S102

BLACK HAWTHORN
0-4-0ST

The characteristic elegance of Victorian locomotive design extended to purely industrial classes and the products of the long-vanished Gateshead firm of Black Hawthorn were in the classic mould. The strong family likeness among their locomotives is particularly evident with the 0-4-0STs. Between 1865 and 1896 Black Hawthorn supplied these locomotives to industrial concerns around the country, from civil engineering contractors to collieries and gasworks. Most differed only in detail from the engine depicted here. Some had only a rudimentary weatherboard while at least one - No. 774 of 1884, latterly at Bromley-by-Bow gasworks in east London - had a completely open footplate. In 1874 the North Eastern Railway acquired four Black Hawthorn 0-4-0STs for shunting work; apart from the squared-off cab, they were practically identical to the High Level model.

The kit is modelled on Black Hawthorn No. 266 of 1873. This was originally a contractor's engine named Wellington but later it moved to Holwell Ironworks in Derbyshire, where it acquired a new name, Holwell No. 3, and a short, stubby chimney to replace the tall, flared pattern with which it was built. From 1946 Holwell No. 3 worked at Middle Peak quarries near Wirksworth, which supplied the limestone used as a flux in the steel industry. The quarry was latterly owned by Tarmac Roadstone Holdings. Here the Black Hawthorn acquired a curious birdcage-like extension to the right-hand side of the cab. Its livery at Wirksworth (and perhaps earlier) was mid-green, broadly lined in red, with red coupling and connecting rods and red buffer beams. It appears not to have been fitted with coupling links.

Though it was latterly spare to a diesel, Holwell No. 3 was still occasionally steamed at Wirksworth until the mid-1970s, making it one of the very few industrial locomotives in this country to achieve a working centenary. The last survivor of the Victorian tradition of locomotive-building in Britain, it shunted the quarry and worked to the BR exchange sidings with short rakes of hopper wagons, 16T minerals and iron ore/chalk tipplers. Old no. 266 is one of just four Black Hawthorn locomotives that have passed into preservation and it can now be found at the Tanfield Railway in County Durham, renamed Wellington and with its cab and chimney restored as closely as possible to original condition. This is the form in which the locomotive is represented in the kit. AII measurements were taken directly from the prototype.

Additional components requlred
Motor - Mashima 12/24
Couplings, pick-ups and hornblocks to choice
Wheels - Alan Gibson* 3ft diameter 10 spoke, code 4536 BH (P4) 4836 BH (00/EM)
Crankpins - Alan Gibson* G4M42

GENERAL NOTES ON CONSTRUCTION

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

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

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

Despite the small size of the prototype, this is not a simple kit to build. While the parts have been drawn and mastered as accurately as humanly possible, much depends on the individual modeller's skill and, in

particular, on the qualities of patience and dexterity. If any procedure appears over-complicated, try and ask yourself what the alternative (if any) would have been.

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

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

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

If something isn't right, think twice before reaching for a file or drill. Any problems with the fit or alignment of components are likely to have been caused by errors earlier in the assembly sequence. Distortions and misalignments can build up and it becomes 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 any parts together. If you are patient and carefull, 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

Lightly oil the thread of an M2 bolt and. push it through the hole at the front of the footplate (1). Put the nut on finger-tight and solder it to the top of the footplate (the oil will stop solder reaching the thread), Remove the bolt, Bend the firebox (A) and smokebox (X) formers through 90 degrees and punch out the rivets on the smokebox - some half-etched holes have been included along the side of the fret for a practice run. Anneal and bend the smokebox (2) using part No. 3 as a guide to its shape. Fit the front smokebox former (3) to the footplate, checking that it is at 90 degrees to the footplate, Now fit the smokebox. Before fitting the smokebox front (4), check that the smokebox door (41) will fit snugly into it. The smokebox front fits inside the smokebox, flush with the leading edge. Do not fit the door at this stage

Bend and fit the bunker frame (5) and then remove the top cross-member. Anneal, bend and fit the firebox (6). Make sure it is the correct shape by checking it against the firebox former - this will affect the fit of other components. The lower and front edges of the firebox should be parallel and square, and the firebox should not be twisted in any way, When fitted, its lower edge fits between the inner edges of the footplate. Grind the locator tab from the firebox top.

Referring to Fig 3, fit the bunker fronts (7 and 8). Use the bunker frame as a guide to position, rather than the firebox. The outer edges of the bunker fronts should be flush with the outer face of the bunker frames. Fit the bunker sides (9 and 10) - the front edges should be flush with the front faces of the bunker fronts. Fit the cab floor (11) - this needs to sit right up against the firebox former (A) and should lie flat on the bunker former. Anneal the bunker insides (12 and 13) and bend them to shape, using the cab floor as a guide. When they are ready to be fitted, solder on the water handles (14 x 2) and then

solder the bunker insides into place. Fit the dampers (15 x 2) and the handrails on the bunker sides (see Fig. 13). Cut away the bottom cross-member on the bunker frame. Clean any excess solder from the cab area,

Open up the holes on the footplate to take the securing pip and then solder the leaf springs (16 x 4) in position. File off any protrusions behind the springs as they might interfere with the fit of the boiler. Fit the reverser rod (17) outside the rear spring on the right-hand side.

Saddle tank assembly

Study Figs. 4-7 before beginning work. Remove the saddle tank frame (18) 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 sides and then bend up the ends (C). Check that everything is square and use the piece of wood to hold the ends in position while soldering. Drill out the injector mounting holes.

Before bending the saddle tank wrapper (19), ensure the locator pins on the tank frame ends will fit into the holes on the wrapper without forcing. Bend the wrapper to the profile shown in Fig. 5. (The rectangular panel should be on the inside of the wrapper). This is best done by annealing the metal and carefully forming the two outer bends around a suitable bar (approximately 3.5mm diameter) clamped in a vice. When positioning the bends, measure from the centre line of the tank wrapper and not the edges. If you get the bends in the wrong place, bend the material still further around the bar and then flatten out the opposite end of the bend between two pieces of wood (fig. 6). 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. 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. When you are happy with the shape of the wrapper, solder it to the frame and file off the locator tabs. Carefully file off any excess material along the sides and bottom and dress the curves on the saddle tank with emery paper.

Gently curve the tank filler mounting flange (20) and solder it into place. Fit the two small rivet strips (21 x 2) on the rear of the tank and check that the holes will accept 0.4mm wire. Drill out the injectors to the sizes shown in Fig. 7 (this is best done while they are still on the sprue) and solder them to the underside of the tank.

Fitting the saddle tank

Grind off all the locator tabs under the footplate and then, making sure the footplate itself is absolutely straight, lay it on a flat surface. Push an M2 bolt through the hole in the rear smokebox former (X) and loosely fit a nut to it. Put the saddle tank in position, up against the smokebox and just resting on the edge of the firebox. Tighten the nut up to the front 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, tighten up the nut and then tack the saddle tank to the smokebox and firebox. Make a final check that everything is as it should be and then and then solder it along the join lines - being careful not to de-solder the tank assembly - and then remove and keep the M2 nut and bolt. Solder on the tank mounting flange (part 24 fits on top of part 23, which should be formed to shape).

Fit the valances (25 x 2) to the footplate. Pack wet tissue around the springs as a heat sink to stop them unsoldering while you are doing this.

Cab assembly

Bend up the roof former (26), using Fig. 9 as a guide, and then bend up the two locator tabs. Fit the rivet strip (27) to the inside of the cab sheet (28) as in Fig. 9. Push the locator tabs through the holes in the cab sheet and solder the former into position. Grind off the excess locators where they protrude through the roof.

Put the cab on a flat surface and slowly lift the central area of the cab sheet, rolling the corner around the former as you go (Fig. 10). Make sure the cab rear is flat against the work surface. When the cab has been folded through 90 degrees, maintain pressure on the bend and solder the former to the cab at the corners.

Repeat this process for the cab front (Fig. 11). Check for squareness and make any adjustments that are necessary by gentle nudging with the soldering iron while holding the cab against the flat surface.

Solder the rivet strips (29 x 2) to the cab front. Tin the area at the back of the cab where the buffer beam will be attached. You may find it easier to add the gauge glasses (53) at this stage - see Final Body Assembly below.

Fitting the cab

Study Fig. 2 to see the relationship between the various components, noting especially which parts overlap and which are flush. Bend the tab (B) at the rear of the footplate down through 90 degrees. Place the cab assembly in position with the tab on the cab front in the slot on the firebox. Push an M2 bolt through the slot in the back of the cab and the hole in the tab. Fit an M2 bolt and adjust the position of the cab until you are satisfied that it is sitting square and level. Check too that it is centrally located in relation to the cab floor.

A small amount of brass packing (marked P on fret diagram) may be needed between the tab and the cab back to keep the cab front and rear parallel. It is possible - but very unlikely - that you may need to trim some material from the rear edge of the cab floor. When everything looks right from every direction, tack the cab front to the firebox. Then, after a final check, solder the cab to the tab at the rear of the footplate, keeping solder away from the nut and bolt. They can be removed once soldering is complete and the cab floor soldered to the rear edge of the cab. Finally, lightly oil the thread of the M2 nut and solder it over the hole in the footplate beneath the cab.

Buffer beam assembly

Try the rear buffer beam in position (Fig. 2). The rear face of the beam, at each side, butts up against the valance, footplate and bunker frame. The top edge is level with the cab floor. Once you can see where it fits, solder on the rear buffer beam.

Fit the front buffer beam (31). Add a generous fillet of low-melt solder, especially where it butts up inside the valances. Some of this solder may subsequently need to be ground away to allow clearance for the chassis sideframes. Clip the mounting pegs to length and fit the buffers (32 x 4). Drill out holes for the couplings (not supplied).

Tin the rear of the step backing pieces (33 and 34) and then bend them to shape. Punch out the rivets on the step fronts (35 x 2) and solder them to the backing pieces. Fit the footsteps (36 x 2) and then solder the completed steps the underside of the footplate, behind the valance and hard up agagnst the rear buffer beam. A fillet of low-melt solder between the steps and the rear buffer beam will help brace the assembly.

Detalllng the body

This is shown in Figs. 12-14. Fit the dome (37), tank filler (38), chimney (39) and sandboxes (40 x 4). 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.

Fit all handrail knobs and handrails (see Fig. 13). Tack a piece of wire to the rear handrails to hold them in position while soldering, and then remove. Fit the blower pipe to the left-hand side of the smokebox. Fit the bracing struts between the tank and the cab front. Bend up and fit the riveted strips (43 x 2) to the cab front, directly above the braces. Drill a 0.5mm hole in the centre of the tank filler, fit a short length of 0.5mm wire and trim so it sits slightly proud.

Drill out the clack valves (44 x 2) while they are still on the sprue. To represent feedwater pipes, solder 0.5mm wire to the clacks as shown in Fig. 13. Remove the clacks from the sprue, trim the mounting pegs flush and bend the wire to shape. The feedwater pipes run along the top of the footplate - the one on the right-hand side passes in front of the reverser rod. The clacks should align with the rear face of the springs. On the model, the clacks are not physically fitted to the boiler to allow clearance for the boiler to be fitted into the body at a later stage. Now solder the feedwater pipes to the injectors under the tanks and also at the point where they touch the footplate.

Bend and fit the lamp iron (45) to the back of the cab. Bend and fit the safety valve levers (46). Drill out the dome valves (47 and 48) and the balance springs (49 x 2) - again, this is best done while they are still on the sprue. Solder 0.4mm wire to the balance springs to the dimensions shown in Fig. 12. Drill out the reverser lever (50) and solder a piece of 0.4mm wire to it to represent the catch (see Fig. 1). Trim it slightly proud of the rear face of the reverser. Solder the reverser to the slot in the cab floor. If you wish to have this part finished in polished brass, put it to one side and position it after painting the body. Fit the regulator pivot and firebox door handles to the backhead (51) using 0.4mm wire. Trim the height of the brake handle (52) so it aligns with the opening in the cab rear and then solder it to the footplate.

Final body assembly
If you want to have polished brasswork on the loco, you should paint the bodywork and backhead now before fitting the brass components. Alternatively, solder all the brass detail components in place first and then, before painting, lightly coat them with Brasso - this can be gently rubbed off once painting is complete to leave bare brass.

Drill into the gauges (53 x 2) using the smallest drill you have and solder fuse wire to them, using Fig. 12 as a guide for the pipe runs. Fit the gauge glasses (54 x 2) to the backhead. Fit the gauges to the rear of the spectacle plate. Drill the dome and fit the valves and the whistle (55). Fit any remaining pipework. Make sure the rear face of the backhead is free of any projections and then fit the regulator lever (56) on its pivot. Fit the completed backhead to the rear of the firebox. The balance spring linkages fit inside the safety vafve levers.

Fit the displacement lubricator (57) on the smokebox. This is very fragile.

ASSEMBLING THE CHASSIS

The chassis can be built either rigid or with simple three-point compensation. A fully sprung chassis is not an option as there is insufficient clearance inside the body to allow vertical movement at the rear axle.

If building a compensated chassis, remove the cut-outs for the hornblocks on the front axle.

Ream out the axle holes in the frames (58 and 59) to accept the 1/8in bearings and solder these in place. 00 modellers should file the rear axle bushes flush with the inside of the frames to allow clearance for the gearbox.

Assemble the frames using, according to gauge, the appropriate spacers (60-3) as in Fig. 15. Check the frames are square and parallel. Grind off excess locating tabs.

Bend up the dummy-inside motion (64 and 65). Open out the hole in the centre of the chassis and pass a length of 1 mm wire from one frame to the other, threading it through the holes in the inside motion. Locate the tabs on the insides of the frames and solder the motion in place. Solder the wire in place, leaving approximately 1mm standing proud of the outer face of the frames.

Tin the rear of the brass chassis overlays (66 and 67) and sweat them into place, making sure they do not obscure any of the slots in the frames - clean them out with a blade if necessary. Cut and file the overlays to match the hornblock cut-outs.

Fit the webs (68 x 2) to the chassis.

Layer up the connecting and coupling rods (69-76) and then ream out the holes for crankpin bushes to the sizes shown in Fig. 16. 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 front coupling rod holes opened out to accept a crankpin securing nut reversed. Use a thin shim washer (or a crankpin bush filed down) between the rod and the wheel.

Assemble the 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 L-shaped spacer (61) 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 1.5mm rod until it rests on the front axle and then solder it in place against the spacer. Remove the wheels and axles.

Choose the appropriate motion bracket (77) for the gauge you are building to. Fold up the pick-up mounting tags and fit a piece of gapped copperclad paxolin across them - see the section below on pick-ups. Try the motion bracket in its slots - it should go fully home. If you will be using a wheel press to fit and quarter your wheels, you may find it preferable to permanently fit the motion bracket only when the wheels are on, otherwise it may foul the wheel press.

Open up the holes in the cylinder saddle (78) and fold it to shape as shown in Fig. 18. Slide it into position in the chassis and check that it sits right down at the bottom of its location slots. Secure it in place with 14 BA nuts and bolts. The cylinders will be assembled in situ on the chassis but are fully removable. Fig. 17 shows how they line up in relation to the frames.

Punch out the rivets on the firebox (79) and bend to shape, using a needle file handle to form the corners. Solder the ashpan (80) to the rear angle. Fold down and trim the mounting lugs so they fit snugly into the recesses on the top edges of the frames. The width across the lugs (dimension L in Fig. 16) should be 14mm in EM and 15mm in P4. Make sure the lugs are of equal length so the firebox sits centrally between the frames. Do not solder them into place - the firebox is removable to allow the gearbox to be fitted. NB the firebox can only be fitted to EM and P4 width chassis - in 00 gauge there is insufficient space between the frames.

Boiler assembly

Carefully bend the boiler (80) to shape so that it exactly matches the front (82) and rear (83) boiler mountings. The motor and 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.

The boiler is removable and simply clips into place on the chassis. 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. If you have any problems, check first of all that the boiler is not fouling on the inner faces of the springs. The fit depends on a number of components being formed and positioned accurately. 0nce the boiler has cleared the springs, do not try and force it home. A gentle tweak of the boiler (especially along the top edges) will remedy any slight misalignments. It is possible that the back edge of the boiler may need to be lightly filed to gain sufficient clearance but be careful to take off the absolute minimum, or you will have a gap between the boiler and firebox.

Once you have got the boiler to fit comfortably, try it 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 again. At this stage you might like to think ahead to how the pick-ups will be wired to the motor, which sits inside the boiler. The most straightforward and unobtrusive way of routing the motor leads is to have them passing through small holes drilled in the bottom of the boiler, directly above the front axle. They will be hidden by the front springs, although this will mean unsoldering the motor tags if you wish to dismantle the loco. You could also have them passing inside the boiler and down through the firebox, which will allow the cylinders to be removed if necessary.

Brakegear

Drill out the brake gear components (84, 87 x 2, 88, 89, 90 x 2 and 90 x 2) to the sizes shown in Fig. 15. Open out the cross-shaft holes in the frames to 1mm. Solder 0.5mm wires into the brake hanger pivot holes and trim them so they protrude from the chassis by about 7mm.

Layer up the parts of the brake shaft balance lever (84-6) with a length of 0.5mm wire between them. Trim this wire to about 10mm long. Push a piece of 1mm wire through the frames and the assembled balance weight lever, leaving about 2mm protruding at either side. Solder the 0.5mm wire on the brake

shaft balance lever to the notch in the rear spacer (63) and trim flush.

Solder pieces of 0.4mm wire into the smaller ends of the actuating levers (87 x 2). Trim one side flush and the other so the wire protrudes about 0.7mm. Push the levers over the ends of the cross shaft as shown, with the pins outwards. Do not solder them into position.

Bend up the brake hangers (88 and 89) and layer the brake shoes (90 x 2 and 91 x 2). Push pieces of 0.4mm wire through the lugs at the backs of the hangers and file almost flush on the outsides, but with about 0.7mm remaining inside. Put the hangers on the 0.5mm wires that protrude from the chassis, using a wheel and axle (with spacing washers) to position them, but do not solder. Link the hangers and actuating levers with the adjusters (92 x 2) as shown in the diagram. The actuating levers can be rotated around the shaft to move the brake blocks closer to or away from the wheels. The adjusters should be parallel to the chassis. When you are satisfied with the position of the components, solder everything up solid except at the brake pivot and where the adjusters meet the hangers. Trim the pivot wires so they stand just proud of the hangers. Now you can remove and refit the hangers as often as you like.

Cylinders and motlon

The whole of the cylinder assembly is removable and must not be soldered into the chassis. Before cutting them from the fret, drill out the slidebar discs to 1mm. Bend up the slide bars (93 and 94) 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. Pin the two halves of the motion bracket together with wire, solder them up and file the wire flush.

Hold 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 and swing the motion bracket/slidebar assembly down through 90 degrees so the slidebars fit snugty 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.

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. 17. Check that the motion bracket is vertical and that the cylinder faces are correctly inclined. Now solder the slidebars to the cylinder saddle at each point of contact, and then solder the disc to the front cylinder face. Remove the wire.

Anneal, bend and fit the cylinder wrappers (96 x 2). Form them to shape as exactly as possible. If you solder the straight sections only to the formers, you will avoid dislodging the slidebars. Now punch out the rivets on the cylinder covers (96 x 2 and 97 x 2) and tin the rear faces. Fit the rear covers over the slidebars and solder them in place. Very carefully drill out the glands (98 x 2) while they are still in the fret until the 1mm wire is a smooth sliding fit. Bend the glands to shape and layer them with the spacer pieces (99 x 2). Use oiled 1mm wire to locate the gland centrally on the slidebars - check the alignment from top and sides - and then solder in position. Solder up the gland detail parts (100 x 2 and 101 x 2) and tidy up the edges with a file before fitting them to the slidebars.

Working up the drill sizes, open out the cylinder front faces and slide bar disc until you have a 2mm clearance hole. This will allow for any displacement of the piston rod. Fit the cylinder front covers and then add the rivet strips (102-5) to the chassis. The completed cylinder assembly should now be removed from the chassis.

Crossheads and connecting rods

Remove the crossheads (106 x 2) from the sprues and trim them to length, straightening the piston rods as necessary. Lay a piece of masking tape over the filing guide F and cut it out around the opening (Fig. 19). Lay the crosshead (front face upwards) on the guide, turn it over and file the rear face until it is flush with the back of the guide. This creates clearance for a smooth sliding fit of the crossheads on the slidebars. Repeat with the other crosshead.

Offer up the crossheads to the slidebars. They should slide smoothly but without any slop, right up to the glands (this engine has a very long crank throw). 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 (107 x 2). Check again that everythIng runs smoothly and that the crossheads travel the full length of the slidebars.

With the cylinders in place, the sandpipes can be fitted. The front ones are a length of 0.5mm wire running down the inside rear faces of the cylinder saddle, in line with the wheels (see Fig.14). The rear ones can be formed to shape from 0.5mm wire and then, for strength, soldered to the brake blocks so they just touch the underside of the footplate. Check with a wheel mounted on an axle that there wIll be no electrical contact with the sandpipes.

Boiler bands can be represented by strips of 0.8mm wide tape cut from a length of sellotape stuck down on a piece of glass. There is one band at either end of the boiler and two equally spaced in between .

Assembling the gearbox (See separate illustration sheet)
While the gearbox etch is still in the fret, progressively drill out or ream each of the holes to the sizes shown in Fig 1. 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.

Before cutting or bending the etch, 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 2. AII bend lines are on the inside of the gearbox. Use a small engineer's square as a check and 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..

1. Bend A (x2) through 45 degrees
2. Bend B through 90 degrees
3. Bend C through 90 degrees
4. Bend D and E through 90 degrees
5. Bend F through 90 degrees . Now push F up against D and solder them together. Use a piece of wood (lolly stick?) to exert pressure - it will stop your fingers getting burned.
6. Solder the strengtheners A to F and to the angled portion of G.
7. Push an uncut 1.5mm shaft through the three holes in D, B and E. This will give the correct alignment for B. Run a fillet of solder along the seam where B joins C to act as a strengthener.

With the shaft still in place, solder B and C to G and then remove the shaft.

Give the gearbox a good scrub with hot water and household cleaner, and allow to dry. If you are building the loco to gauge, spray the gearbox black at this stage. In EM and P4, the gearbox is entirely hidden within the firebox and need not be painted. Cut the gear shafts to the lengths shown in Fig 3 and remove any burrs with a fine file, finishing with emery paper.

Motor
The rear (brushgear end) motor shaft needs to be cut short by approximately 5mm to clear the rear smokebox former. The best cutting tool to use is a carborundum disc in a mini-drill. Slip some paper over the end of the shaft and motor to stop filings entering the bearings and brushgear. 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.

When this is done, 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 F. One of our pilot models was fitted with a flywheel - a lIttle filing was necessary in the smokebox area to create clearance - but with 97:1 gears and a slow-revving motor the difference in running compared to a non-flywheel version, was all but impossible to tell.

When fitting the gears, test under power at every stage of assembly. Do not move on to the next step until you are satisfied everything is running smoothly. Make sure Your work area is free from filings and other debris and that all the gearbox components are spotlessly clean. Do not secure the shafts in place until everything is running smoothly.

Stage 1 gears and gearshaft.
Pass a 2mm gearshaft through the upper holes in D and E. Withdraw it through E and slip the stage 1 gear (27/10T) with its collar on to the shaft. Slide the shaft through the hole in D and then test the gearbox under power. To adjust the mesh, the motor screws can be loosened and the motor moved up or down - the stage 1 gearshaft will need to be removed for access.

Stage 2 gears and gearshaft
Following the same procedure, pass the other 2mm diameter shaft through the middle hole in E and slip the stage 2 gear (20/10T) over it.

Idler
Align the idler gear with the 1.5mm diameter holes in B and E and push the shaft through. Ensure the shaft does not foul the stage 2 gear.

When you are satisfied that everything is running smoothly and evenly, use a tiny spot of adhesive at one end of the shafts (in case they need to be removed), securing them shafts in place on the outside of the gearbox side fames D and E. Glue the collar in position on the stage 1 shaft. The ideal adhesive would be Loctite 601 Retainer but be careful not to let it penetrate onto the gears. Epoxy or a gel-type superglue will also do the trick.

Final drive.
Push a 1/8in diameter axle through the bushes in D and E and the gear. The runs up against the inside face of the gearbox. Check that it meshes satisfactorily while revolving freely on the axle. Do not glue the gear in place until the gearbox is finally installed in the chassis and the wheels are in place.

Lubrication
This gearbox is a precision component. For results and minimum noise levels, use a Teflon-based grease such as Tri-Flow or Pronatur (available from Exactoscale) - although the prototype ran well enough using WD-40!

Run the motor/gearbox in for an hour or so at least before fitting it to the model. Drive it forwards and then backwards, for a bit at a time, gradually increasing the revs. Allow a minute or two for cooling between each cycle.

Fitting the gearbox/boiler/and cylinder assemblies
It is best to practice this sequence several times before the final assembly, so you are sure of where the various sub-assemblies are to go and how best to get them into position. Remember that nothing is soldered or otherwise fixed permanent in place unless specified.

Hold the motor/gearbox assembly inside the boiler so the gearbox butts up against the rear face of the boiler. Loop the bottom of the gearbox round the curved chassis spacer and, still holding the motor and boiler together, locate the lugs on the rear of the boiler mounting in the in the slots in the chassis. Make sure the boiler is not twisted in any way. Push an axle through the rings. It should be free to revolve. If tight, 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 for you to slide 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 excess solder or for slots that are not fully opened up.

Now carefully dismantle the assembly. The chassis, cylinder assembly, brake hangers, firebox bottom and boiler should be painted at this stage.

Fitting the wheels and motor/gearbox
When the gearbox is completely run in and you are ready for the final assembly sequence, offer up the motor/gearbox assembly as before but this time with the leads from the motor brush tags passing down to the pick-up area using one of the aforementioned routes. As you fit the axle, slip on the brass gear. Fit and quarter the wheels - the right crank leads by 90 degrees. Fit the bushes to the crankpins, add the coupling rods and check for free running by pushing the model along. Fit the securing nuts to the crankpins (see Fig. 16) and cut the front crankpins off flush.

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 using a tiny drop of Loctite 601 Retainer.

The final drive gear can now be secured to the axle with Loctite or Epoxy. Use the minimum amount and avoid getting adhesive in the bearings - heat from the soldering iron can destroy unwanted bonds that may form, but be careful of the plastic gears.

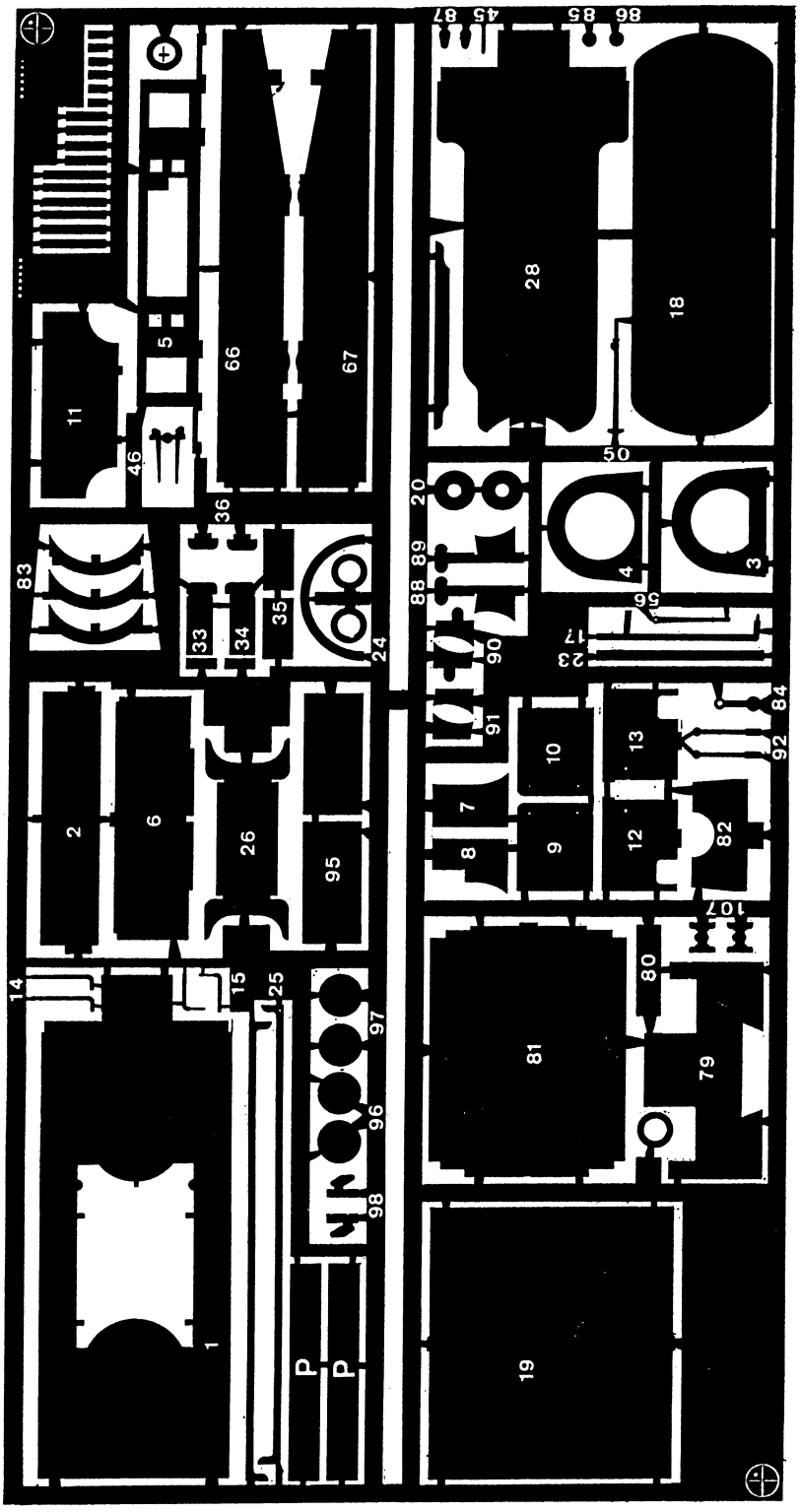
Pick-ups
Most modellers have their own preferred method of fitting pick-ups. The Black Hawthorn is not the easiest model to wire up but suitably shaped wiper pick-ups can be run to the wheel rims from strips of copperclad on the underside of the lower motion bracket. The front pick-ups should fit unobtrusively beneath the front axle and cylinder saddle and if you run the pick-ups to the rear wheels just below and inside the frames, they should be virtually invisible from normal viewing angles, especially if painted matt black. Make sure you allow adequate clearance around the chassis components to prevent shorting. After being cut to length (allowing a reasonable amount of slack), the motor leads can be soldered to the copperclad strips.

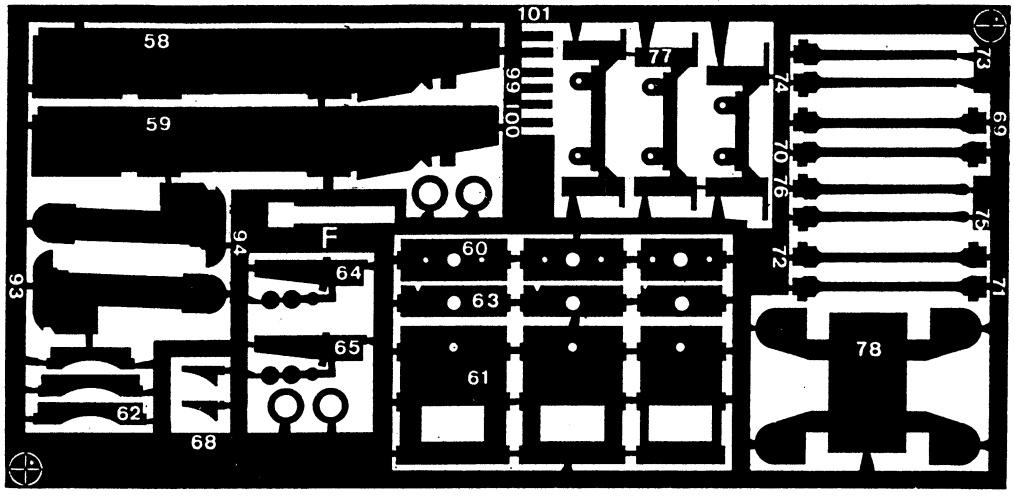
Final assembly Once the body is in place it acts as a retainer for the various sub-assemblies. Fit the lower part of the firebox to the chassis as described earlier. Lower the body onto the chassis, invert it and fit the M2 bolts either end (short one at the rear). When the body and chassis are fixed together the firebox lugs are nipped between them, preventing it from moving.

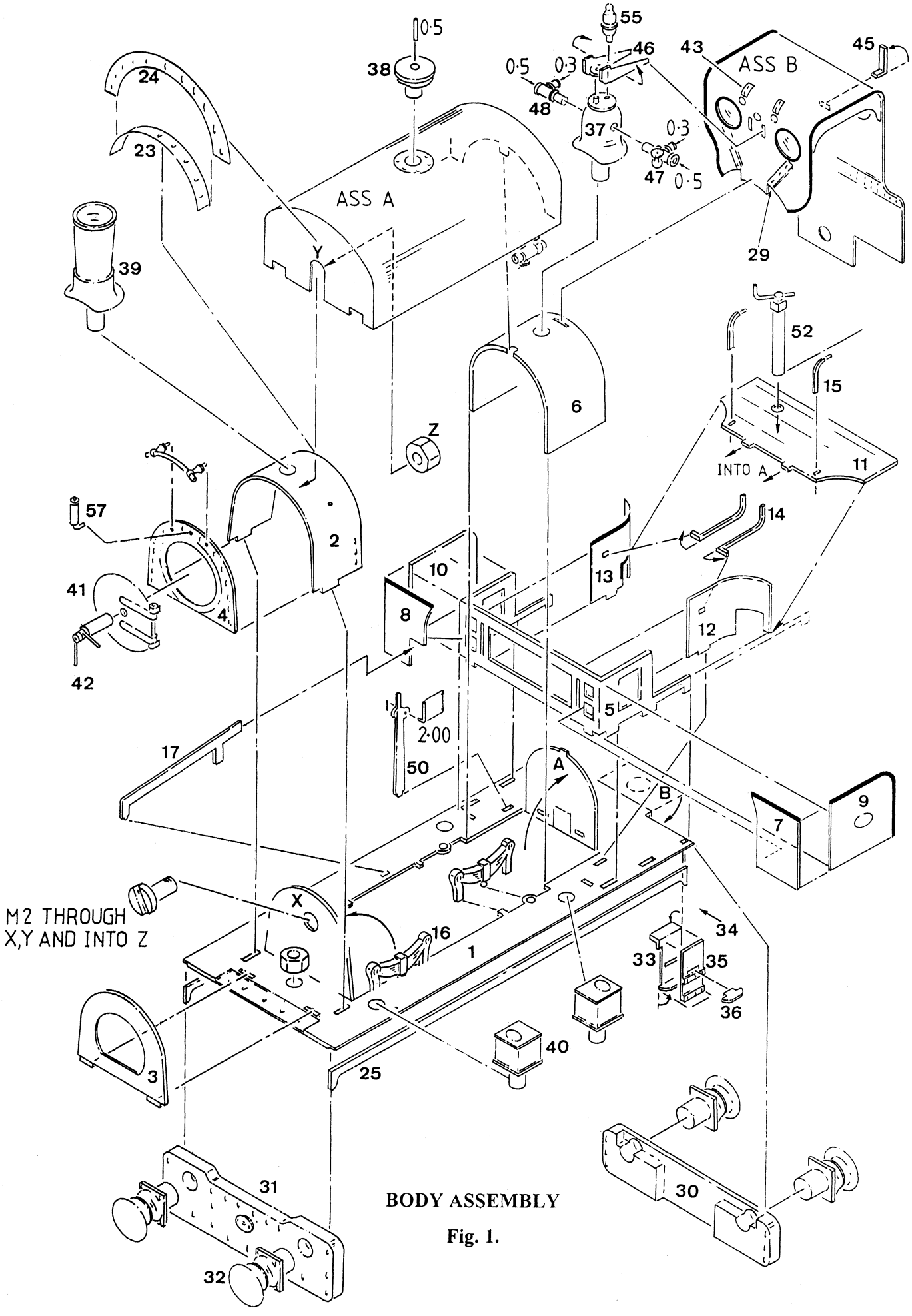
BLACK HAWTHORN 0-4-0 SADDLE TANK LOCOMOTIVE.

PARTS LIST

1. FOOTPLATE
2. SMOKEBOX
3. FRONT SMOKEBOX FORMER
4. SMOKEBOX FRONT
5. BUNKER FRAME
6. FIREBOX
7. LH BUNKER FRONT
8. RH BUNKER FRONT
9. LH BUNKER SIDE
10. RH BUNKER SIDE
11. CAB FLOOR
12. LH BUNKER INSIDE
13. RH BUNKER INSIDE
14. WATER HANDLES X 2
15. DAMPERS X 2
16. LEAF SPRINGS X 4
17. REVERSER ROD
18. SADDLE TANK FRAME
19. SADDLE TANK WRAPPER
20. TANK FILLER FLANGE
21. SADDLE TANK RIVET STRIPS X 2
22. INJECTORS X 2
23. TANK MOUNTING FLANGE
24. TANK MOUNTING FLANGE
25. VALANCES X 2
26. ROOF FORMER
27. CAB SHEET RIVET STRIP
28. CAB SHEET
29. CAB FRONT RIVET STRIP X 2
30. REAR BUFFERBEAM
31. FRONT BUFFERBEAM
32. BUFFERS X 4
33. LH STEP BACKING
34. RH STEP BACKING
35. STEP FRONTS X 2
36. FOOTSTEPS X 2
37. DOME
38. TANK FILLER
39. CHIMNEY
40. SAND BOXES X 4
41. SMOKEBOX DOOR
42. SMOKEBOX DOOR HANDLES
43. CAB BRACE RIVET STRIPS X 2
44. CLACK VALVES X2
45. LAMP IRON
46. SAFTEY VALVE LEVERS
47. LH DOME VALVES
48. RH DOME VALVES
49. SALTER BALANCE SPRINGS X 2
50. REVERSER LEVER
51. BACKHEAD
52. BRAKE HANDLE
53. GAUGES X 2
54. GAUGE GLASSES X 2
55. WHISTLE
56. REGULATOR
57. DISPLACEMENT LUBRICATOR
58. LH FRAME
59. RH FRAME
60. 61. 62. 63. CHASSIS SPACERS 00/EM/P4
64. LH INSIDE MOTION
65. RH INSIDE MOTION
66. LH CHASSIS OVERLAY
67. RH CHASSIS OVERLAY
68. WEBS X 2
69. LH INNER SIDE ROD
70. RH INNER SIDE ROD
71. LH OUTER SIDE ROD
72. RH OUTER SIDE ROD
73. LH INNER CON ROD
74. RH INNER CON ROD
75. LH OUTER CON ROD
76. RH OUTER CON ROD
77. MOTION BRACKET
78. CYLINDER SADDLE
79. FIREBOX BOTTOM
80. ASHPAN
81. BOILER
82. FRONT BOILER MOUNTING
83. REAR BOILER MOUNTING
84. BRAKE SHAFT BALANCE LEVER
85. BRAKE SHAFT BALANCE WEIGHT
86. BRAKE SHAFT BALANCE WEIGHT
87. ACTUATING LEVERS X 2
88. LH BRAKE HANGER
89. RH BRAKE HANGER
90. BRAKE SHOE LAYER (WITH LUG) X 2
91. BRAKE SHOE LAYER (OUTER) X 2
92. BRAKE ADJUSTERS X 2
93. LH SLIDE BAR/MOTION BRACKET
94. RH SLIDE BAR/MOTION BRACKET
95. CYLINDER WRAPPERS X 2
96. REAR CYLINDER COVERS X 2
97. FRONT CYLINDER COVERS X 2
98. PISTON GLANDS X 2
99. SPACER PIECES X 2
100. INNER GLAND DETAIL X 2
101. OUTER GLAND DETAIL X 2
102. CHASSIS FRONT RIVET STRIPS X2
103. CHASSIS REAR RIVET STRIPS X 2
104. WEB RIVET STRIPS X 2
105. MOTION BRACKET RIVET STRIPS X 4
106. CROSSHEADS X 2
107. CROSSHEAD BACKING PIECES X 2







BODY ASSEMBLY

Fig. 1.

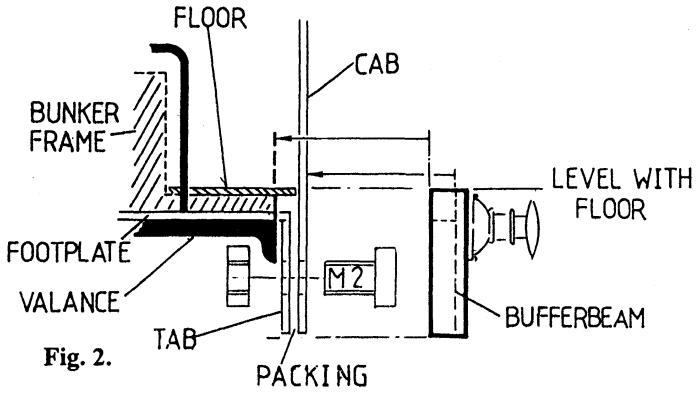


Fig. 2.

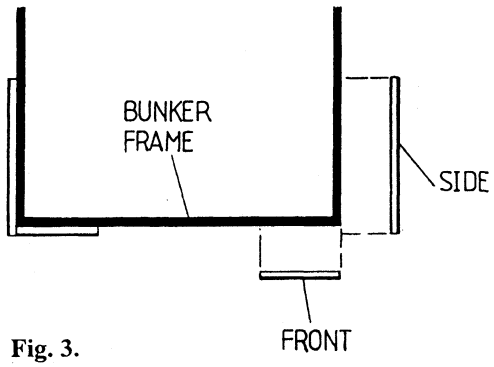
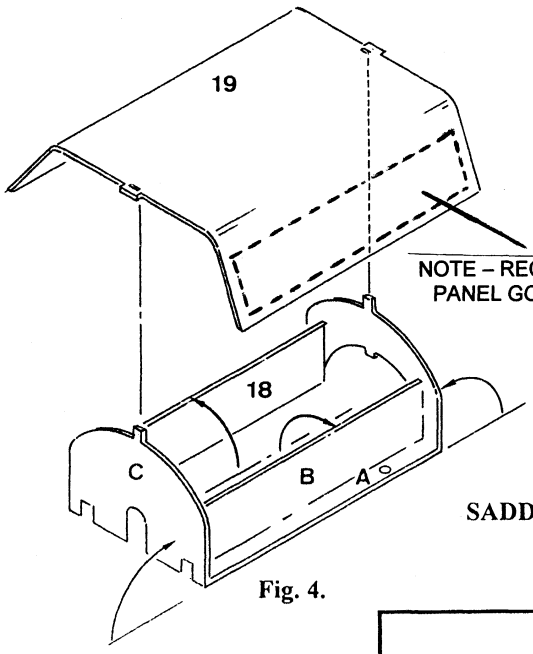


Fig. 3.



NOTE – RECTANGULAR PANEL GOES *INSIDE*

Fig. 4.

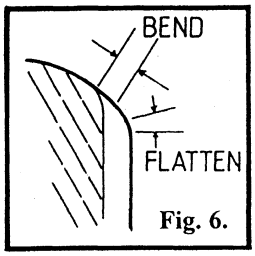


Fig. 6.

SADDLE TANK ASS. A

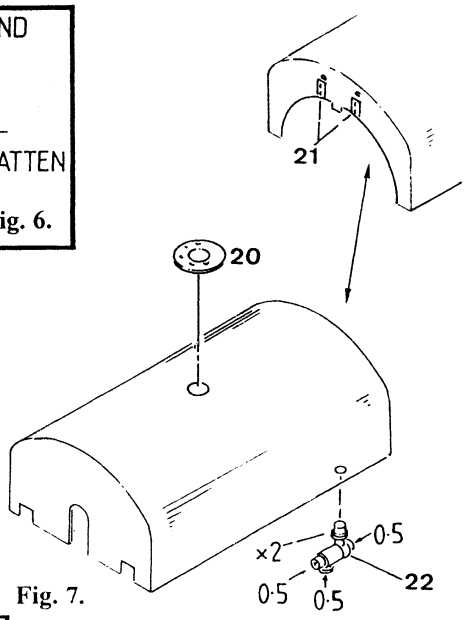


Fig. 7.

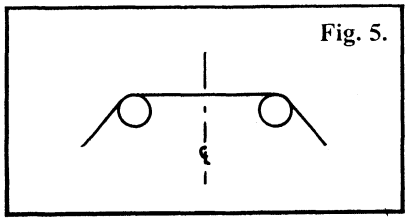


Fig. 5.

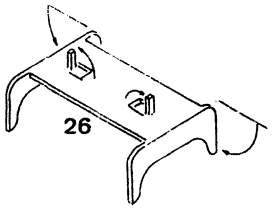


Fig. 8.

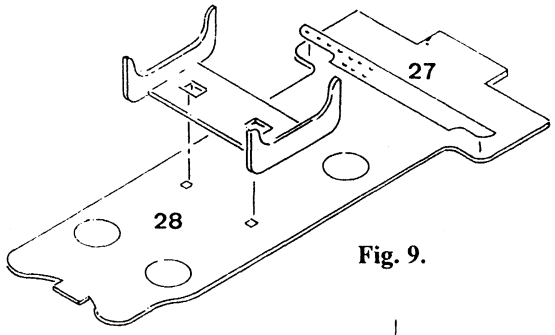


Fig. 9.

CAB ASSEMBLY B

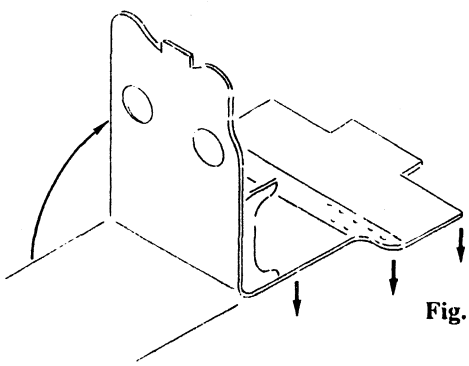


Fig. 10.

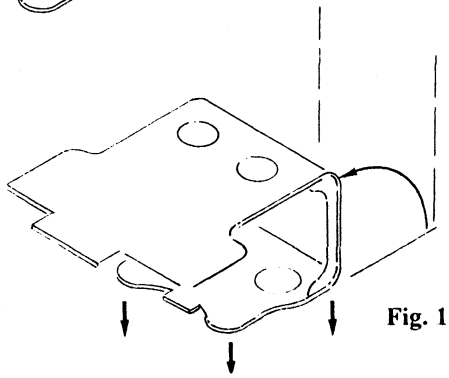
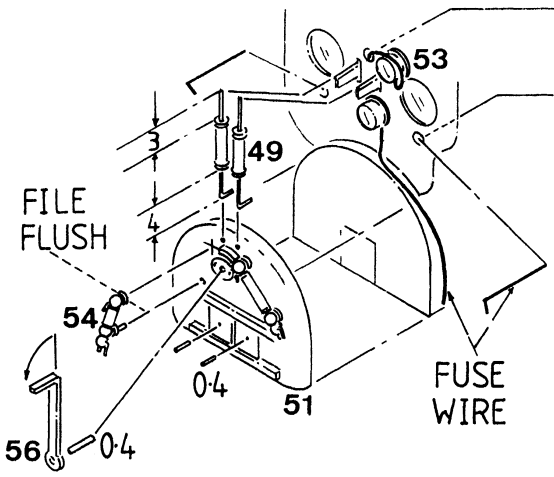
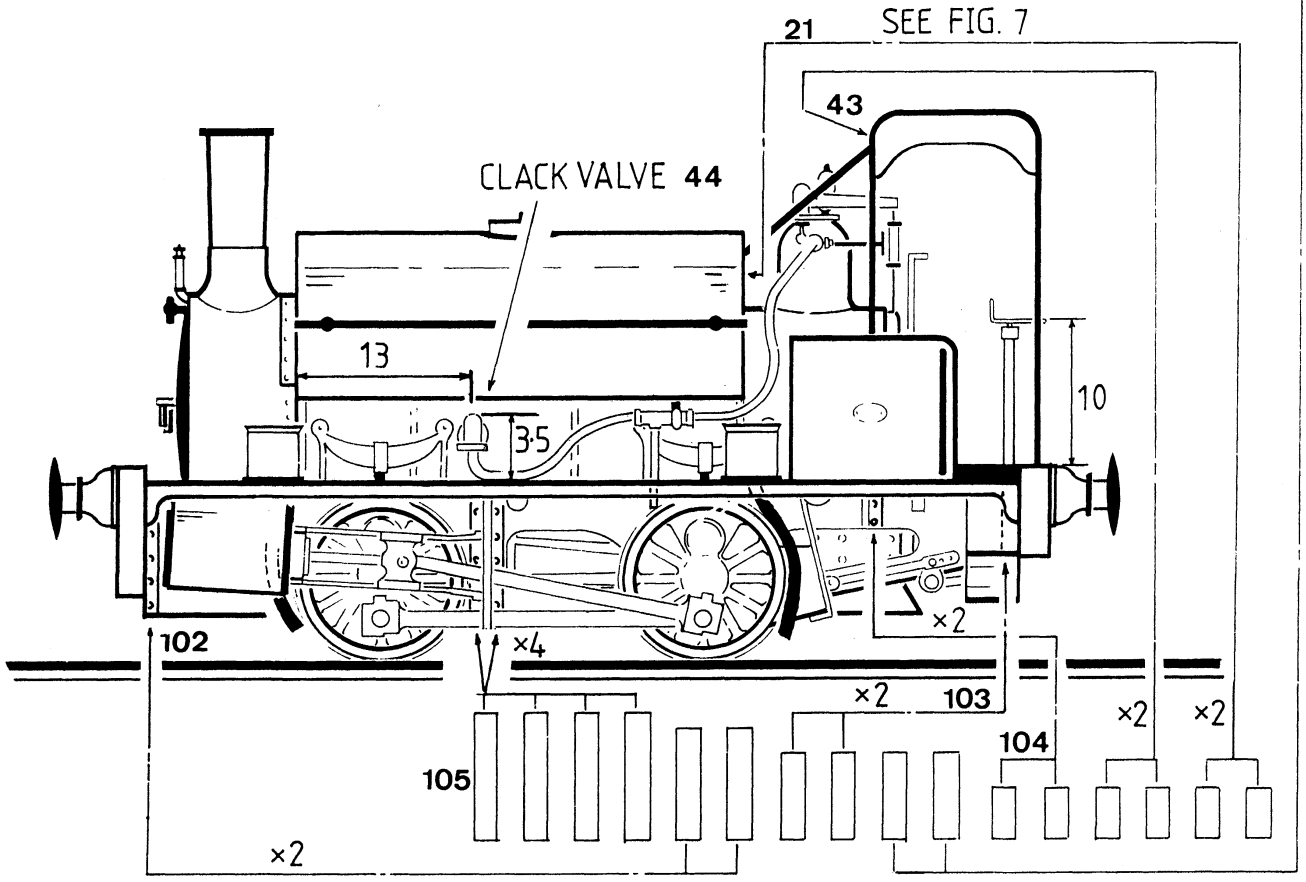


Fig. 11.



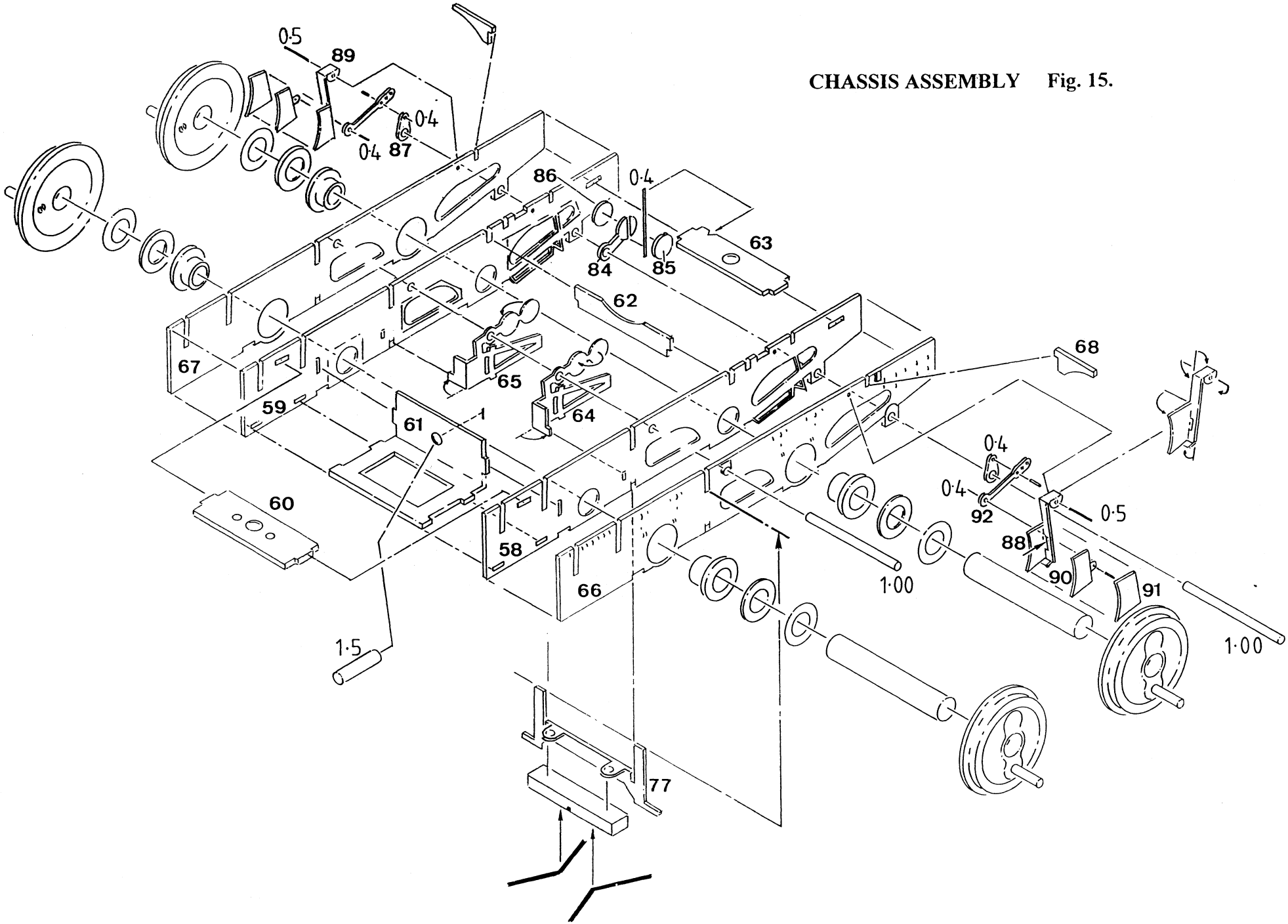
CAB DETAIL
Fig. 12.

PIPEWORK AND HANDRAILS
Fig. 13.



RIVET STRIPS (AS VIEWED IN FRET) Fig. 14.

CHASSIS ASSEMBLY Fig. 15.



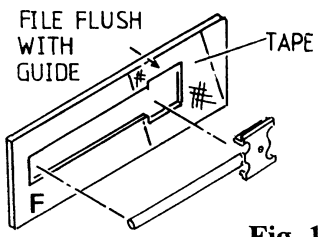


Fig. 19.

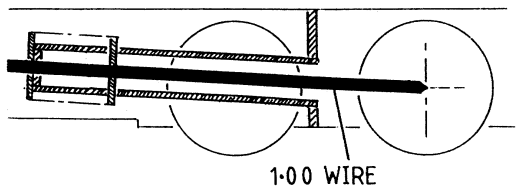
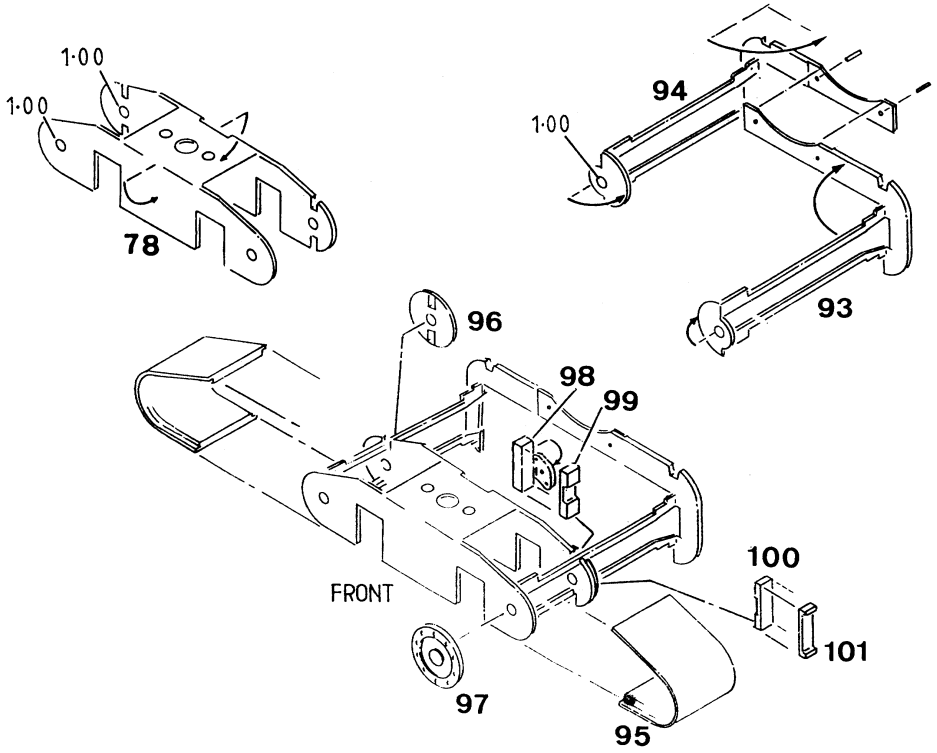


Fig. 17.

FINAL ASSEMBLY Fig. 16.



CYLINDERS AND MOTION Fig. 18.

97-1 GEARBOX

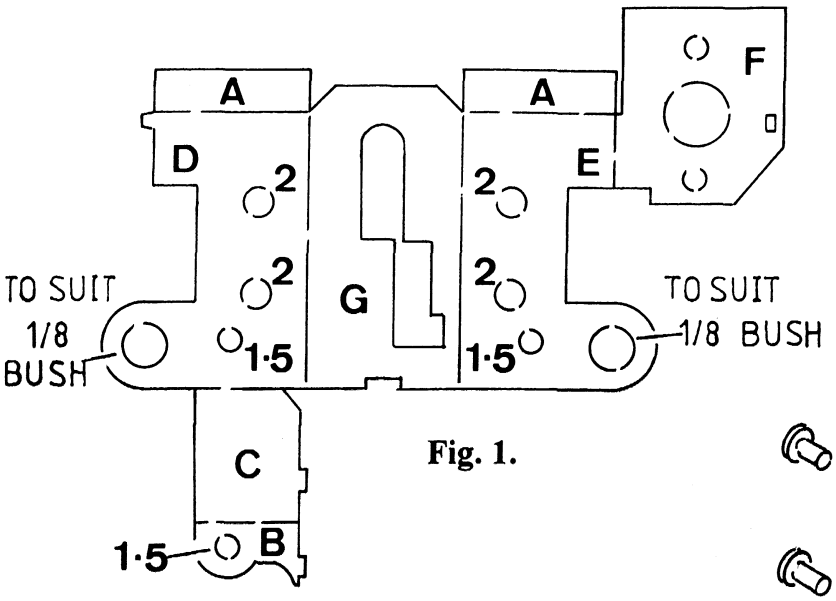


Fig. 1.

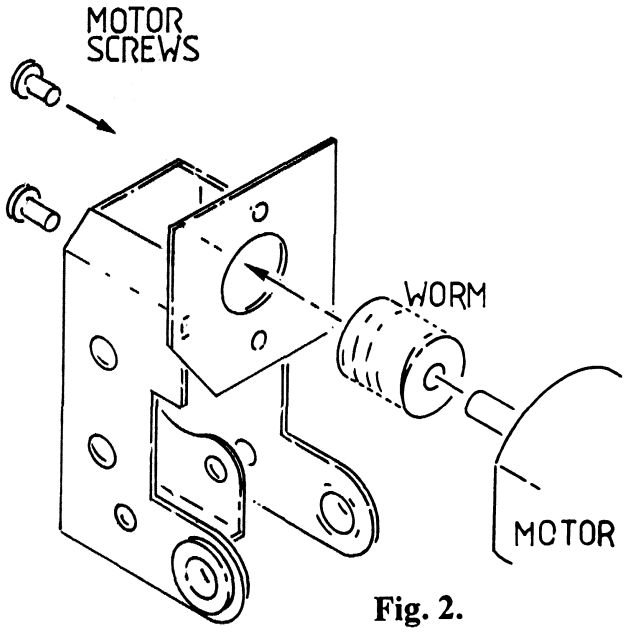
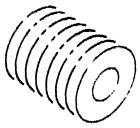
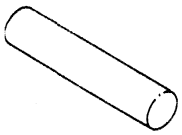


Fig. 2.

	Kit contents
	Worm x 1
	Double gear (2mm bore) x 2 Stage 1: fine and coarse teeth Stage 2:: coarse and coarse teeth
	Gear shafts x 3 Stage 1 and 2: 2mm dia Idler: 1.5mm dia
	Collar x1 (2mm bore)
	Idler gear (1.5mm bore) x 1
	Axle bushes x 2
	Brass gear x1 (1/8in bore)

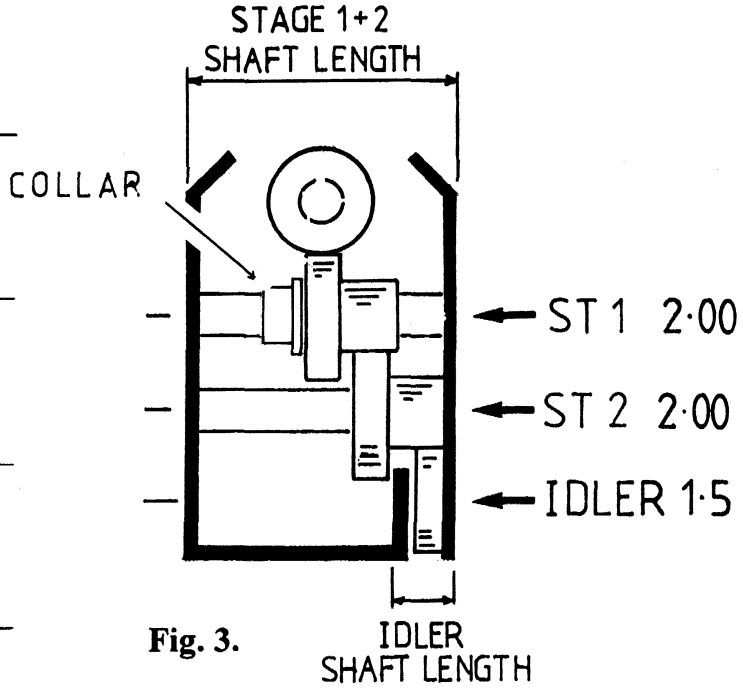


Fig. 3.