Lever Frames and Associated Products

If you read no more than this do so now:

You should before construction know:

- What every lever is intended to do
- If and how you will make mechanical links into the lever frame
- If and where you will mount electrical switches in the lever frame
- What kind of catch handle you will be using
- What the colours and numbers sequence for each lever will be
- What your interlocking requirements are, and where you will place the locking unit
- Where and how you will mount the lever frame
- Do NOT finally fix the lever frame in place if adding interlocking, until linked to the interlocking modules.

Now read on:

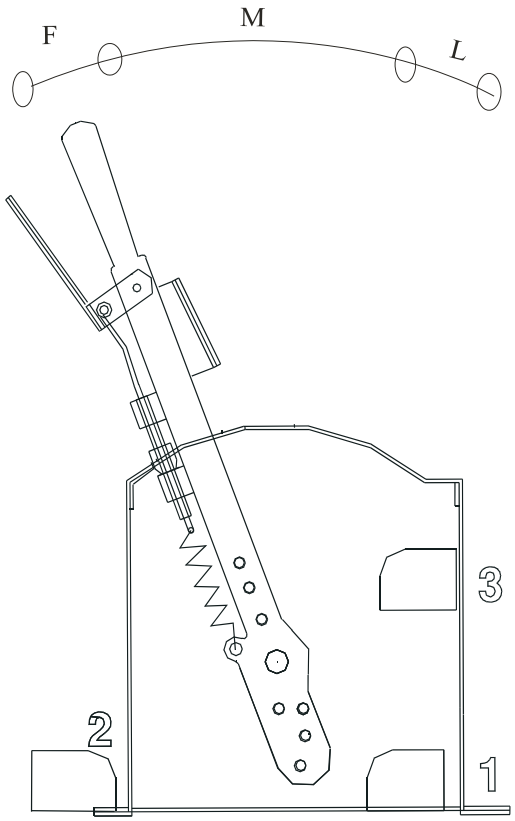
- Basic alternative arrangements
- How to make the lever frames
- How the interlocking works (Only included if purchased)
- How to assemble the interlocking unit Only included if purchased)

AMBIS Engineering Division

Moving Modelling closer to the prototype in operation and appearance.

Basic Alternatives

First sector release switch(1)
Middle Sector mechanical movement
Last sector push switch operates(2 or 3)

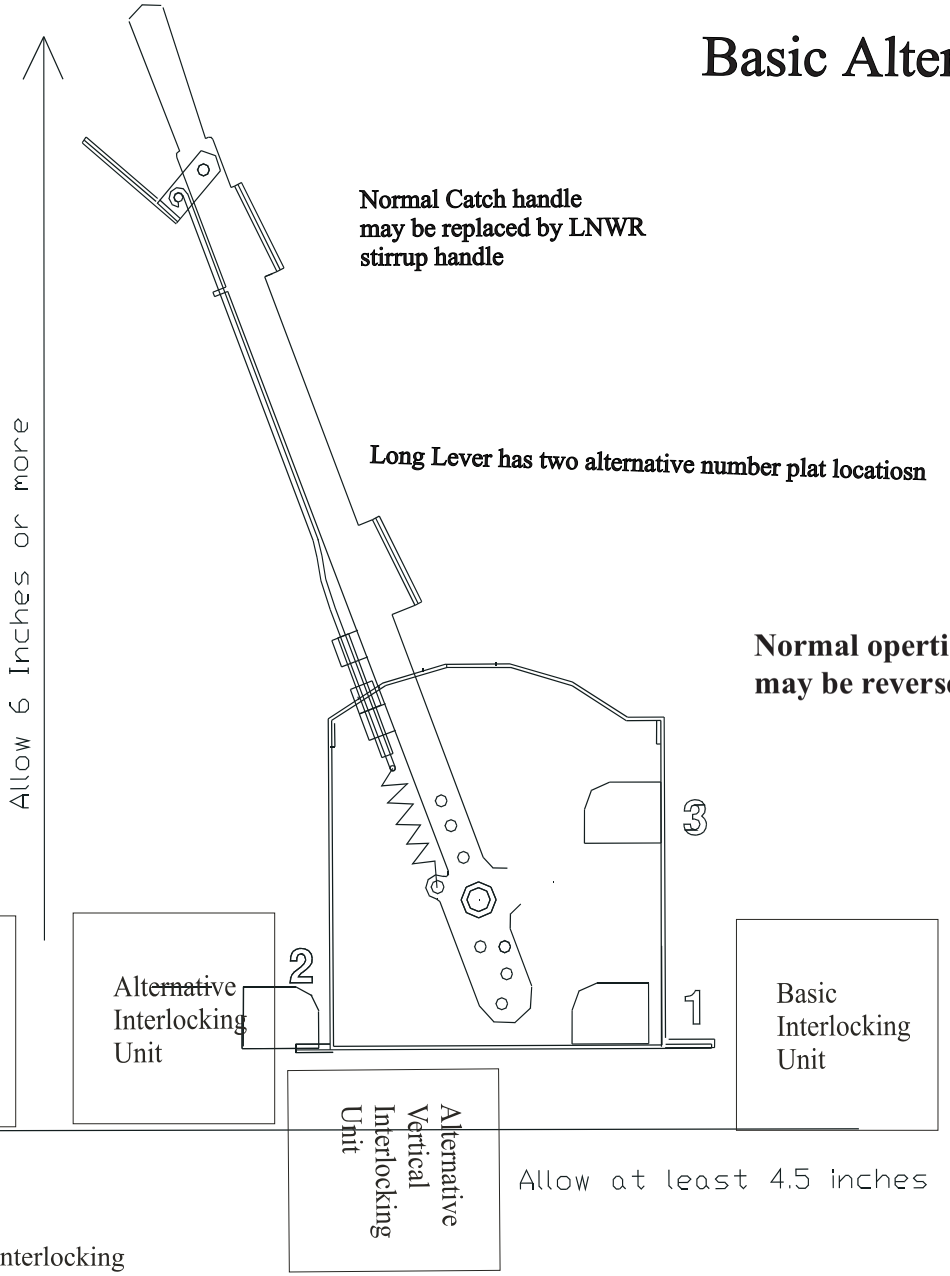


To mount interlocking units raise lever frames about 9mm

Switch Position 2 -
- Works as push switch

Switch Position 3
- Works as Push switch

Switch Position 1 - obstructs Interlocking
- Works as Release switch



The rest of these notes are in four sections:

1. Basic construction principles

2. Lever frame base unit

3. Levers–

Standard Levers

Long Levers

4. Interlocking

Principles

Construction

1. Basic construction principles

All etched parts should be clean.

Remove from fret by cutting through tabs, remove any sign of tab material and for thicker parts smooth edge with a file, particularly where they join another part.

All bends except where specifically mentioned should be made with the part etched away metal to the inside of the bend.

Special note should be taken of nickel silver parts, you may have between 1 and 2 tries at forming the bend before the metal breaks. Normal nickel silver sheet does not fracture so easily.

Where bends need to be particularly crisp, before bending, score with sharp implement, such as an old knife blade, along the etched line.

We do not usually advise any method of construction other than soldering. For heavy sheet parts such as the lever frame a powerful soldering iron over 100watts — or a resistance soldering unit — or a gas gun will be necessary. AMBIS— usually uses normal solder —lead/tin — but low melt or silver solder techniques may be used at your own discretion.

Make sure all holes and slots are sized for their purpose. Thick etched sheets leave a “cusp” of metal along edges, this can vary by small amounts and delay construction until removed.

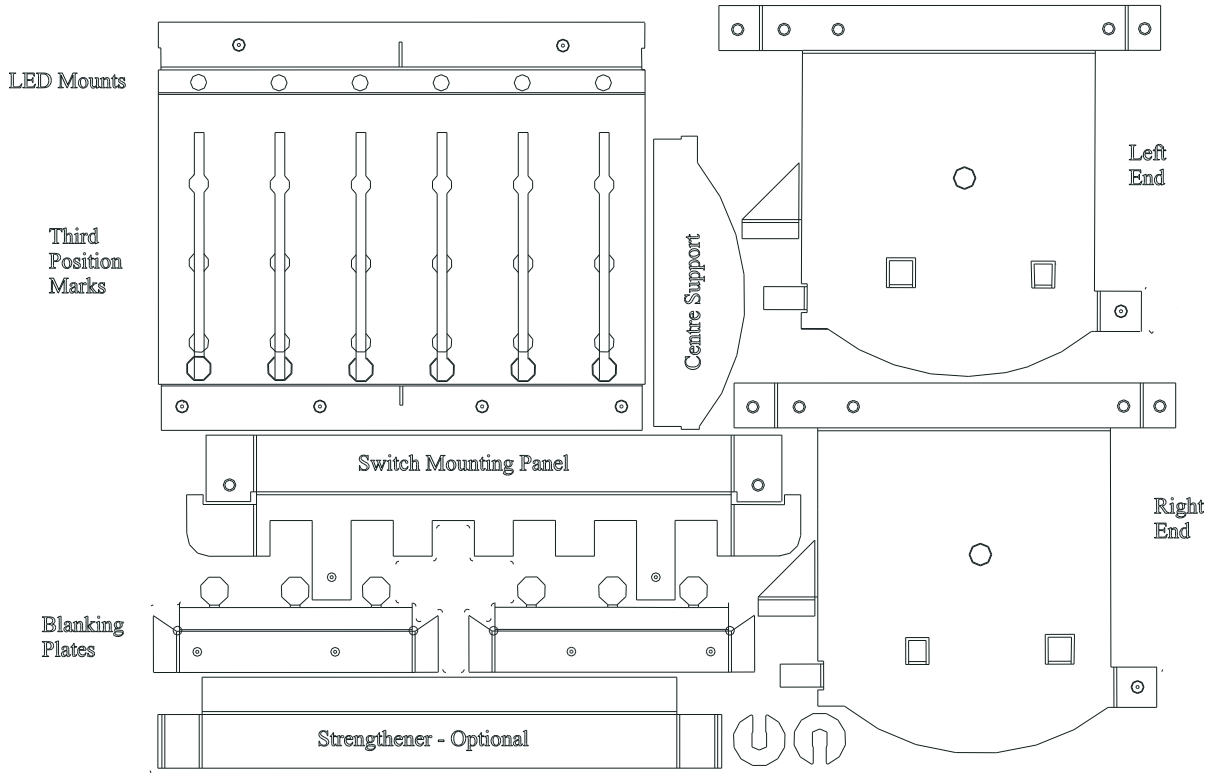
2. Lever Frame Base Units

These come in two, three or six lever modules. The principle of construction is the same.

The six lever module has a central support beam and has two parts to the hole mask units.

For modules joined togther there are a number of points to consider:

- There are locating tabs on the base end panels, but the main alignment tool is the lever fulcrum point. A $^{1}/_{8}$" top hat bush (4mm scale locomotive axle bearing) should be pushed outwards through one end panel into the next. End of frame units should have the bearing pushed in from the outer face. Either solder the two adjoining end units together or simply rely on fixing the bearing in place.
- If fitting electrical switches at the lower positions 1 or 2 the feet of the end panels should not be bent over between modules as they will interfere with the switch mounting. Position 3 does not incur this problem.
- If position 2 is used for mounting switches the fold over foot to the panel end should be removed as the switch panel mounting takes its place.
- DO NOT rely upon the switch locating part to fix the switches in position as the lever action can move the switch out of position. The position of the switches in relation to the lever movement in the frame are critical to reliable electrical switch operation.
- If no switches are to be mounted in position 1 or 2 the fold over feet extensions may be removed altogether. If this is done it will remove the continuity between Mk3 designs and earlier lever frame patterns.



- If position 3 is not to be used for mounting electrical switches the bracket attached to the end panels may be removed before assembly. It should not interfere with construction if folded into the frame and may be retained if desired.
- But if using position 3 for electrical switches where the screw mounting point is upwards this projection will need to be trimmed back otherwise the switches can not be fitted into the lever frame after the upper switch mounting brackets have already been bent into position.

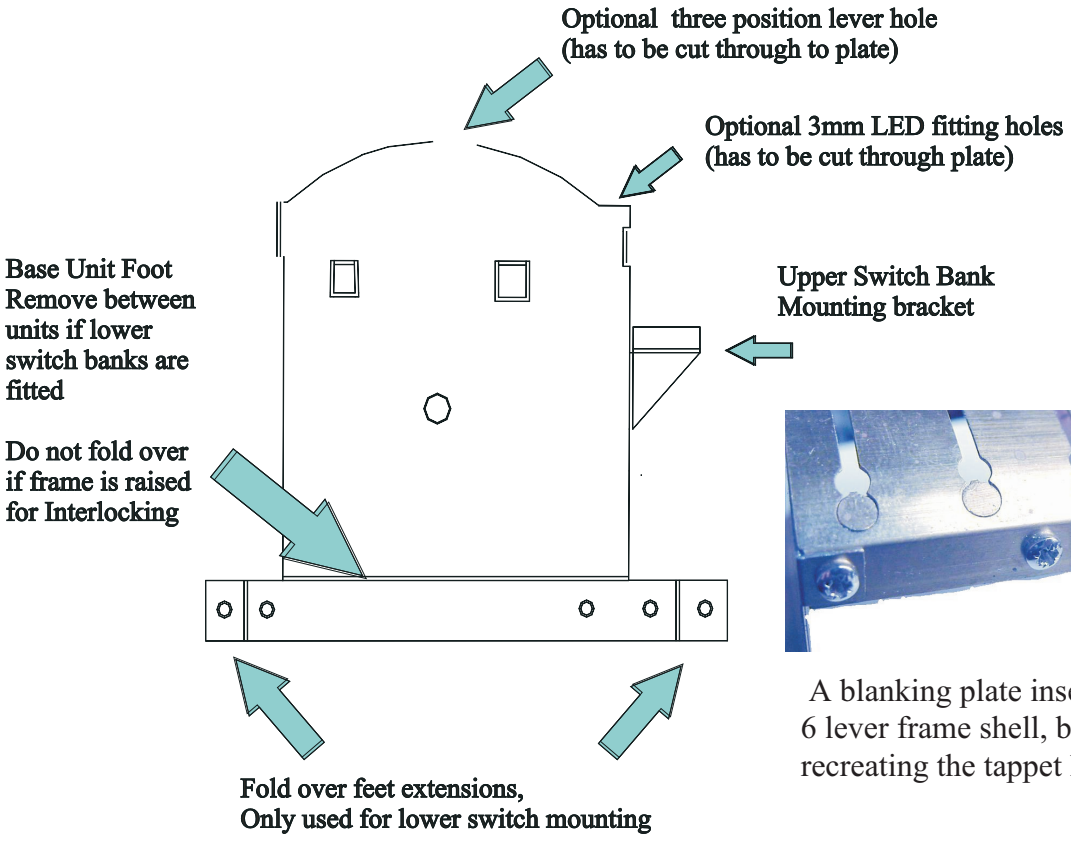
Assembly

Firstly remove the top panel and curve to the shape to the end panel. This may be done with a broomstick or solid metal rod pressing the sheet over the inside of a corner and fine tuning with flat nosed piers, or with a bending machine. One just takes longer than the other method. Once the top curve has been formed the other corners can be fashioned in the sheet — start from the edge working inwards.

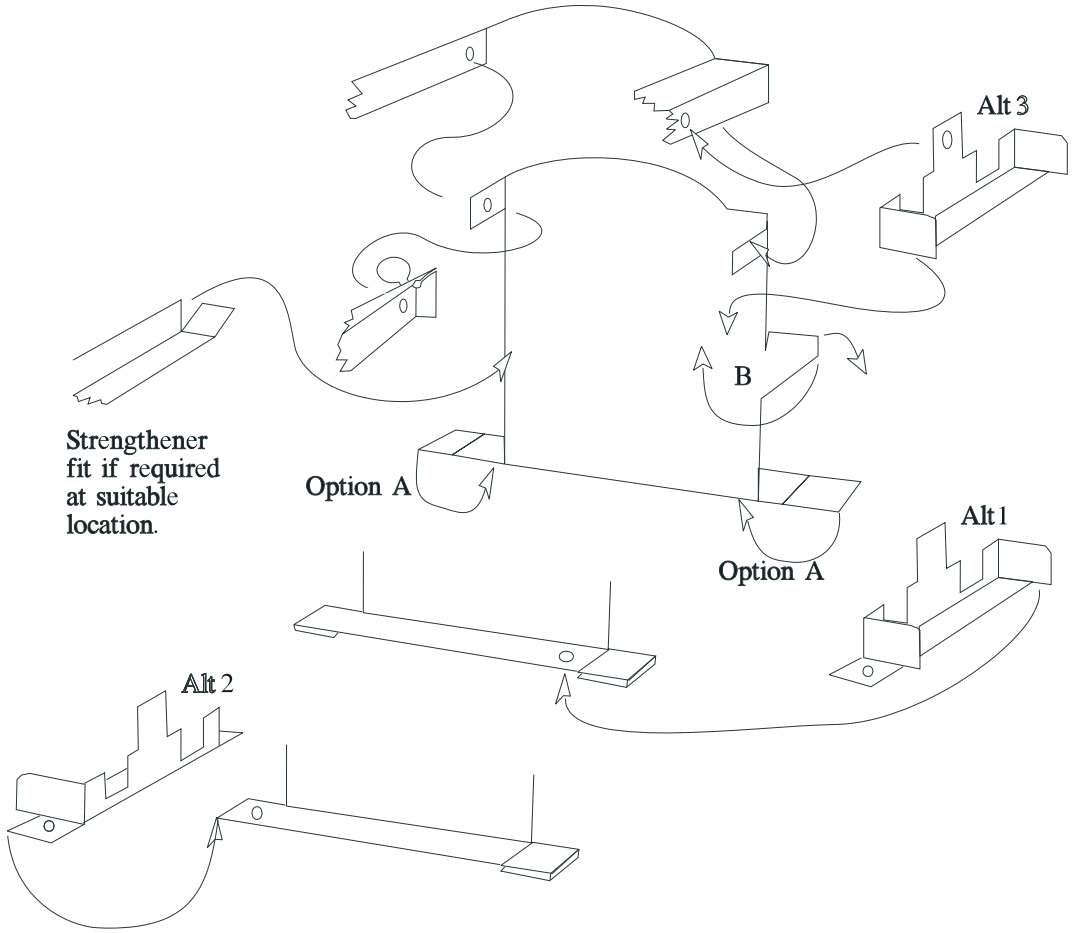
Fix the 6 lever module middle support in place in the slots provided.

Fix the end panels down to a jig - a block of wood will suffice — using the mounting holes in the end panel feet. Use the top panel as a spacer — it fits onto the end panels not between them. Once the end panels are fixed it is easier to solder the top panel to them.

Next make up the blanking plates. Fold over the inserts and fix. Bend the blanking plates so they locate inside the top panel and are fixed by the self tapping screws provided. When you are happy with the fit of these plates, round the hole which the tappet will sit in, by filing away the blanking plate.

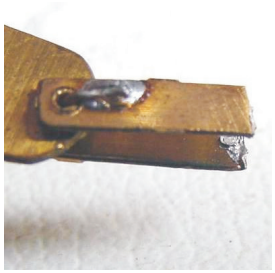


A blanking plate inserted into a 6 lever frame shell, before recreating the tappet hole.



Now fix in place the switch bank panel (positions 1 and 2 only), and if you wish the strengthener panel at the opposite side of the frame. If using position 3 the panel must be screwed in place to the top panel, as the switches will not slot in once the panel is secured in place and we do not suggest you solder close to the plastic frame of these switches.

If fitting the push button switches you will need to move the latching hook so that is doesn't latch on, and remove the button mounting and smooth flat. Test fit the switches.

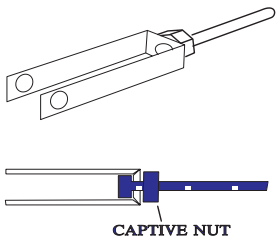


You may consider blackening or painting the base unit black, once assembly is complete.

TIPS

Keeping bearings working

Trapping the small brass tubes without risk of soldering the bearing up as one using soft brass wire as a retainer. Put a piece of wire through the tube and bend to a U shape, then solder the wire down away from the tube



Connecting Levers for mechanical operation

Use part x on lever etches fold up and fit 10BA nut and bolt (supplied). Attach with tube and wire as shown above.

3. Levers.

There is very little difference between the long and standard levers. Both may be assembled before fitting into the lever frame (Mk 3 pattern).

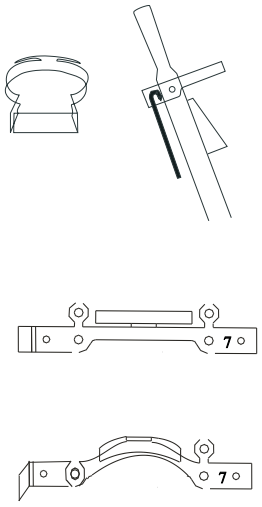
Please note the long levers have an additional option - the mount a lever number plate in either a high or low position -- remove the mounting brackets from the outside layers of the levers that which you choose not to use. Some railways did not number levers on a plate attached to them, you may decide to remove all number plate supports from each lever.

Once assembled the lever handle may be shaped by rounding its edges. You may also decide to trim the length of, or shape the catch handle. As an alternative a stirrup handle may be fitted - as for example the LNWR railway usually used.

When complete and tested finish the lever off by painting to your railways colour code. The most common - but not universal colour scheme was:

- Stop and shunting signals - red
- Section Signals (a fairly modern idea) red with a horizontal white stripe.
- Distant signals - yellow
- Points - Black
- Economic Facing points (two levers operating as one) - black with blue chevrons (or blue with black chevrons if you prefer)
- Facing point locks, bolt locks and release bars - blue
- Level crossing bolt locks, gate stops and wicket gates locks/release levers - brown
- Gongs, electric ground frame releases, direction levers, mechanical indicators for barrow crossings - green
- Electric ground frame release, direction levers - blue and brown
- Detonators -- black and white
- Spare levers - white

The difference in working parts of a long lever is the pull wire guide. Fold its fingers over the wire to retain

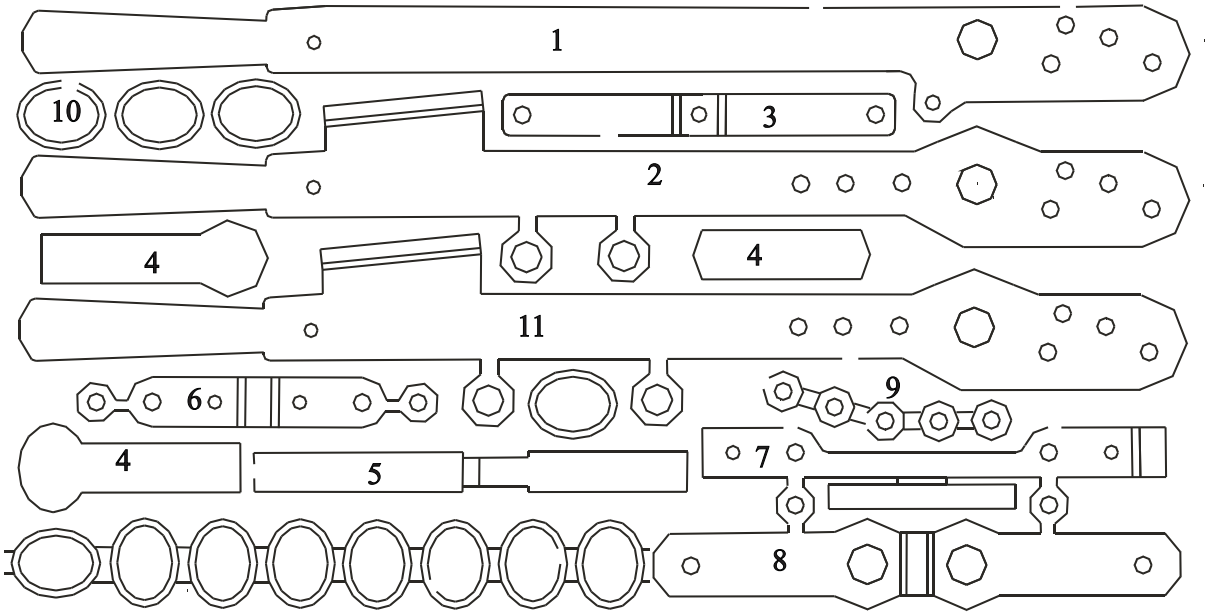


The stirrup Type catch handle

Two colour levers were generally painted with an upward or downward pointing chevron approximately 10 inches deep.

Assembly

First make up the lever from the three layers supplied (parts 1,2 and 11). We suggest tinning surfaces, use pins/clamps to aligned and reheat until joined together. A really hot iron can make easy work of this, you will be wasting your time with 50 watts or less heat, one end will cool before the other heats up.



One etching for a standard lever. The number series for number plates supplied ranges from 1, A and a upward, for changes or supplementary levers to a signal diagram.

Fold over the number plate tabs and twist around the locking tubes rings. Fix number plate parts as desired. (Parts 4 and 10)

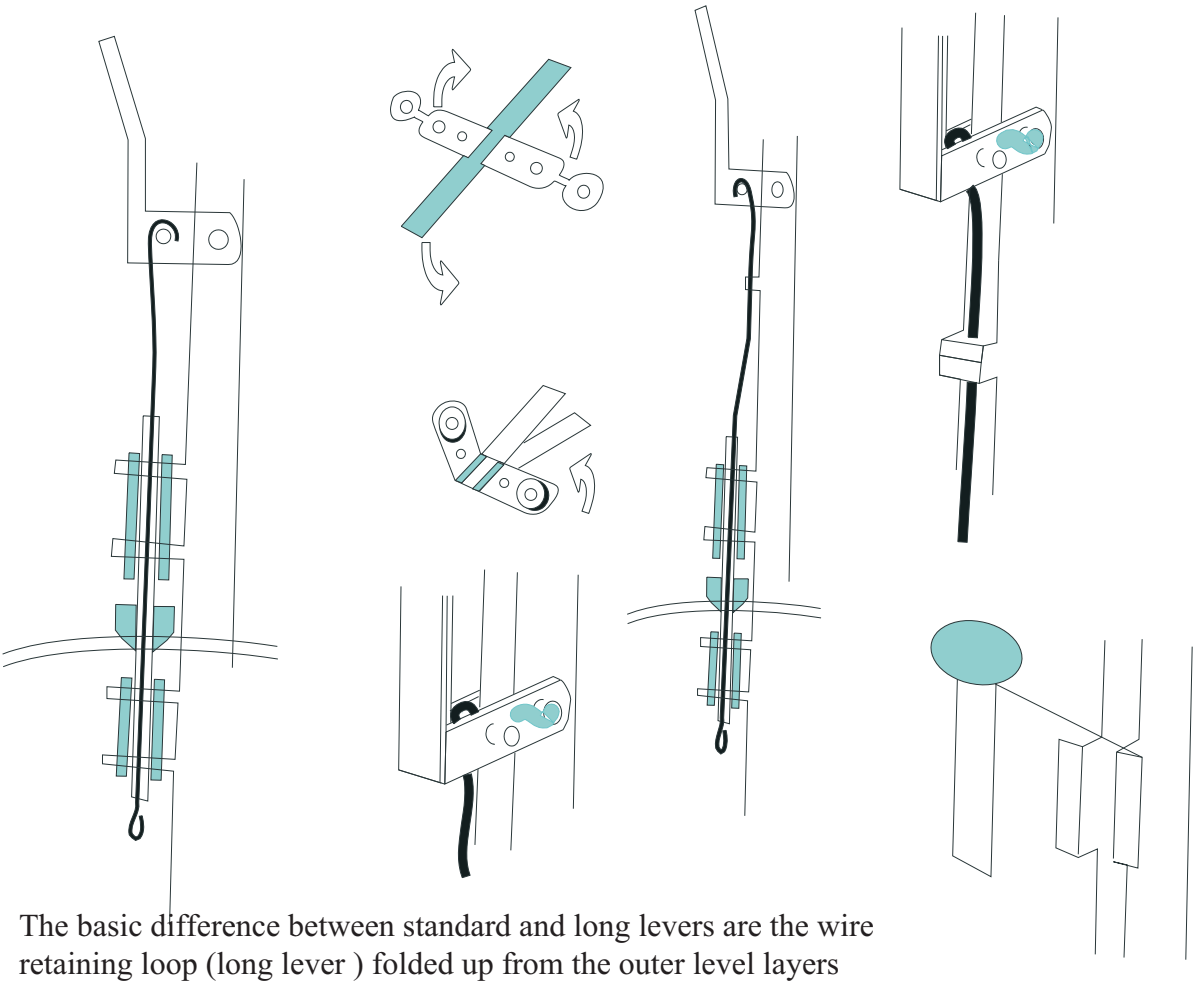
Cut and fix between the locking tubes rings some $^{1}/_{16}$" inside diameter tube. You may chose to fit one piece per lever and cut away the centre portion - beware you may run out of tube if too generous. The aluminium rod supplied is to allow you to align these two tubes while it is being heated to solder up.

Next cut a section of $^{1}/_{16}$" tube approximately 6mm or ¼" longer than the overall dimension of you wider tubes. Cut off one tappet from the set supplied and feed the narrow tube through it and the wider tubes. Solder the tappet in place at the lower end of travel.

Next make up the catch handle (parts 5 and 6) or stirrup handle (part 7) , following the diagrams enclosed. The soft brass wire is used to fix the small tube in place away from the bearing surfaces. The thicker brass wire is used to trap the release wire - not yet fitted.

Make up a return spring from the continuous spring supplied. It should be no longer than 1 cm including end loops. If you do not have a hard wire cutter (do not use ordinary cutters as the wire will damage teh cutting edge), nick the wire and bend sharply, this will ususally break the spring wire. Fold the end loops by using a pair of pliersto bend the wire through 90 degrees - on almost a complete loop of the spring..

The tappet must rise out of the frame top plate. This can be controlled by the size of the fixed outer locating tube, the position of the tappet on th emoving guide rod (tube), the length of the pull wire (which effects the catch handle movement) and the relative location of the guide rod and pull wire,



The basic difference between standard and long levers are the wire retaining loop (long lever) folded up from the outer level layers around the release wire.

The phosphor bronze wire is used to link the catch handle with the return spring. Form a loop a one end, attach the spring, pass the wire upwards through the centre tube, then attach the spring to the lever. Pass the wire through the catch handle and bend over -- the catch handle should be in the released position -- so that the release pull wire is short enough to work. When happy with this action of the release wire/catch handle you may solder the tappet to it at this stage, otherwise leave this until the lever is mounted in the lever frame so you may judge how much movement is required to release the tappet from the hole in the base unit.

If using the mechanical link connector (part 3 and a 10BA nut and bolt supplied) fix this to the correct hole in the lever (lower holes give 3, 4, 7 or 10 mm throws). The 10mm throw hole is required for the interlocking connector. The pull operating connection holes are not etched through all three lever layers, if required these should bedrilled through before assembling lever frame.

Part 8 may be added around the lever a give a cranked operation for vertical mounting of the locking frame or rodding- but if fitted will need to be done after the lever is inserted into the base unit (it won't pass through the frame top panel).

Finish the lever off by painting as required.

After slotting the lever into the frame, the fulcrum - a 1/8" steel rod may be inserted through the main hole. Cut off and trim to length a brass spacer tube 1/8" inner diameter to hold the lever upright. The length for this tube cannot be determined until this stage is reached. Sandwich this spacer in place between lever and lever or lever and bearing, using the steel rod.

When all levers have been inserted in the frame, two rod retaining clips may be fitted. Slot the steel rod so that the clips (on the frame etching) fit over the rod. It has been known for the rod to move sideways and fall out of the frame base at one end. Other fixing methods might be a "bookend"at both ends of the lever frame.

List of parts for lever frames:

For one 6 lever frame:

- Wrapped etched parts: 1 etching titled 6 lever frame, 1 etching providing 6 levers
- One large bag with two smaller bags within containing

Twice

3 tappets, 1 top hat bush ⅛ " inside diameter, Phosphor- bronze wire, brass tube 1/16" inside diameter, tube outside diameter 1/16", brass rod diameter 1mm, brass tube ⅛"inside diameter, soft brass wire, 3 tension springs.

And
A piece of aluminium rod 1/16" to assist is aligning holes and assembly.
One ⅛"silver steel rod to length of lever frame.

Other parts in series, currently available:

Operating cranks (not to scale)
Mechanical Interlocking components
Electrical Switches from Maplin Electronics (also available through Squires)

And AMBIS stretcher parts, operating cranks for 4mm and 7mm scales

Discussion paper on inter baseboard connections - for mechanical systems

Levers frames and accessories supplied to order by
AMBIS Engineering Division
27 Stanhope Gardens
Ilford Essex IG1 3LQ

Mail Order and exhibitions ONLY or through selected retailers

E-mail to alan@austinalan.wanadoo.co.uk
Answer phone (44) 020 8554 9877.

Proprietor : Alan Austin
UK Value Added Tax No: 506 2751 63

4. Interlocking.

Principles.

This form of interlocking was based upon the Hornby-Dublo two rail system point operating mechanism. However this itself relies on earlier ideas. Some time after going into production AMBIS discovered that a NER signal engineer about 1879 called l'Anson employed a very similar method.

Interlocking of a mechanical form should stop the signalman pulling the wrong levers OFF (or clear or proceed or GO), should the route ahead not be safe for the passage of a train. It should also allow the signals to return ON (or danger or halt or STOP) in an emergency. Essentially this means preventing two conflicting routes through pointwork being constructed and then following the safe practice of allowing only one train to move along a section of track.

Before multi-aspect colour light signalling was introduced this was primarily achieved by a combination of mechanical locking and the application of the principle of block signalling. This means arranging between signal boxes a method which only allows one moving train to occupy the track between each of them, and in an absolute form keeping one block or section of track between moving trains, empty.

However this is a vast subject which has many facets and cannot be fully explained in a few words.

The AMBIS lever frame interlocking system provides a system which can reproduce these practices at a small scale and take account of practices which model makers usually adhere to, such as two rail electrification and the omissions of some safety features. For best use both electrical and mechanical operation of points and signals should be used.

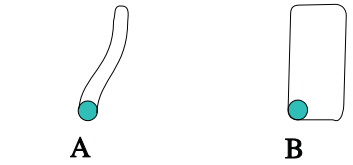
If only electrical interlocking is used it can be a case of "find the error" when a model train does not move. With mechanical interlocking at least the operator can only move the right levers, leaving the actual train to probably be the cause of any inactivity.

To provide the full system of interlocking it is necessary to employ electrically operated signals at some locations using the "push" operation indicated in the lever frame construction notes. This is so levers return signals to ON, in the last sector of lever movement not the first sector, before the mechanical locking mechanisms have any effect. It may be possible to provide this action mechanically, if only some movement -- in the last sector --actually operates the signals.

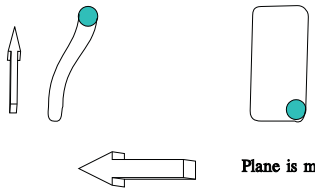
Before construction of any interlocking the builder must have a fully tested "locking table", that is to know what levers must lock or release other levers. How this is obtained from the AMBIS system is introduced in the diagram.

As the lever pushes or pulls a vertical pin through a Z shaped slot in a horizontal plane, that plane moves at right angles to the pin. The plane can have slots cut into it which either allow

Basic Function of Locking

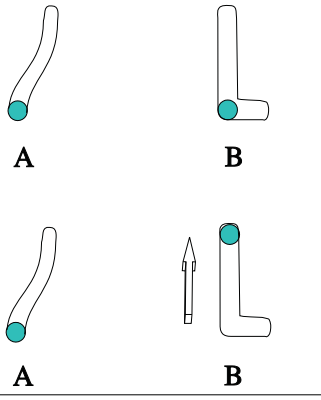


Initial Positions



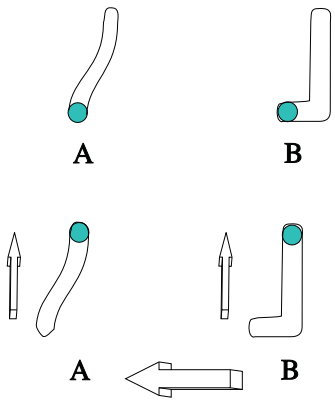
Position after A is moved
Lever B is uneffected

Plane is moved by A



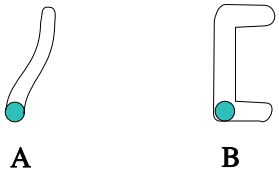
In this case after A is moved
Lever B is locked ON

In this case A cannot be moved
Lever B must be reversed first.



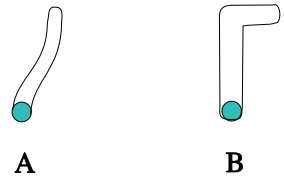
In this case A must be moved
Before Lever B can be reversed.

In this case B must be reversed
Before Lever A can be reversed.



In this case Lever A locks Lever B
EITHER WAY.
This is the basic function of a
Facing Point Lock,
or Holding the Road,
Lever A locks, Lever B a point.

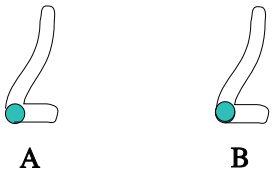
In this case Lever A releases Lever B
EITHER WAY.
This is the also the function of a
Facing Point Lock,
(alternative mode of operation),
Lever A unlocks, Lever B a point.



In this case B must be moved
Before Lever A can be reversed.

B back locks A

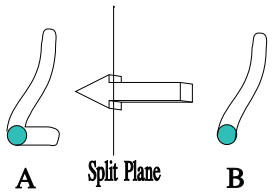
More Complex Locking Examples



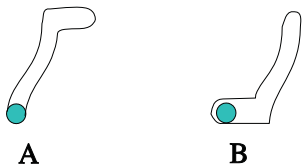
In this case both Lever A locks B ON,
or Lever B locks A ON

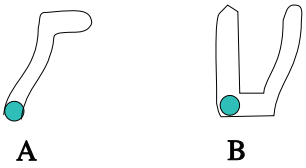
These levers mutally exclude
each other from working.

Example
Applicable to ground signals
controlling movements both
ways through pointwork.

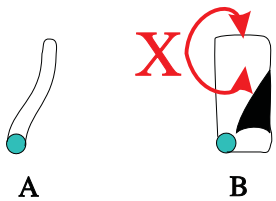


In this case both Lever A can operate
independently of Lever B,
BUT if Lever B is moved
Before Lever A is pulled OFF
it will Lock Lever A ON.





The three slot solution can be created from
standard parts - but the shapes are not etched
into the locking planes. Use the "patches" provide
if required.
Not all planes in a locking frame need have three
states or slots.



Tablet Locking
Cannot be made from basic parts.
The black triangular section has to be
added from additional parts.
It MUST be sprung loaded to work.
Lever B can be reversed independently of A
But if A is reversed B is locked ON.
However if B has already been reversed
it can be normalled.
Applicable to locking signals in the rear
from being reversed to allow a second train
onto a line, whilst allowing normal
sequence of pulling signals off.
Example A is an advanced starter,
whilst B is a starter signal.

NB.

This sprung loaded catch may not be required if the operation of signals is electronic or mechanical and ONLY in the first or last section of lever movement at X - see Page Two.

PLEASE NOTE

For specific track plans it may be vital to consider using MIRROR images of the Z slot operation - especially for split plane operation and three slot solutions.
In this case all locking shapes should also be mirror imaged.

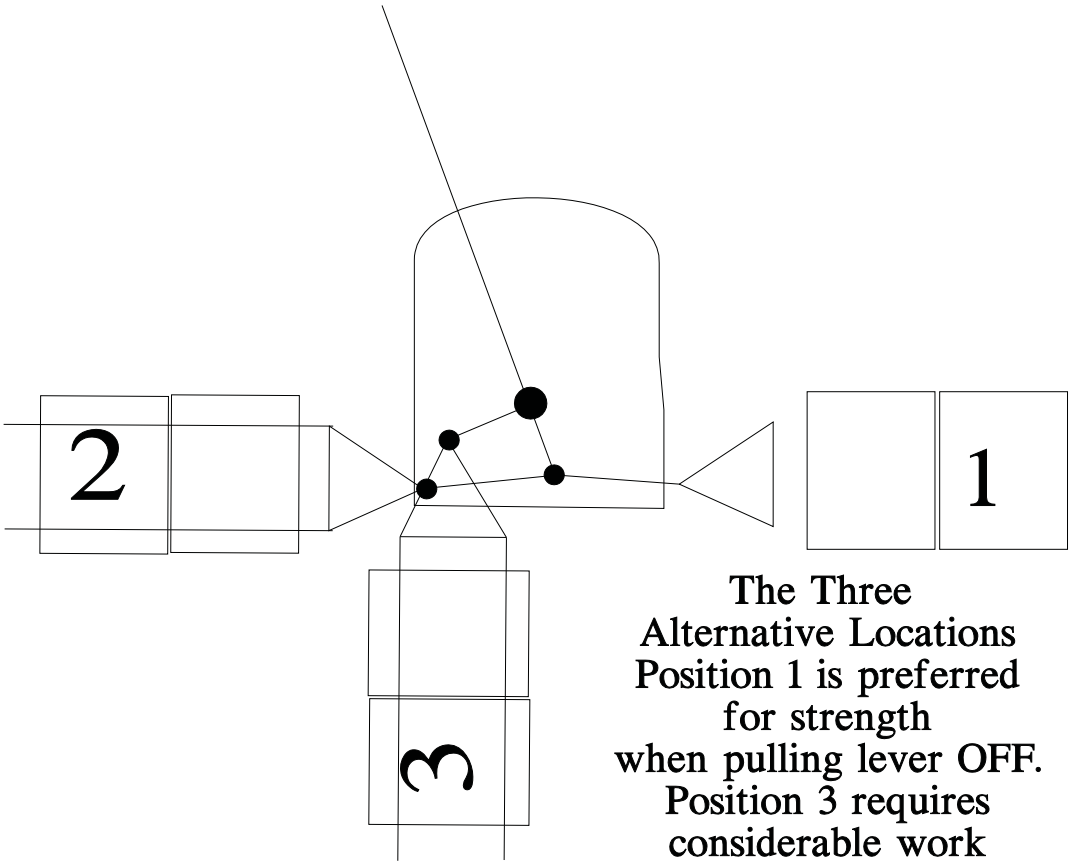
of inhibit the pin's movement. This can be set at either end of the pin's movement ands thus the basic interlock requiremenst can be provided - to lock or release another lever.

This can be made more complex by linking the action of one lever to another which controls other levers - to lock based upon a sequence of movements. One lever can mutually lock or be locked by another and so on.

It is also possible to move a plane by an external motor or from another lever frame and thus lock or unlock ground frames from a central control position.

Being careful on the order in which levers are put into the lever frame can produce economies, but no one answer will be correct. Each railway company used engineers with their own system or style and so different company engineers are not likely to agree on a single solution to a track layout. It is noticeable that only railway-like not model layout plans can be readily interlocked as often modellers will want to operate a railway in by real railway standards an unsafe method. In this area a little understanding can be a dangerous and confusing thing.

Anyone interested in interlocking but who has no prototype experience to work from can contact AMBIS who are prepared to give advice, on the understanding that a solution can be one of many. One answer is to obtain a complete signal box diagram from a real place.



The Three
Alternative Locations
Position 1 is preferred
for strength
when pulling lever OFF.
Position 3 requires
considerable work
to implement

Construction.

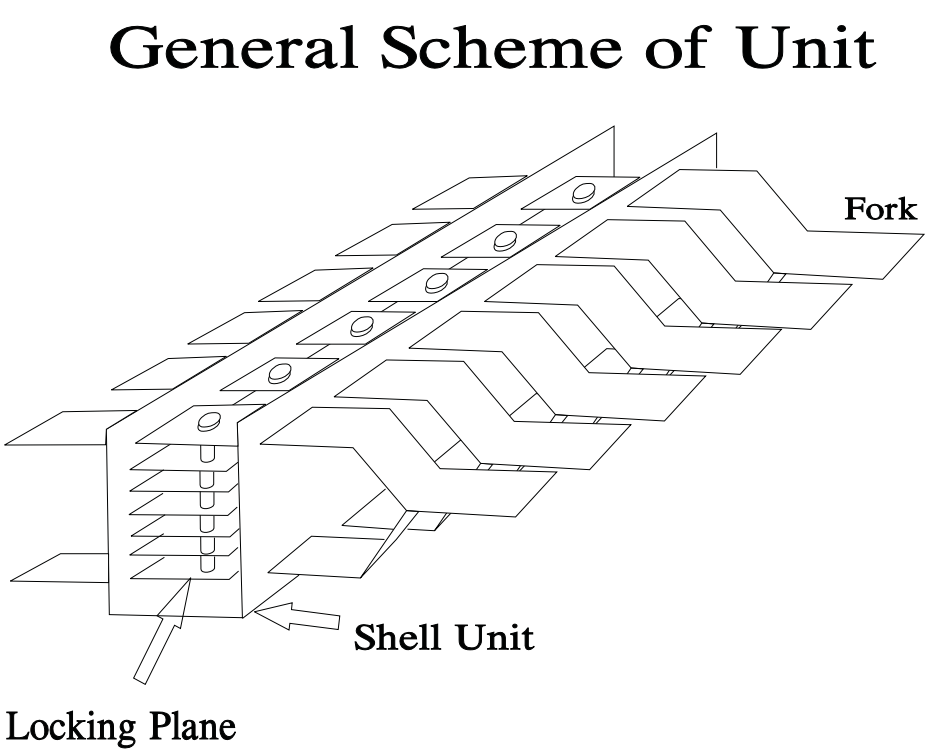
This is undertaken in three parts:--

- Firstly a shell or frame has to be constructed.
- Next is fitting the moving planes
- Thirdly the lever frame connecting forks need to be fitted.

It is possible to pass 12 moving planes past one lever, by installing two banks of frames next to each other. If only one bank is used the “forks” may be reduced in length as long as they still slide within the frame.

The frames are supplied in 12 lever long sections. The may be butt joined to span a greater number of levers. No direct provision is made to join the planes together. It is suggested that when joined a rivet or screw joint is made - do not rely on solder. As it is possible to make mistakes in cutting the slots in the planes “patches” are supplied. These may also be used to join planes together.

The frame shell



Is is importnat that the “forks” and “planes” slide easily in the frame unit, clean up the slots if they cause any friction.

Fold up from the single etching and strengthen the fold lines with solder.

Two bracket pieces are supplied to fit over the open shell top. Fix these so they do not obstruct the slots in which the forks slide.

The Moving planes

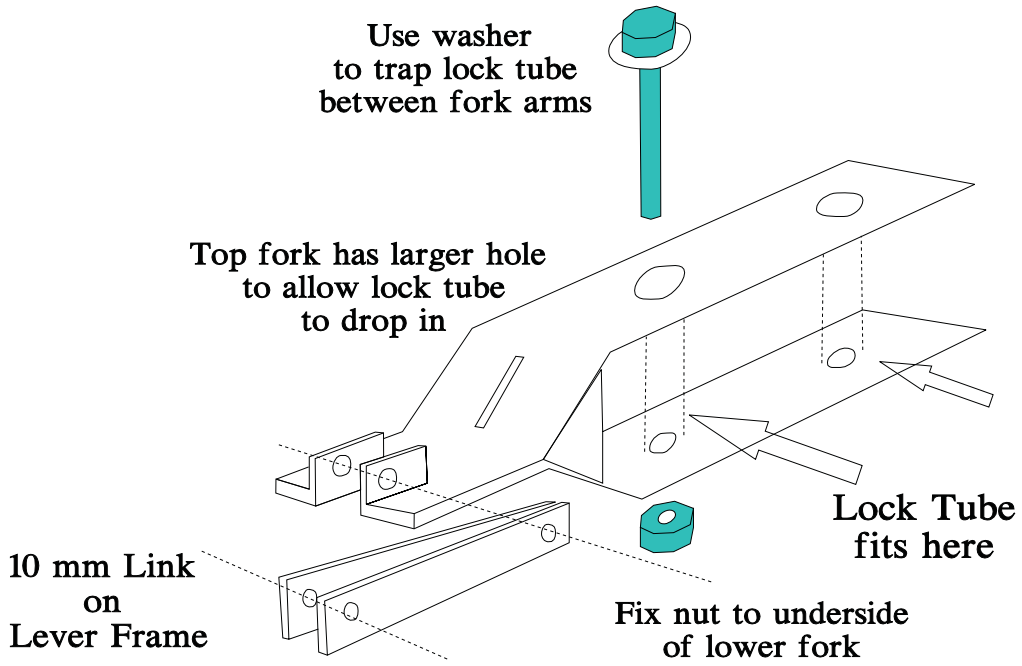
The plane units have marks indicating the basic slot patterns. The normal “at rest” position is marked with a hole. It is not important which way the planes move, except where the interlocking arranegements require a specific sequence of lever movements. All plane moves will normally be in the same direction - the the left or right.

The slots should be 3mm to 1/8” wide normally, and only work well when the pin attacks a slot angle or less than or equal to 45° from its direction of travel. The pin is expecting to move 10mm, any less induces unecessary strain in the fork linkage. Planes can be sub divided by cutting through well clear of any slots cut into it, and should be longer than they are wide - that is always span 3 or more levers and should not drop out of any guiding slots in the frame shell otherwise they may jam when moved.

The “forks”

These are made to spread the load on joints, hence the pushing movement is divided into two, and supported by a fillet - we call them “forks” after tuning forks.

The movement from the lever frame should be as straight a line as possible, hence the advice to raise the lever frame shell up to 9mm from a base line. If not the connecting link and the fork may be bent by an operator tyring to force a locked lever.



Forks and Connecting Links Modified Instructions

A design failing has resulted in the top part of the fork having too small a hole in it. This should be opened out so that the sleeve over the long screw supplied can be dropped into the mechanism. The washer and screw act as a keeper plate holding the tube in.

To fix the screw a 10BA nut should be fixed to the underside of the lower fork before assembly is finalised. Putting the whole unit together is best done independent of the lever frame. It does need to be firmly fixed down parallel to the levers so that the required 10mm movement is available at both ends of the interlocking where the slots are in the planes.

Holes in the frame shell are provided to help fixing the nuts and to provide fixing points. It means that the lever frame should be accessible to enable the interlocking to be connected to it -- so make the lever frame removable.