The detector blades are also fixed to the switch rail brackets, these detect the points locked via an adjustable cam and microswitches housed in the bodies. Another fixed cam on the drive lock slide also detects the lock arms in the correct position. A pump unit mounted away from the track pumps hydraulic fluid into the hydraulic actuators via two pipes, one for normal and one for reverse.

Up to 78 separate parts make up one Clamplock plain lead set of points, so not all are listed here. Also Clamplocks can be fitted to all types of rail and different configurations such as double slips, switch diamonds etc. for these, many other different parts are needed. The Clamplock handbook lists all these parts and specifications.

The pump unit available in 50 & 110 volts has a snorkel valve which prevents air entering through the filler port if the fluid drops dangerously low. It also has a Pilot operated check valve (POCV), which will not allow fluid to enter one hydraulic actuator without detecting fluid leaving the other which double checks the points are actually wanting to move.

Various actuators are now available, the new type have coloured bands signifying what they are, these are as follows:

| | |
|---|---|
| **Standard (no band):** | These are obsolete, not to be used. |
| **Standard (red band):** | Small diameter, self bleeding. Used on Bull-head rail only. |
| **Large diameter (green band):** | 45% more thrust than above and self-bleeding. |
| **Largest diameter (blue band):** | 75% more thrust than green band NOT self-bleeding (switch diamonds only). |
| **Largest diameter (blue & red band):** | As above, but self-bleeding. |

***Green, blue and blue & red banded actuators MUST not be used on Bull-head type rail.***

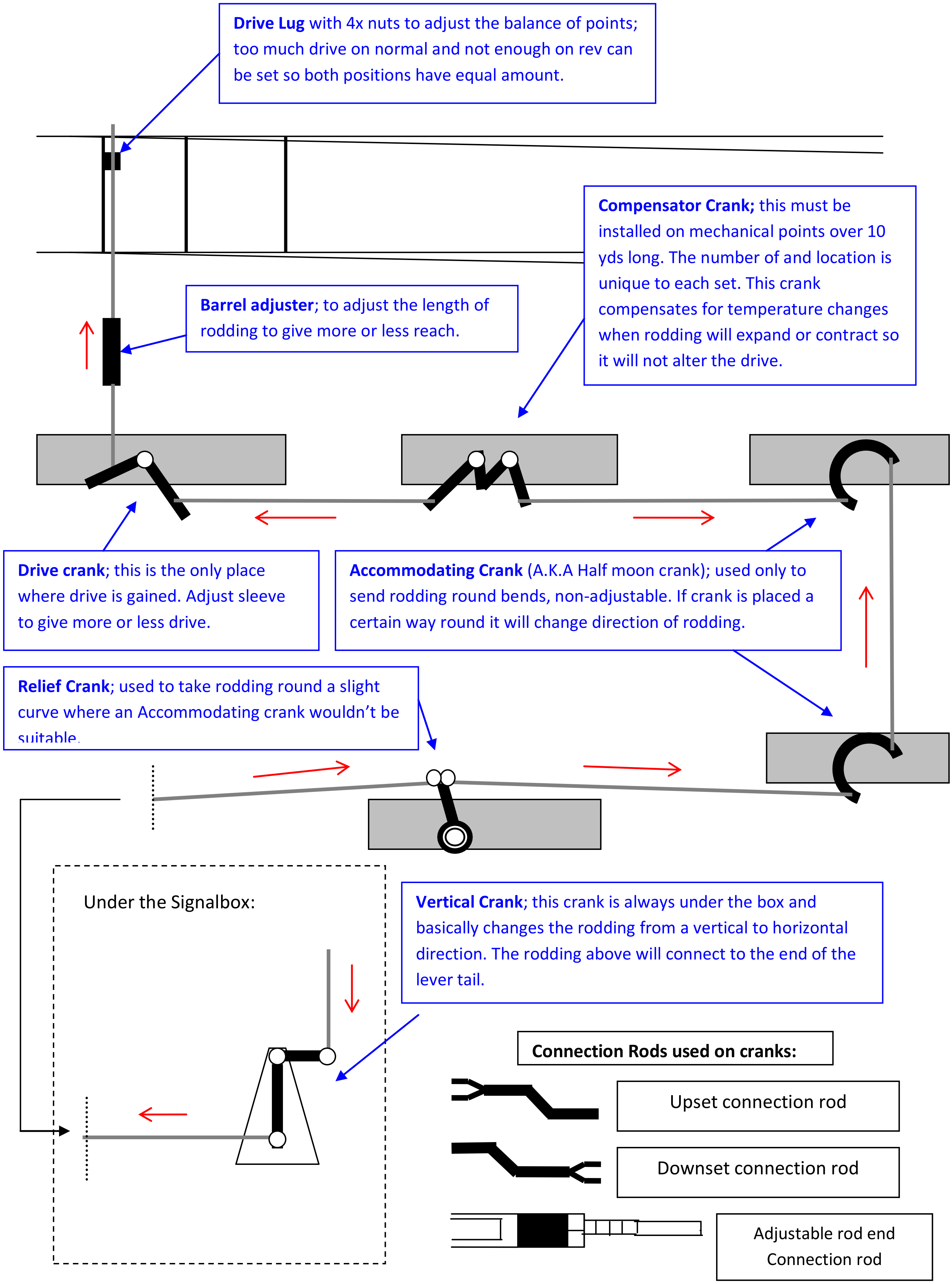
## Mechanical points:

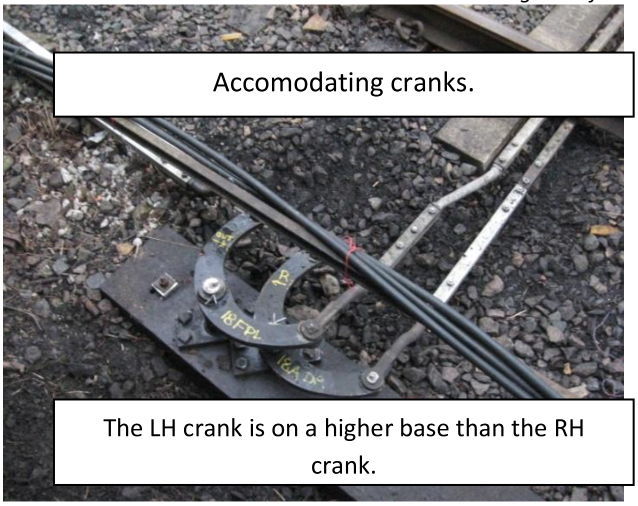
Mechanical points are operated purely by human physical strength via a complex arrangement of rodding, cranks, compensators, and rollers.
Mechanical points require a lot more care and attention than other more modern sets of points as there is a vast amount of moving parts.
Any amount of wear in the fittings will almost amount to systematic failure especially during warmer weather as rodding expands in hot temperatures and contracts again at night when it cools.

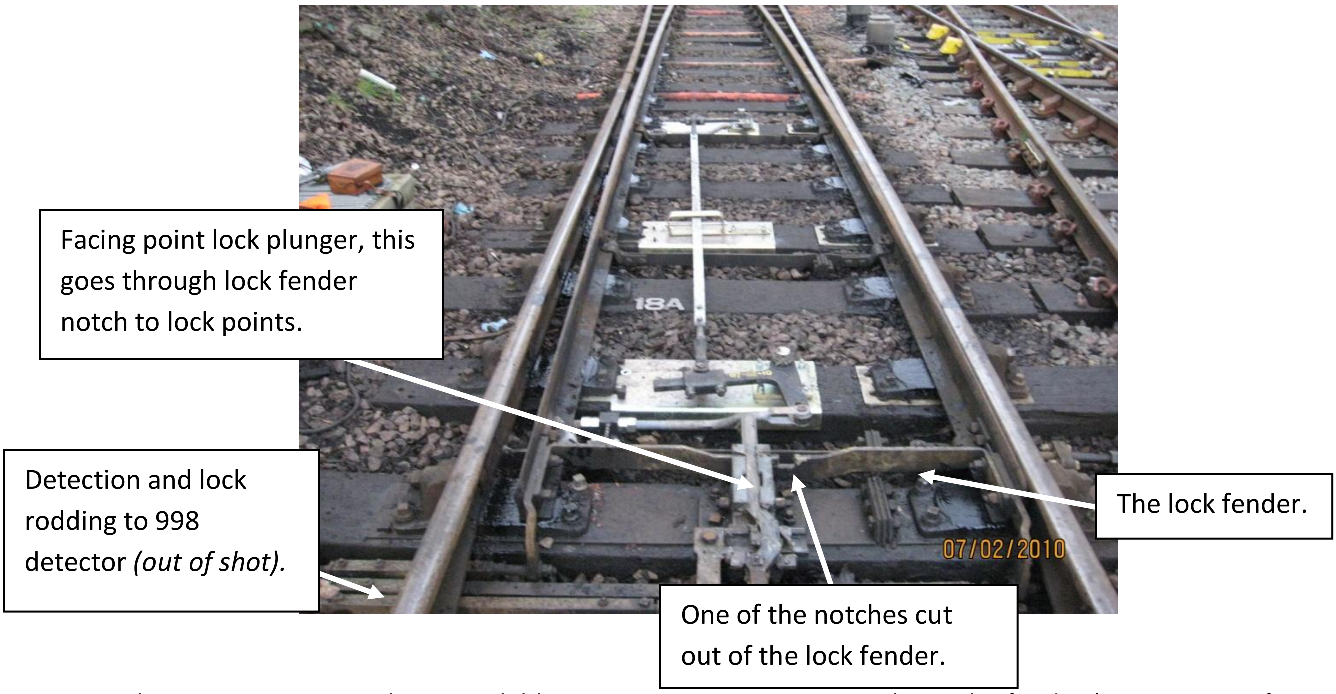
The rodding direction is constantly being changed from a push to a pull via cranks and compensators.
The rodding is set-up originally so that the amount of push equals pull exactly to the nearest mm.
The compensators are positioned exactly where required, so that during hot weather, when the rodding expands they will open or close and equal the push/pull again so the points will remain in sync.

Some mechanical points are fitted with a facing point lock (FPL), this physically locks the points either normal or reverse. A 998 type detector gives the signaller (and the interlocking) a normal or reverse indication only when the FPL is fully locked.
The lock fender has two notches cut out, these are cut-out by the signalling technician on installation. It is vitally important that these notches are worked out with precision as they are not adjustable and if the FPL lock fails the FPL test a new lock fender will have to be cut, bearing in mind they cost around £300-400!

This is a diagram of a basic mechanical set of points and fittings.




There are temporary shims available in 1mm & 3mm sizes to pack out the fender (up to a max of 3.5mm either side) to compensate for a lock plunger going through with the 3.5mm gauge inserted but these are temporary and must not compromise the switch openings.

Other mechanical points are controlled by a ground frame (GF). These are basically the same as a set of mechanical points operated by the signalbox, except the levers are outside in a small frame and a electric release is needed from the signaller or a special key called a Annetts key which unlocks the points. The points are unlikely to have a FPL or detector box as they are usually for engineering work or emergencies, are trailing and required to be secured with a clamp for every movement.

**Other points:**

There are many other types of point operating devices/methods, these are as follows:

**M3 & M3a machines;** these are very old and are still in use. They are a very heavy machine with a sump full of oil and have brass contacts to detect normal or reverse.

**SGE (HB) machines;** these again are old and are still in use. Known as crocodile points because of the markings on the lid, they too are very heavy. The motor is mounted on the outside and the detection and motor contacts are mounted in separate compartments. They are extremely slow as they move a very large crown wheel at just 30 volts.

The **SGE (HA) machines** actually operates its own facing point lock which goes through a lock fender similar to a mechanical set of points.

**The HPSS (high performance switch system);** the UK railways newest points system. This is state-of the-art technology and is a totally new innovation to previous systems. It uses a motor and torsion bar to moves the points, and has sensors which detect the switch blade position. It is set-up using a LCD handheld device.

**'TOPS' (train operated points);** these are basically a hydraulic actuator which holds a set of points in one position. The train can go over these points in either direction but no more than 15mph. The points are detected by two 998 detectors and display a yellow (or similar) light to the driver to state the points are set for him to proceed. There is no indication for the signaller whatsoever.
The train passes over the points in a facing direction without any intervention from the points, but the returning train now travelling in a trailing direction pushes over the points by force of the wheels. The whole train passes through the points, and the hydraulic actuator pushes them back for the next move. The detection circuit also passes through the hydraulic system to check there is enough pressure to hold the points closed (for facing moves only), this must be above 50 bar to display the proceed indication.

**IBCL (in-bearer Clamplocks);** these are virtually the same as normal Clamplocks, except the equipment is mounted actually in the first sleeper, which is made of metal and is hollow. The fittings do vary considerably.

**Air points;** these are very old and are operated by air. Inside the point machine there is a ram which when filled with air depending on which way the points will move extends or retracts and drives the point blades normal or reverse.
The air pressure is around 50-60 bar and when operated they are <u>extremely</u> fast.
Detection is normally detected in a separate unit with brass contacts.

**Points Gauges:**

All sets of points that have detection or a facing point lock need gauges to set them up.
Here is a run-down of some of the gauges and what they do. Not all are shown.

| | |
|---|---|
| **3.5mm 'flat' gauge;** | this is used to check all FPL's to make sure it doesn't lock with this inserted between switch blade and stock rail. Also used to check depth & width of notch on lock fender. |
| **5mm 'flat' gauge;** | shared with the 3.5mm above, it is not normally used anymore in this format. *The gauge is 50mm wide and could be used to check minimum FWC.* |
| **1.5mm 'finger' gauge;** | this is used to check the FPL WILL enter with this inserted between switch blade and stock rail, to ensure a FPL has a slight lee-way and will not shave the lock blades.<br>This is also used on clamplock detection to set the microswitch, detection made. |
| **5mm 'U' gauge;** | used to set the detection on machine points. Detection broken. |
| **3.5mm 'U' gauge;** | used to set the detection on machine points. Detection made. |
| **2mm 'finger' gauge;** | used to set detection on clamplocks to set microswitch, Detection breaks. |
| **6/8mm gauge;** | used to set the detection on additional 998 detectors on adjustable stretcher configured points. |
| **4mm insulated gauge;** | used on clamplocks to check distance between lock arm and drive lock slide, to ensure correct height and will not short circuit the track circuit if the lock arm touches the drive lock slide. |
| **3mm 'curved' gauge (x2);** | used to check distance of lock arm on clamplocks to drive lock slides underneath to ensure they are fully locked. |
| **2mm 'hook' gauge;** | used to set detection on clamplocks (placed behind detector blade), detection made. |

**4mm 'hook' gauge;** used to set detection on clamplocks (placed behind detector blade), detection broken.

**Batter gauge;** has multiple settings to check the residual switch openings on the rear stretcher.

The HW contact set-up kit comes with around ten more gauges to set up each individual contact and also a weigher to weigh each contact.
A hydraulic fluid pressure gauge is also available to check the pressure of a clamplock hydraulic system.

**Switch openings:**

Each set of points require a switch opening to be in tolerance, these figures are below:

Clamplock (exc IBCL) plain lead: 105-110mm (measured over the lock arm)

Clamplock switch diamond: 82-87mm (measured over the lock arm)

Machine (exc HPSS) operated points: 102-120mm (measured over first Pway bolt)

Machine operated switch diamonds: 102-120mm (measured over first Pway bolt)

Mechanical operated points: 102-120mm (measured over first Pway bolt)

**FWC measurements:**

The FWC is measured over the last rear stretcher. No measurement can be written here as it has to be worked out individually using a formula.

This formula takes into consideration the track gauge and residual switch opening.

The formula is:
TG (actual track gauge) **+** Nom FWC (Nominal FWC found in TRK1202 document) **+** adjustment factor (this is a figure used for the differences in point layouts only on 'E' switches and above) **+** RSO (residual switch opening) **–** nominal track gauge (tolerance for vertical or inclined rail) **= Required FWC.**

So for instance a set of points is measured for track gauge and it is 1440mm, the points are a vertical D switch, so nominal FWC is 56mm *(taken from TRK1202),* adjustment factor does not apply, the normal RSO is 1.5mm and the nominal track gauge is 1432mm.

So…………
1440mm + 56mm +1.5mm – 1432mm = **65.5mm** (this is the required FWC that the stretcher will have to be fitted to).

If the switch was an 'F' switch on vertical rail it would work out at:

1440mm + 67mm + 1.5mm + 2mm *(adjustment factor now applies)* – 1432mm = **78.5mm**

Document NR/TRK/1202 covers all different configurations and measurements required to work out the required FWC. An incorrect FWC can result in FBC (flange-back contact) where the gap is too small and the train wheels hit the rear of the switch rail which may result with broken stretchers and possible derailment.