend the firebox former (X) up through 90 degrees.

Anneal the firebox (2) until it looks like beaten silver. You can do this on the hot plate of your cooker, over a gas flame or even with a resistance soldering unit (but don't crank it up too far or you will punch a hole clean through the brass). Bend it to shape around a suitable rod so that it clips neatly around the firebox former, flush with its rear face. The small hole in the firebox is to the rear. Solder the two tabs that project beneath the footplate, check that all is square and then solder the firebox to the former from the inside. Trim off the tabs.

Drill or ream out the holes in the bunker frame (3) to the sizes shown in Fig 11, and then bend it to shape (all etched fold lines are on the inside). Start with the outermost sections, move inwards and finish with the bunker lids, which are a prototypically bad fit. Form the curve in the left-hand bunker around a rod or drill bit of approximately 3/16th in diameter. Detail and fit the reverser (4) - a pin through the bottom pivot locates the reverser on the bunker. Solder the water handles (5) in place; note that these are right and left-handed. The bunker frame sits right down on the footplate - try it in place and if necessary clean out the corners of the location tabs with a needle file. When all is well, solder the tabs into the slots in the footplate.

Along the top edge of each cab side (6) is a narrow outer strip (shown shaded on the fret diagram) which is used to position the bends. Without cutting these off, or separating the two sides from each other, remove the cab sides from the etch in one piece. Place this assembly in a vice as in Fig 4, clamped up with two packing pieces of hardwood (lolly sticks are fine) to prevent the jaws of the vice marking the metal or damaging the beading. Align the outer strips so that the forward edge lines up with the top of the jaws and the hardwood packing pieces. After checking everything is level, take another piece of wood and use it to make the first bend (the bunker front), doing both cabs simultaneously.

Move the whole assembly up in the vice so that the notch in the alignment strip is level with the top of the jaws, and then make the second bend (the cab front). Remove the cab sides from the vice, tweak if necessary with flat-nosed pliers, and then separate them. Before cutting off the alignment strips, solder a

length of 0.7mm wire along the inside top edge of each cab side to act as a strengthener. Now you can solder the cab sides to the bunker frame and the footplate.

Fold up the bunker coal shute (7) as shown in the diagram. To obtain the correct profile, bend it until it fits the slots on the underside of the footplate. Check for fit but do not solder in position yet. With the shute temporarily in place, try the cab front (8) in position - it should fit snugly between the shute and the front faces of the cab corners. When everything fits, solder in the cab front, followed by the coal shute. This should align with the front of the bunkers so the saddle tank will be a snug fit; file flush if necessary.

Saddle Tank assembly

Study Figs 2-4 before beginning work. Remove the saddle tank frame (9) from the fret and place it face down on a flat surface, with the bend lines facing upwards- Hold down area A with a piece of wood held up against the bend line and gently bend area B up through 90 degrees. Repeat this process for both inside faces and then bend up the ends (C). Check that everything is square. Use your piece of wood to hold the ends in position while you solder the small pips on B to the outer ends of the frame. Trim off flush.

Remove the tank wrapper (10) from the fret, complete with the alignment strips/bending guides along the edge. Set it up in the vice in the same way as you bent up the cab sides. Bend the whole lot over at once, exerting equal pressure along the length of the tank, but hold the piece of wood you are using to apply pressure approximately 1mm above the packing pieces, opposite the fully etched area. If it is touching the packing pieces, the radius of the curve will be too sharp. Remove the wrapper from the vice and then, using flat-nosed pliers, gently tweak the bends so that they are just over 90 degrees. Remove the alignment strips.

Now you can anneal the saddle tank wrapper before bending the main radius. After annealing, the large top radius can be formed by placing the wrapper on an open phone book and rolling a steel bar of about 8mm diameter over it while exerting constant downward pressure. Use smaller diameter bars to get in near the corners - The metal can be re-annealed if work hardening occurs. Try to get the wrapper as near as possible to its final shape before fitting, rather than relying on the frame to pull it into shape. Before fitting it to the frame, run a straight edge along the length of the wrapper to check for bowing. Finger pressure should be enough to correct any kinks.

When you are happy with the shape of the wrapper, spring it on over the top of the frame. It should be a tight fit but not so tight that you need to use force. Try springing the wrapper out slightly if you have trouble. Make sure the wrapper is the right way round. Curve the very ends of the wrapper so they blend into the small inside radii (R) next to the smokebox - this gives the illusion of a separate saddle tank sitting on top of the (largely imaginary) boiler.

When the wrapper is in position, check that everything is centred correctly and then solder it to the frame, one end at a time. Work on a flat, smooth surface - the thin metal will be comparatively soft after the annealing process and if you can wait a couple of days for it to harden off, you will be less likely to induce any accidental dents or buckles. Use a piece of wood to hold it as you tack solder it in place, first in the centre and then at the outer edgesMake sure the flats on the underside at the front end are soldered tight up against the edge of the former . the rear edge is not so critical as it cannot be seen on the assembled model. Do not put any pressure on the centre of the tank as this may cause distortion.

Carefully file off any excess material along the sides and bottom and dress the curves on the saddle tank with emery paper. Drill or ream out the holes for the tank fittings. Push a length of 1.6mm OD tube as far as it will go into each of the balance pipe holes and solder in place. Use the filing guide to trim the protruding sections to length and deburr by finger-twisting a drill bit of around 1/8in diameter in the ends. These tubes will act as locators when the time comes for the balance pipe to be fitted. Complete the assembly of the saddle tank by soldering in place the injectors (11x2, pre-drilled 0.5mm) and the footsteps (12x2).

FIttIng the saddle tank

Bend up the smokebox (13) and solder it to the saddle tank, making sure it is flush at the front. Check that the smokebox tabs will locate comfortably in the footplate slots. Although they will not be fitted until later, check that the front sandboxes (44x2) sit nice and flat in their holes on the footplate and open up and deburr the latter if necessary - it will be difficult to get at the holes when the tank is in position. Remove all protrusions from the underside of the footplate and then, placing it on a flat surface, set up the saddle tank/footplate assembly.

Push an M2 bolt through the hole in the firebox former (X) and through the hole in the rear saddle tank stretcher (Y). Loosely fit a nut to it. Tighten the nut up to the rear inner face of the saddle tank (finger-tight only). Adjust the position of the tank while it is lightly held by the nut. When you are satisfied that it is sitting square and level with the footplate, tack the saddle tank in position. Make a final check that everything is as it should be and solder it along the join lines, being careful not to de-solder the tank assembly.

After removing the M2 nut and bolt, fit the smokebox side overlays (14x2) flush with the smokebox front. If they will not sit flat check, for solder at the smokebox/saddle tank join. Fit the smokebox front overlay (15) choose either RSH or Hawthorn Leslie pattern. For an RSH loco, add the tank mounting brackets (16x2) - the plate with six rivets goes on the smokebox side. Engines with the Hawthorn Leslie-pattern smokebox front did not have these brackets.

Completing the bodywork

As shown in Fig 11, fit the drain cock lever (17) and ashpan damper (18) to the cab floor, followed by the handbrake stanchion (19). Bend the handbrake cut-out cover (20) to shape and fit it to the cab rear (21), after folding out the semi-circular top plate. Trim off any excess material.

Try the cab rear into place, making sure that it is vertical and square. Use a straight edge to check that the cab front and rear are level. Check the fit, especially along the top edge where the sides butt up against to the cab rear. To allow for variations in the way the front bunker may have been formed, the strips over the cab opening have been etched over-length and will need trimming. After making any necessary adjustments, check that the cab rear is still vertical and then solder it at this top anchor point and to the footplate.

Remove the cross bracing from the bunker frame to clear the mechanism. As in Fig 13, fit the reverser linkage (22) using 0.5mm wire as a pivot, and add the injector operating rods (23x2).They fit the notches in the bunker fronts.

Soldering from the inside face, fit the valances (24x2) to the footplate, ensuring the cutaways are on the inside, at the lower edge of the valance. Make sure the footplate is flat while you are doing this. Solder at one end first, check for distortion and then solder the other end. Repeat with the second valance. Check that the footplate is still level, that the valances are straight and that there are no gaps between valances and footplate. When satisfied, run a fillet of solder along the inside.

Layer the front and rear bufferbeams (25x2, 26, 27) noting the differences between the rivets, as shown in the diagram, and tack-solder them in place. The top edges should be almost, but not quite flush with the footplate - no more than a hair's breadth above it. The ribs on the inside face of the buffer beams are strengtheners and should not be used for alignment When satisfied that they are correctly aligned and at the right height, run a good fillet of solder along the join and especially where they butt against the valances. Some of this solder may subsequently need to be ground away to allow clearance for the chassis sideframes.

Fit the buffers (28x4) - choose either RSH or Hawthorn Leslie pattern. Coupling hooks of your choice can be added at this stage but the links (not supplied) are best left until the model has been painted. Solder an M2 nut into the circular recess in the footplate, under the cab. Check that the bolt will go into it. Fold and fit the rear tank supports (29x2).

Bend up and fit the rear step assemblies (30x2, 31x2). Use a length of 0.5mm wire to position them the correct distance from the inside face of the valances. Fit the rivet strips (32) to the steps. Fit all handrails and knobs, opening out the holes if necessary with a tapered broach (see Fig 12). Fit the lamp irons (33, 34) and then bend and fit the whistle mount (35).

Solder or epoxy in place the detail castings for the chimney (36), dome (37), tank filler (38) and safety valve (39). Add the etched safety valve lever (40). Drill the smokebox door (41) and fit the smokebox door handles (42). Leave the front of the handle mounting pin very slightly proud of the door face. Now fit the smokebox door, making sure you position it centrally on the etched flange. Using epoxy instead of solder allows subtle adjustment.

Drill out the clack valves (43) while they are still on the sprue. To represent feedwater pipes, solder 0.5mm wire to the clacks as shown in Figs 12-14. Remove the clacks from the sprue, trim the mounting pegs flush and bend the wire to shape. The feedwater pipes touch the top of the footplate and the rear face of each clack should be in line with the inner vertical face of the saddle tank frame (see F, Fig 2). This allows clearance for the boiler to be fitted into the body at a later stage - the clacks only appear to be touching. Now solder the feedwater pipes to the injectors under the tanks and also at the point where they touch the footplate. Run the injector overflow pipes through the footplate, trim to length and the solder to the injectors and to the footplate. Fit the sandboxes (44x2) - choose either RSH or Hawthorn Leslie pattern.

Open up the holes in the backhead casting (45) to accommodate the various detail fittings shown in Fig 11. Fit the shelf (46) and regulator (47). Make the firebox door handles and regulator pivot from 0.4mm wire. Do not fit the backhead at this stage - wait until it's painted.

ASSEMBLING THE CHASSIS

The chassis can be built either rigid or with simple three-point compensation, which is easy to effect and will greatly improve the running quality of the model. Study Fig 15 before starting.

Form the line of three rivets in the centre of the sideframes (48, 49), but ignore the single half-etched mark above this. If building a compensated chassis, remove the cut-outs for the hornblocks on the front axles. Ream out the axle holes in the frames to accept the 1/8in bearings and solder these in place. Modellers building to 16.5mm gauge should file the rear axle bushes flush with the inside of the frames to allow clearance for the gearbox.

Fit the detail parts (50x2) behind the holes in the frames. In 16.5mm, these will need filing wafer-thin to avoid fouling the gearbox. Assemble the frames using the appropriate spacers (51-4) according to gauge, as in Fig 15. The rear spacer (54) also forms the firebox bottom. Form the rivet detail and gently curve the sides before soldering in place. Check the frames are square and parallel. Grind off excess locating tabs. Fit the ashpan (55) - 00 modellers will need to trim it to width.

Drill out the brake hanger pivot holes in the frames to accept 1.6mm OD tube. Solder short lengths of tube firmly into the holes and then, using the appropriate brake assembly guide (dimension A equates to the chassis width) and file the outer faces of the tubes flush with the guide faces (dimension B). Cut away the excess tube inside the chassis and file flush.

Cut a piece of 1 mm wire to be a tight fit between the frames. Use a short piece of 1 mm wire to layer up the counterweight assembly (56, 57) and trim slightly proud on either side. Drill the counterweight along with the dummy inside motion (58x2) and thread them on to the wire. Solder the motion into the adjacent spacer so the wire sits over the half-etched marker holes immediately above the line of three rivets in the centre of the frames. The bottom edges of the inside motion should be roughly horizontal. Now solder the wire to the frames and motion. The counterweight assembly must be free to rotate at this stage. Solder the valve guide rods (0.5mm wire) into the spacers (52, 53) and trim to length.

Fit the webs (59x2, 60x2, 61x2) to the chassis. Form the rivets in the railguards (62x4) and fit them in place.

Layer up the connecting and coupling rods (63x2, 64x2, 65x2, 66x2) and ream out the holes for crankpin bushes to the sizes shown in Fig 10. The clearance between the crosshead and leading crankpin is limited in P4. To prevent them touching, the rods should be cut as shown and the top hat bush reversed after being filed to length. The top hats on the rear crankpin should also be reversed in P4 so the connecting rod is parallel to the frames.

For a compensated chassis, assemble your chosen hornblocks (not supplied) according to the manufacturer's instructions. Use the coupling rods in conjunction with axle jigs to position the hornblocks. To set the front axle pivot - and thus the correct ride height of the front end - open out the hole in the front spacer so you can push a length of 1.5mm brass rod through. Loosely fit the wheels (there is no need to gauge or quarter them at this stage) and place the chassis on a sheet of plate glass. Pack or chock the front end until the top of the chassis is dead level. Gently tweak the rod until it rests on the front axle and then solder it in place against the spacer. Leave the wheelsets in the chassis for the time being - put “Vaseline” or something similar on the treads to protect them from flux.

Open up the holes in the cylinder saddle (67). Before forming it to shape, modellers in EM and P4 will need to file away an appropriate amount of the half-etched areas to allow for the different frame width. Now fold the cylinder saddle, slide into position in the chassis and check that it sits correctly. Secure it in place with 14BA nuts and bolts. The cylinders will be assembled in situ on the chassis but are fully removable at any stage, even when the model is complete.

Boiler assembly

The boiler is also removable and simply clips into place on the chassis (Fig 19). Only the bottom half of the boiler is modelled. Having it as part of the chassis rather than built into the bodywork enables you to fit a comparativety large can motor and a high-reduction gearbox into a very small locomotive, without any of the mechanism being visible.

Form the rivets on the appropriate firebox/rear boiler mounting (68) for the gauge to which you are building the loco. Carefully bend the boiler (69) to shape so that it exactly matches the front boiler mounting (70) - it is worth spending some time doing this as the fit of the boiler is vital when the various sub-assemblies come together. The motor and the rear part of the gearbox fit inside the boiler and there is very little clearance at the rear end.

Solder the boiler to the mountings. The outer face of the boiler sits on the larger radius of the front mounting. File off the surplus lug at the rear.

Try the assembly in position, with the front mounting locating in the rear slot in the cylinder saddle and the lugs on the rear mounting in their slots on top of the chassis. Now remove the boiler and offer it up to the body. The boiler should fit snugly between the inner edges of the saddle tank.

The accuracy of the fit depends on the accurate forming and positioning of a number of components that are already in place. Do not try and force the boiler home. Instead, check that it is not fouling on something that may be slightly awry. A gentle tweak of the boiler (especially along the top edges) will remedy any slight misalignments. There should be no need to file anything to get the boiler to fit.

Once everything fits comfortably, try the boiler on the chassis again and offer the complete assembly up to the body. Do not proceed further until you are satisfied that the various components can readily be fitted and separated.

At this stage, you might like to think ahead to where the pick-ups will located and how they will be wired to the motor. The most straightforward and unobtrusive way of routing the leads is to have them passing inside the boiler and down through the firebox, which will allow the cylinders to be removed if necessary.

Boiler bands, represented by sellotape, can be added now or later, as you prefer. Stick a few inches down on a sheet of glass and cut strips 0.8mm wide. These can be lifted up on the point of a scalpel and manoeuvred into position. There is one band at either end of the boiler and two, equally spaced, in between.

Brakegear assembly

This method of assembly creates a set of brakegear that is fully removable as well as totally prototypical in appearance. If it seems over-elaborate - some of the parts are very small - you can always simplify the arrangements - Do not solder anything until the instructions specifically say so.

The first step is to drill out all brakegear components (71-80) to the sizes shown. Make sure the wires will pass through the holes. Use a piece of 0.5mm wire to locate the handbrake die block sides (71x2) on the handbrake lever (72) - Solder the sides to the rod so they form a right angle. Trim the wire slightly proud at either side.

To represent the cross-shaft, thread a length of 1 mm wire approximately 20mm long through the chassis, the two actuating levers (73x2), the handbrake lever assembly and the steam brake lever (74, notch facing upwards). Fit the detail pieces (75x2) over the ends of this wire, outside the frames, and then solder them in place along with the cross-shaft, making sure the levers are well out of the way. Trim the faces of the shaft slightly proud.

Solder a piece of 0.5mm wire into the brake cylinder (76) and trim so it protrudes by about 3mm. Solder the brake cylinder into the rear spacer (54). Line up the steam brake lever with the cylinder, so the wire sits in the notch, and solder the lever to the cross-shaft and wire. The lever sits more or less horizontally.

Solder a piece of 0.4mm wire into the notch at the back of the spacer (54) so it is vertical and protrudes about 6mm below it. Position the handbrake lever on the cross-shaft so that the die block assembly sandwiches the 0.4mm wire - again, the lever should be roughly horizontal. Solder the lever to the cross-shaft and the wire into the die block.

Solder the actuating levers on to the cross shaft so they are vertical and up against the inside of the frames. In 00 gauge the pull rods have to be run on the outside of the actuating levers - file a small flat on the bottom of the cross shaft pivot point so the hole in the pull rod lines up with the hole in the actuating lever. Solder a piece of 0.5mm wire between the actuating levers. For EM/P4, trim it almost flush on the outside and 1mm protruding inwards. In 00, trim it flush on the inside and with 1mm protruding outwards. Solder the detail pieces (77x2) (they represent the hexagonal adjusters) to the brake pull rods (78x2).

Use 0.5mm wire to locate the brake shoes (79x4) on their hangers (80x4) - noting which is the top and which is the bottom of each (see drawing) - and solder up two left and two right-handed hanger assemblies. Trim the wires slightly proud of the brake shoe faces to represent the fixings.

Push two lengths of 0.7mm wire through the brake hangers and tubes, at their top pivots. Position the brake assembly guide on the chassis just ahead of the front wheels. Sit the brake rods in the slots in the guide and push a length of 0.7mm wire through the bottom of the hangers and the brake pull rods. Fit the pull rods on to the actuating lever pins. Push the hangers up against the guide so they hang vertically and then, with the guide still in place, solder the front brake hangers to the bottom wire. Solder the wire into the front pull rod -

holes. Reposition the guide just ahead of the rear wheels and repeat the assembly sequence.

Pulling the wires out of the hanger tubes and springing the rods at the actuating levers will release the brake gear. With the brakegear guide removed, solder 0.7mm wire into the pivot holes on the hangers and trim so the wire protrudes slightly at the front faces and by about 0.5mm at the rear.

To refit the brake gear, simply spring the hanger pins into the tubes and the rear of the brake pull rods on to the actuating levers. Finally, rotate the counterweight on the inside motion until it is horizontal and then solder in position. Remove the brake gear and the wheels, cleaning up as necessary.

Cylinders and motIon.
The whole of the cylinder assembly (see Figs 16-18) is removable and must not be soldered into the chassis. Before cutting them from the fret, drill out the holes in the slidebar discs (82,82,83x2) to 1mm. Drill the 0.5mm holes in the slidebars and locate the two layers using wire. Solder the layers together, taking care not to run solder into the bend lines at the motion bracket end. When cleaning up do not accidentally file off the small details on the rear layers.

Check that the turned brass gland body (84x2) fits into its location (see Fig 18), and that it is central between the bars, but do not solder the gland just yet. Remove the stretchers and clean up the slidebars

Bend up the slide bars at the motion bracket end and bend back the discs at the other end. The slidebars should be lightly clamped while you are doing this to avoid distortion. Add little fillets of solder to strengthen the bends. Pin the two halves of the motion bracket together with wire, solder them up and file the wire flush.

Using 14BA bolts, fix the cylinder saddle in position on the chassis. With the slidebars at 90 degrees to them, locate the slidebars in the slots in the cylinder rear face. Swing the motion bracket/slidebar assembly down through 90 degrees so the slidebars fit snugly in their slots and the top of the motion bracket is level with the top of its own slots in the chassis. There may be a slight gap between the slidebar disc and the front cylinder face. This will not affect the running.

Lightly oil a length of 1mm wire and push it through the various holes in the cylinder/motion assembly. Making sure all the parts are fully home in their respective slots, line the wire up with the rear axle as shown in Fig 18. Check that the motion bracket and the cylinder faces are correctly inclined and that the wire runs centrally between the slidebars. Slide the turned gland over the wire and set it in position in the notch in the slidebars. Now solder the slidebars to the cylinder saddle at each point of contact. Solder the disc to the front cylinder face and the gland to the slidebars. Remove the wire.

Anneal, bend and fit the cylinder wrappers (85x2). Form them to shape as exactly as possible (make sure the half-etched lines are on the inside) - The wrapper is fitted so it is flush at the front and overhangs at the rear. If you solder the straight sections only to the formers, you will avoid dislodging the slidebars. Now punch out the rivets on the front cylinder covers (86x2) and tin the faces of the front and rear covers (87x2). Fit the rear covers over the slidebars and solder them in place. Very carefully drill out the gland flanges (88x2) while they are still in the fret until the 1mm wire is a smooth sliding fit. Use oiled 1 mm wire to locate the gland centrally on the gland body. The gland flanges lie about 15° from the vertical, the top innermost. It's probably best to fix them in position with glue to avoid disturbing the alignments.

Working up through the drill sizes, carefully open out the cylinder front faces and slide bar disc until you have a 2.5mm clearance hole. This will allow for any displacement of the piston rod. Fit the cylinder front covers. The completed cylinder assembly should now be removed from the chassis. Draw a line on the bottom of the cylinder wrappers, about 1mm inwards of the slidebar centre line. Place the draincock drill guide on the line and drill two 0.5mm holes in each cylinder. Solder four L-shaped pieces of wire into the outer holes on the draincock linkage (89, 90) and trim almost flush at the front. Solder the wires into the cylinders. Run a piece of wire into the central hole in the linkage and solder the other end to the edge of the wrapper. Trim neatly to length. The small end tap on the front cover can be represented by a piece of 0.4mm wire bent to shape.

Crossheads and connectIng rods
Remove the crossheads (91x2) from the sprues and trim them to length, straightening the piston rods as necessary. Lay masking tape over the rear of the slidebars. Lay the crosshead (front face outwards) on the slidebars and file the rear face until it is flush with the tape on the back of the slidebars. This creates clearance for a smooth sliding fit of the crossheads on the slidebars. Repeat with the other crosshead. Remove the tape and clean up if necessary with white spirit or lighter fuel.

Solder a piece of 0.7mm wire to the crosshead to act as the pivot. Trim it almost flush at the front (to represent the nut) and leave about 1mm proud at the rear. Offer up the crossheads to the slidebars. They should slide smoothly but without any slop. Fit the small end of the connecting rod over the pivot on the rear

of the crosshead, making sure the rod is correctly oriented and checking that the rod pivots freely - Put a tiny drop of oil on the pivot and on the slidebars and then, using the smallest possible quantity of solder applied at the piston-rod end, fit the crosshead backing plates (92x2) over the protruding pivot. When soldered in position, trim the pivot flush. Check again that everything runs smoothly.

Drill and fit the rear sandboxes (93x2) at this stage, with the pipes formed from 0.5mm wire bent to shape. To make Hawthorn Leslie rear sandboxes, file off the filler necks and replace them with the Hawthorn Leslie pattern supplied with the castings. The front sandpipes can be fitted as a length of 0.5mm wire running down the outer faces of the brake hangers (see Fig 14).

Fitting the gearbox/boiler and cylinder/slidebar assemblies
Though this sequence is described as it would be done on the final, working model, it is best to practice it several times first, so you are sure of where the various parts and sub-assemblies are to go and how best to get them into position. Remember that nothing is soldered or otherwise fixed permanently in place unless specified.

At this preliminary stage, you can try out the assembly sequence (Fig 19) using just the folded up gearbox mount (see the gearbox section overleaf) before the gears themselves are fitted. Temporarily screw the mount to the motor, holding it inside the boiler so the gearbox butts up against the rear edge of the boiler. Still holding the motor and boiler together, locate the lugs on the rear boiler mounting in the slots in the chassis. Make sure the boiler is not twisted in any way. Push an axle through the bearings. If the gearbox shell is square and the chassis bearings are correctly aligned, it should be free to revolve. If these are fine but it is still tight, then the boiler is probably off centre on its mounting lugs.

To fit the cylinders, tilt the gearbox back slightly without forcing and at the same time lift up the front of the boiler sufficiently to slip the cylinder/slidebar assembly into place. The tab on the front boiler mounting locates in the slot in the cylinder saddle rear face. If you get stuck, do not force anything. Remove the assembly and check for any excess solder or for slots that are not fully opened up.

Offer up the chassis to the body and secure using M2 bolts. Check that the rear motor shaft does not foul the body and trim if necessary using a carborundum disc in a mini-drill. If the chassis will not go fully home, right up against the footplate, the cylinders are probably fouling. Carefully mark the point where the cylinder front edge touches the valance and gently file off until all is well. Now dismantle the assembly.

Fit the rivet strips (94-8) to the chassis and, if you have not already done so, add the boiler bands. The major assemblies - body, chassis, cylinder assembly, brake gear, backhead and boiler - can be painted at this stage, but you may prefer to leave this until the loco has been test run.

108:1 Gearbox assembly
Study Figs 6-9. Before cutting the gearbox etch (99) from the fret, progressively drill out or ream each of the holes to the sizes shown in Fig 6. Components should be offered up until they a tight push-fit in their holes. Once the gearbox is assembled, the shafts are fixed but the gears are free to revolve.

Remove burrs by inserting the tip of a drill bit (of much larger diameter than the hole) and gently rotating it between your fingers.

Solder the 1/8in bushes into place with the larger-diameter shoulders on the opposite side of the etch to the bend lines. File the inside (non-shouldered) face of the bush flush. Remove burrs as above. Now cut the etch from the fret with a heavy blade and trim off the tabs.

The gearbox can now be folded up as indicated in Fig 7. AII bend lines are on the inside of the gearbox. Bend the sides first, then the mounting plate, and finally the strengtheners. Now solder the mounting plate to the side and the strengtheners.

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

De-flux the gearbox by scrubbing with household cleaner, then rinse and allow to dry. Cut the gear shafts to the overall width of the gearbox and remove any burrs with a fine file, finishing with emery paper. Check that the gears themselves are free from any dust or swarf left over from manufacture. Cut the insulated wire into two equal lengths and solder to the motor brush tags. Insulate the lower terminal with tape. For testing, connect the other ends to the output leads of your controller.

Push the worm on to the front motor shaft (mounting screws end) until it is flush with the forward end of the shaft. Screw the motor on to the mounting plate.

Referring to Figs 8-9, fit the first-stage gearshaft with the 27/10T gear and the 2mm collar. Use the collar to position the gear under the worm and then test under power. To adjust the mesh between the worm and the gear, slide the gear away from the collar to gain access to the bottom motor screw. Loosen the motor fixing screws slightly and move the gearbox relative to the motor until you have a good mesh - neither too tight nor too loose. When satisfied, tighten the motor screws and glue the collar in place. Lightly glue the shaft on one side only - this will make it easier to remove should you subsequently need to gain access to the motor screws.

Fit the second stage gearshaft into the gearbox so that the 20/10T gear fits into the recess.Test under power and then glue the shaft in place. Fit the single thin 20T idler in position. The boss on this gear goes up against the gearbox shell. Glue the idler shaft in place.

Temporarily fit a 1/8in axle along with the final brass 20T (making sure the latter is correctly meshed with the idler gear) and then tighten the grubscrew and test the gearbox under power.

Fitting the wheels

When the gearbox is completed and you are ready for the final assembly sequence (Fig 19), offer up the motor/gearbox/boiler sub-assembly as before but this time with the leads from the motor brush tags passing down through the firebox. As you fit the rear axle, slip on the final drive gear but do not mesh it yet. Fit and quarter the wheels - the right hand cranks lead by 90 degrees. The kit includes axle washers of varying thicknesses which should be used to eliminate all sideplay on both axles. Fit the bushes to the crankpins, add the coupling rods and check for free running. Fit the securing nuts to the front crankpins and cut the front crankpins off flush. Fit the balance weights (100x4) to the wheels, directly opposite the crankpins - epoxy is best for this. Make sure they lie flat and don't foul the rods.

Secure the cylinder assembly to the chassis using 14BA nuts and bolts. Attach the connecting rods to the rear crankpins and make sure the chassis runs smoothly without any tight spots. Once satisfied, cut off the surplus crankpins and secure the nuts with a tiny drop of Loctite 601 retainer. Mesh the final drive gear, tighten the grusbscrew and test under power once more.

Pick-ups

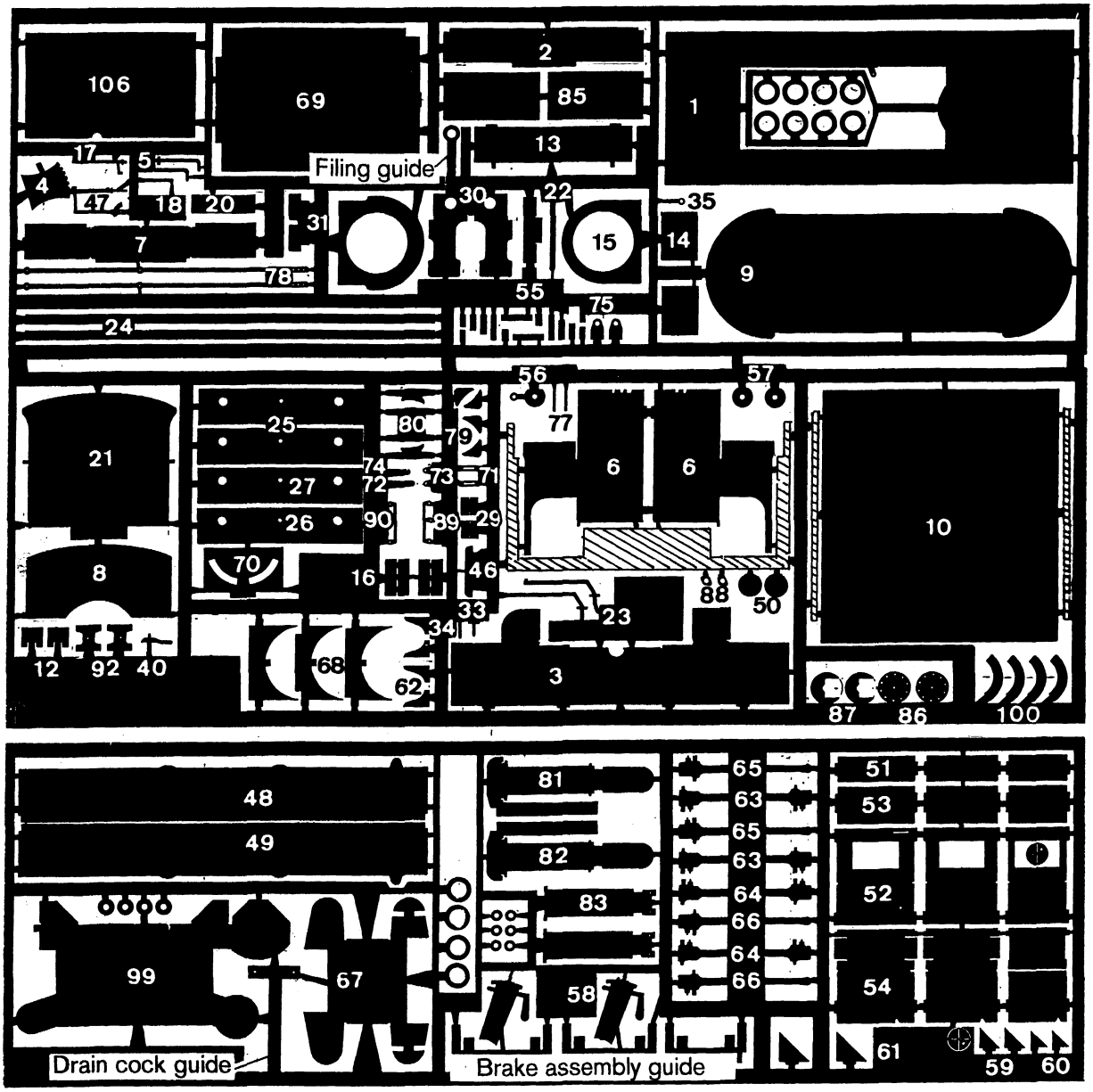
Most modellers have their own preferred method of fitting pick-ups. Suitably shaped wiper pick-ups (phosphor-bronze or 0.33 hard brass wire) can be run to the wheel rims from busbars running between strips of gapped copperclad fixed across the chassis at suitable points, such as on the front spacer, under the smokebox and between the inside motion, in front of the rear axle. Make sure you allow adequate clearance around the chassis components to prevent shorting. The motor leads can be fed down through the firebox and, after being cut to length (allowing a reasonable amount of slack), they can be soldered to the copperclad strips.

Final assembly

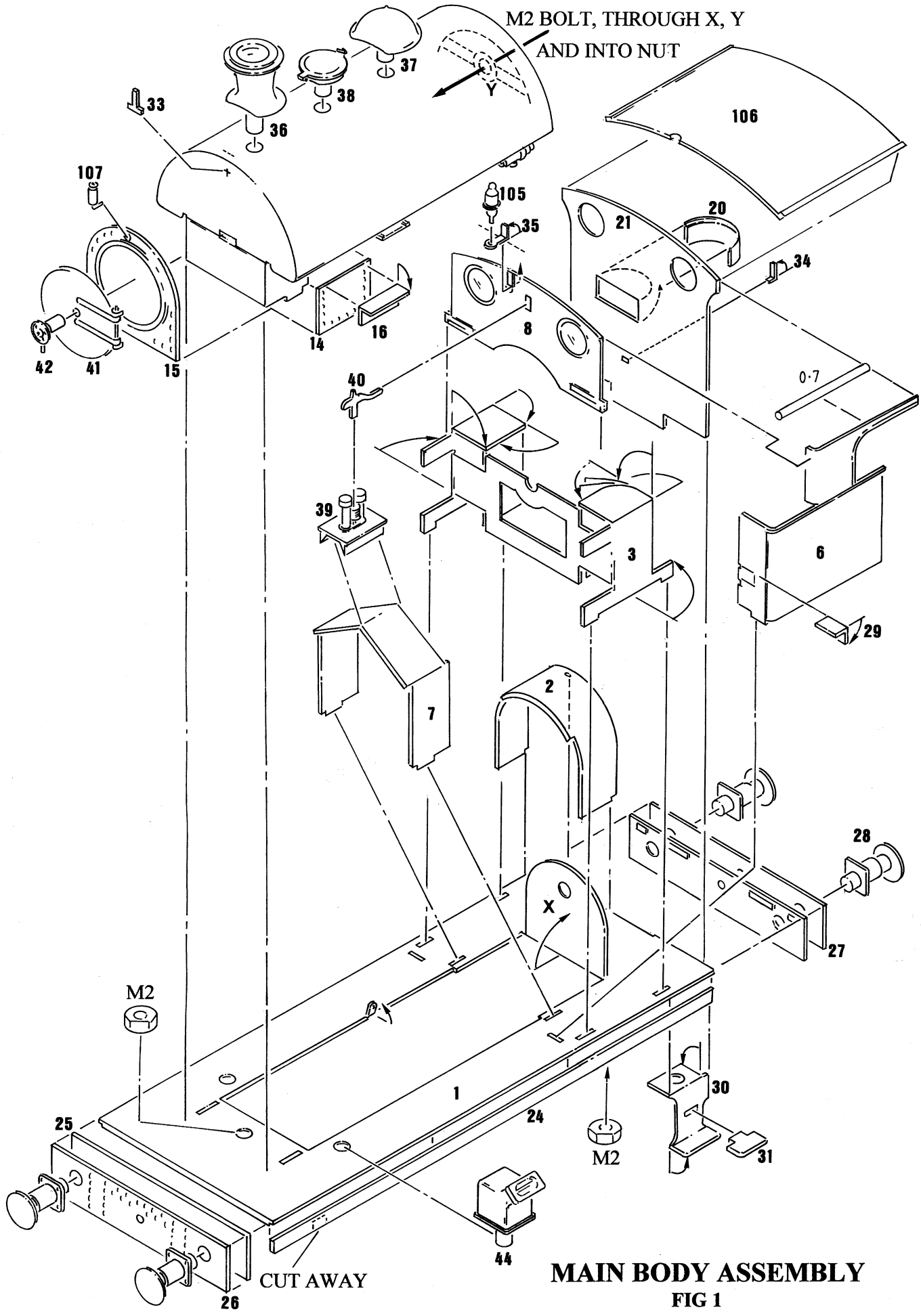
Fit the gauges (101x2) inside the cab and add lengths of fuse wire, as shown in Fig 11. Fit the gauge glasses (102x2) and the wheel valves (103x2) to the backhead and then glue it to the firebox. Using fuse wire to represent the whistle lever, add the steam turret (104), fit the whistle (105) and run fuse wire from the steam turret to the whistle. Form the cab roof (106) and attach it, when painted, with epoxy adhesive. Fit the lubricator (107) to the smokebox.

Once the body is in place it acts as a retainer for the various sub-assemblies. Check that the boiler and cylinders are correctly positioned and lower the body on to the chassis. Slip a small piece of packing (bubble wrap is ideal) between motor and body to deter the motor/gearbox from trying to rotate about its own axis. Invert the loco and fit M2 bolts at either end. Fit the brake gear as described earlier and test the loco on the track. Weight can be added for improved adhesion and haulage capacity, especially inside the saddle tank and in the bunkers (chopped-up lead sheet looks remarkably like coal). Finally, fit the saddle tank balance pipe.This can be formed from a single length of 0.5mm wire but getting it in and out is difficult. It is more easily represented by two 27mm lengths of 0.5mm wire, pushed as far as they will go into the locating tubes. The opposite end is routed past the inside of the valve tail rods, as in Fig 10, which hold it in tension - it is almost impossible to see that the two ends don't actually meet. The wires can easily be removed before taking the loco apart for maintenance.

R.S.H. 14" 0-4-0 SADDLE TANK LOCOMOTIVE



1	Footplate	29	Rear tank support x 2	60	Middle webs x 2	88	Cylinder gland flange x 2
2	Firebox	30	Step (LH and RH)	61	Rear webs x 2	89	LH draincock linkage
3	Bunker frame	31	Footsteps x 2	62	Railguards x 4	90	RH draincock linkage
4	Reverser	32	Step rivet strips	63	Coupling rod - rear LH, front RH	91	Crossheads x 2 (LW)
5	Water handles (L and R)	33	Front lamp iron	64	Coupling rod - front LH, rear RH	92	Crosshead backing plates x 2
6	Cab sides (+ alignment strips)	34	Rear lamp iron	65	Connecting rod - rear LH, front RH	93	Rear sandboxes x 2 (WM) (HL)
7	Coal shute	35	Whistle mount	66	Connecting rod - front LH, rear RH	94-8	Rivet strips
8	Cab front	36	Chimney (WM)	67	Cylinder saddle	99	Gearbox
9	Saddle tank frame	37	Dome (WM)	68	Firebox front/boiler mount (P4/EM/00)	100	Balance weights x 4
10	Tank wrapper (+ alignment strips)	38	Tank filler (WM)	69	Boiler	101	Gauges x 2 (LW)
11	Injectors x 2 (LW)	39	Safety valve (WM)	70	Front boiler mount	102	Gauge glasses x 2(LW)
12	Footsteps x 2	40	Safety valve lever	71	Die block sides x 2	103	Wheel valves x 2 (LW)
13	Smokebox	41	Smokebox door (WM)	72	Handbrake lever	104	Steam turret (LW)
14	Smokebox side overlays x 2	42	Smokebox door handles (LW)	73	Actuating levers x 2	105	Whistle (LW)
15	Smokebox front overlays (HL)	43	Clacks x 2 (LW)	74	Steam brake lever	106	Cab roof
16	Mounting bracket x 2	44	Front sandboxes (WM) (HL)	75	Cross-shaft details x 2	107	Lubricator (LW)
17	Draincock lever	45	Backhead (WM)	76	Brake cylinder (WM)		
18	Ashpan damper	46	Backhead shelf	77	Adjuster detail x 2		
19	Handbrake stanchion (LW)	47	Regulator	78	Brake pull rods x 2		
20	Handbrake cutout cover	48	LH frame	79	Brake shoes x 4		
21	Cab rear	49	RH frame	80	Brake hangers x 4		
22	Reverser linkage	50	Frame details x 2	81	LH slidebar/motion bracket		
23	Injector operating rods x 2	51-4	Spacers (P4/EM/00)	82	RH slidebar/motion bracket	(LW)	Lost-wax brass casting
24	Valances x 2	55	Ashpan	83	Slidebar front layer x 2	(WM)	Whitemetal casting
25	Bufferbeam packing x 2	56	Counterweight lever	84	Piston gland x 2 (TB)	(TB)	Turned brass
26	Front beam detail	57	Counterweights x 2	85	Cylinder wrapper x 2	(HL)	Hawthorn Leslie alternative included
27	Rear beam detail	58	Dummy inside motion x 2	86	Front cylinder cover x 2		
28	Buffers x 4 (WM) (HL)	59	Front webs x 2	87	Rear cylinder cover x 2		



MAIN BODY ASSEMBLY

FIG 1

FIG 2

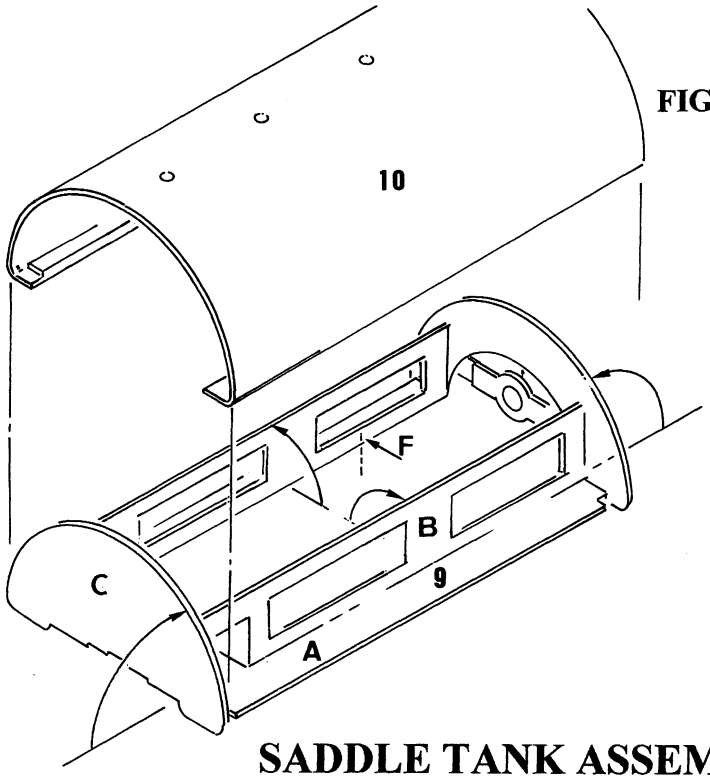
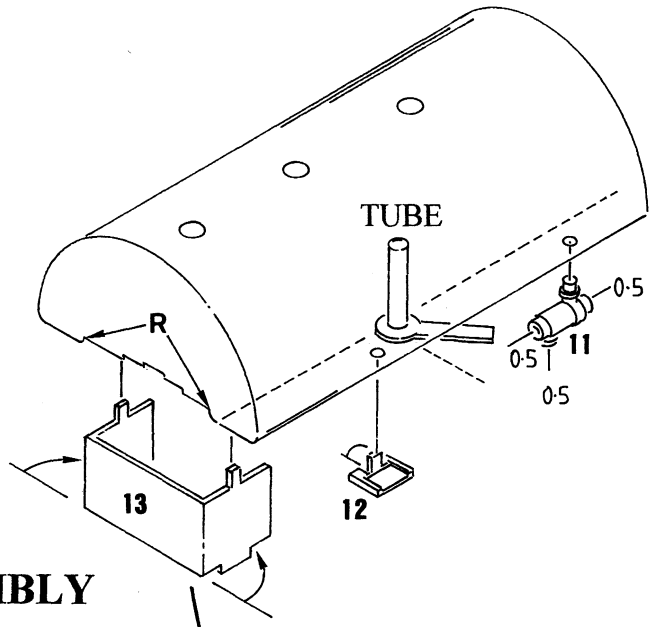


FIG 3



SADDLE TANK ASSEMBLY

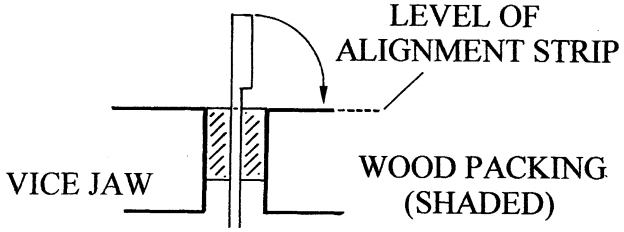
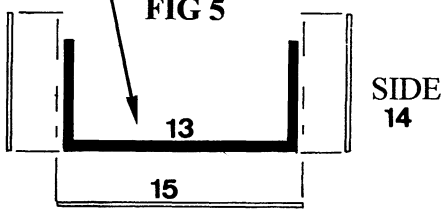


FIG 4

FIG 5



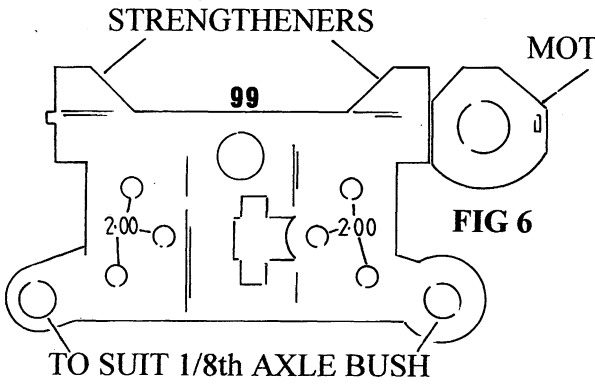


FIG 6

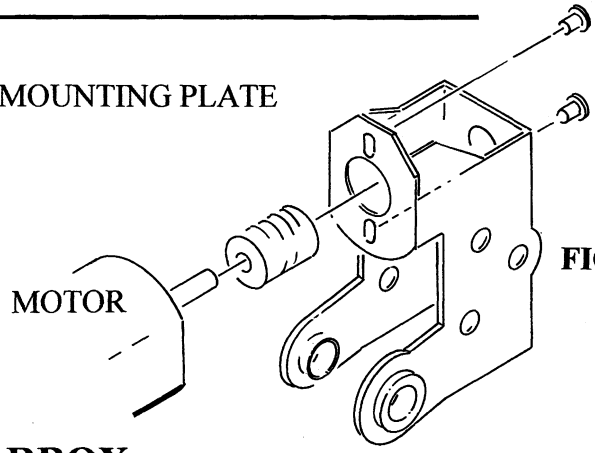


FIG 7

108:1 GEARBOX

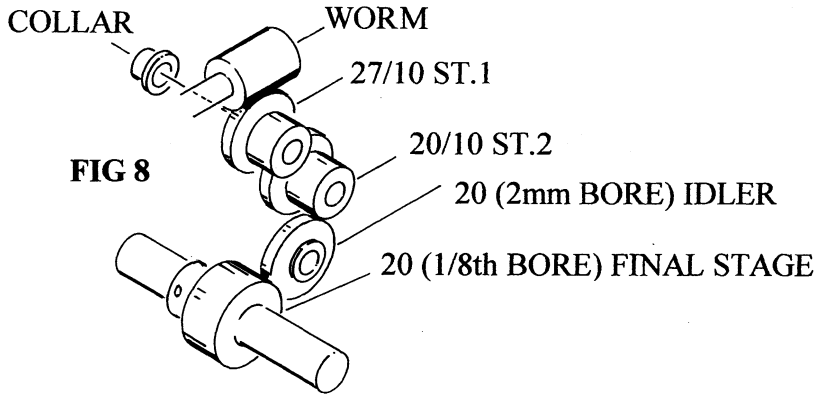


FIG 8

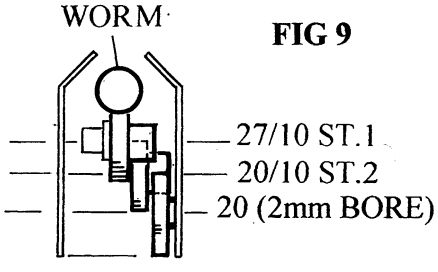
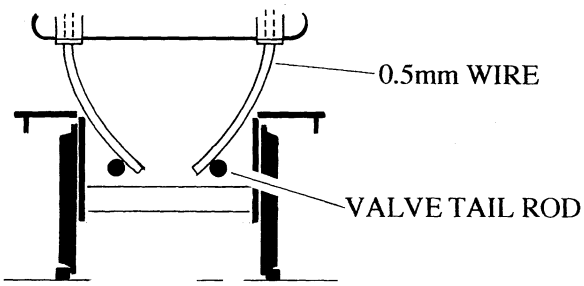
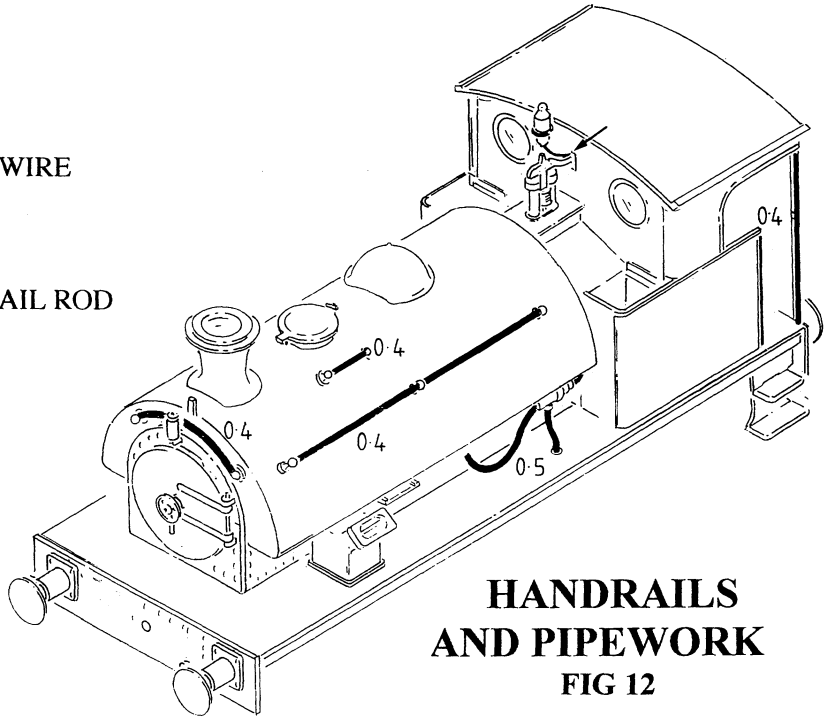


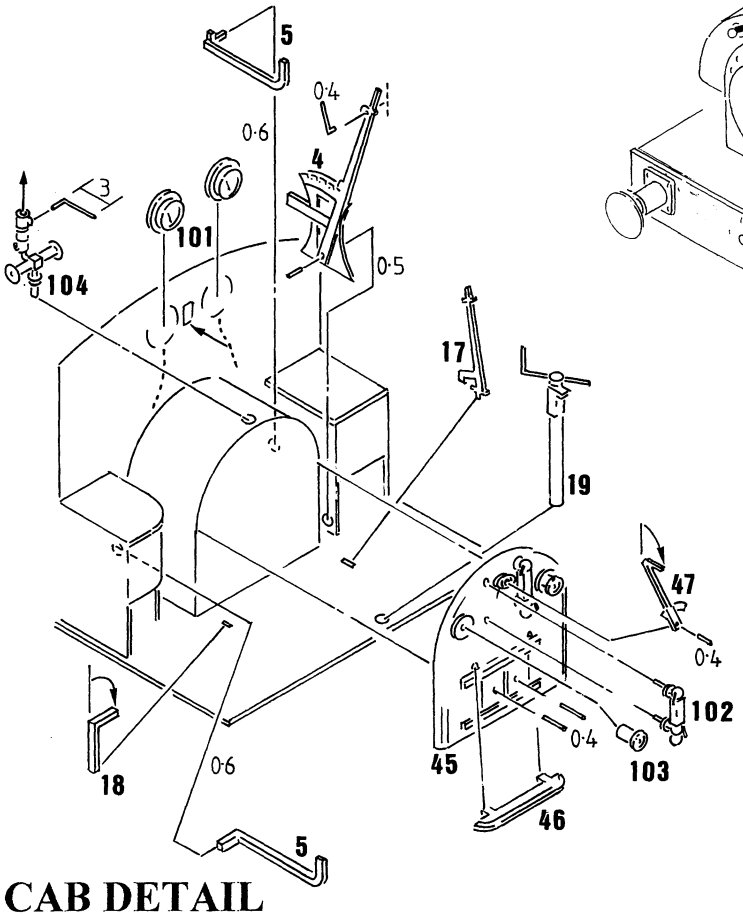
FIG 9

BALANCE PIPE FIG 10

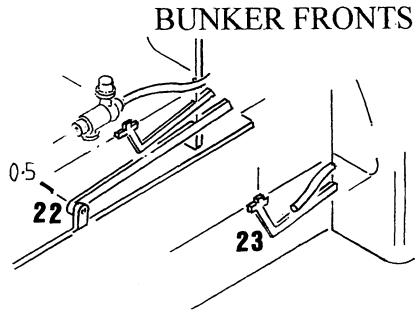




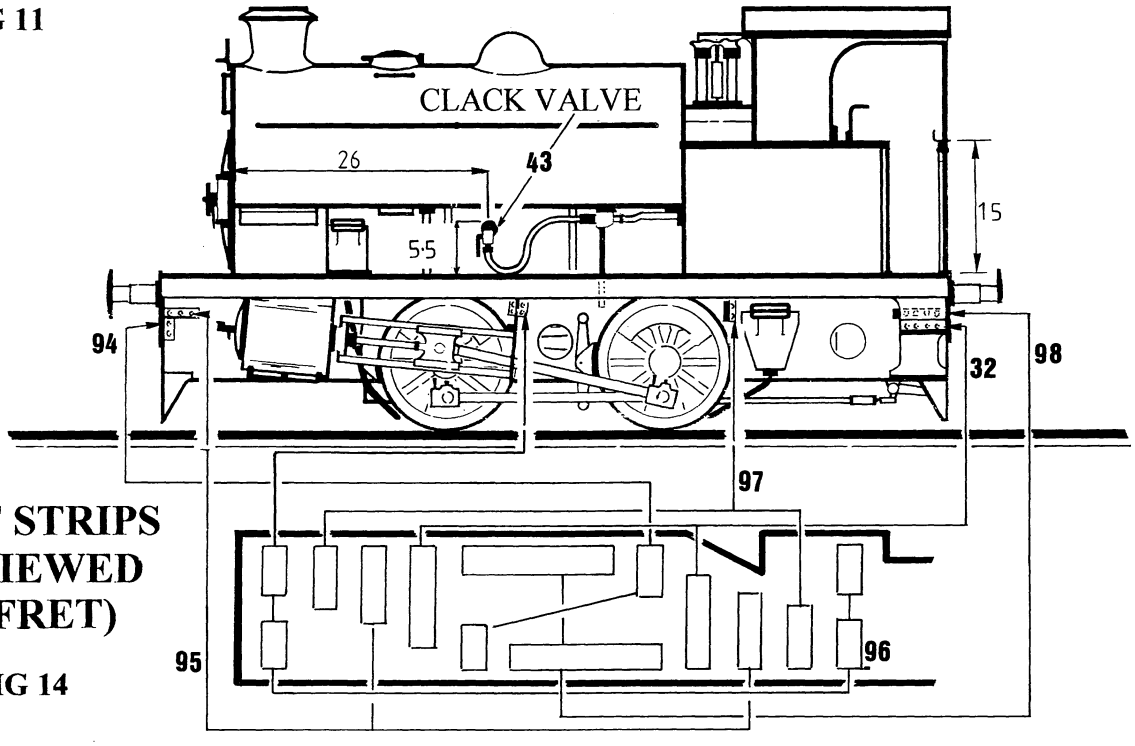
HANDRAILS AND PIPEWORK
FIG 12



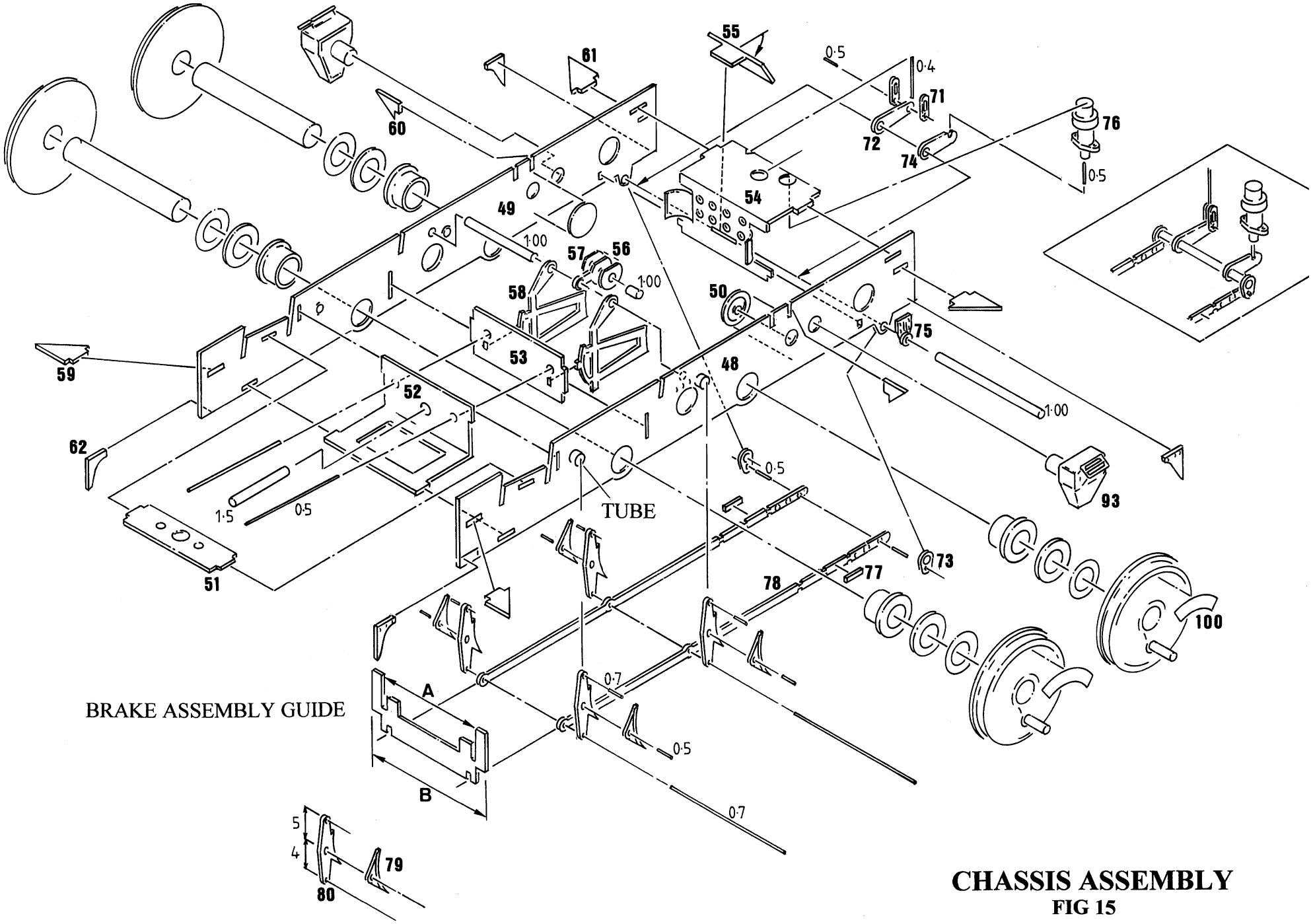
CAB DETAIL
FIG 11



DETAILS UNDER SADDLE TANK
FIG 13



RIVET STRIPS (AS VIEWED IN FRET)
FIG 14



BRAKE ASSEMBLY GUIDE

CHASSIS ASSEMBLY
FIG 15

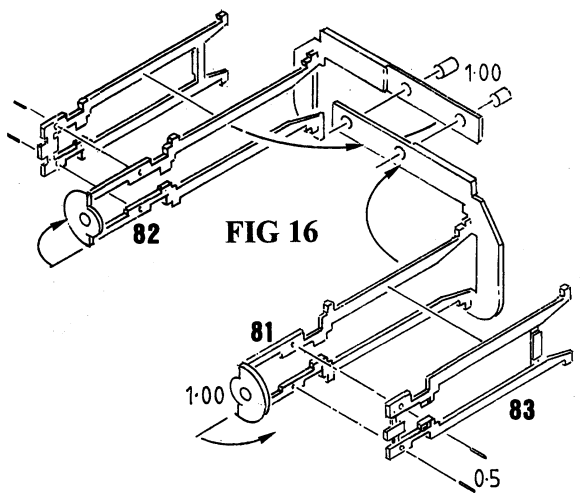


FIG 16

CYLINDERS AND MOTION

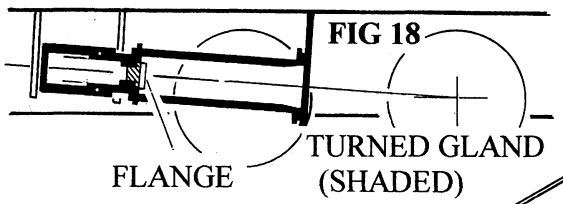


FIG 18

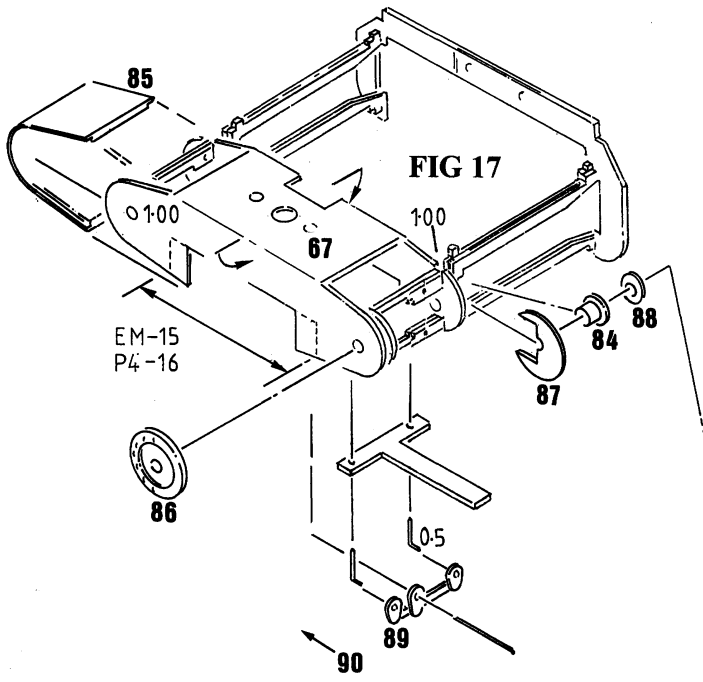


FIG 17

FINAL ASSEMBLY

FIG 19