The Pantograph.

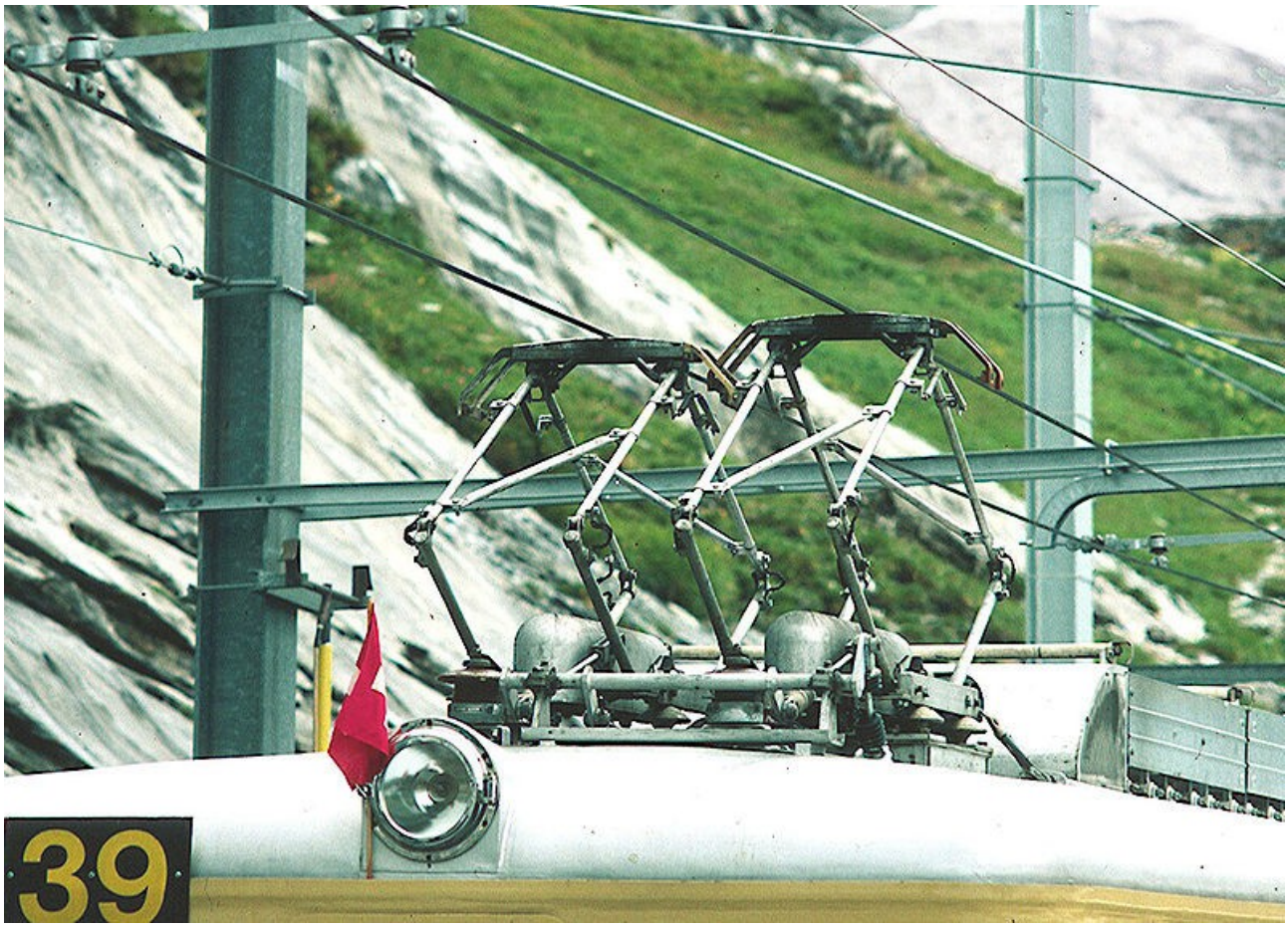
Nothing defines the age or function of an electric locomotive -more than its pantograph. In essence these are simply nothing more than sliding contacts to carry current from the over head wire to the motor. But the process of mechanical evolution that produced this...

Early European electric locomotives were based on 3 phase AC technology. This meant that there had to be one connector wire for each phase. Common practice of the time (1890) was to have one phase carried through the ground rails with two overhead -although there were designs with 3 overhead wires. Early pantographs as such were simply bent copper bars spring loaded to the cable, the low running speeds meant that frictional wear between the copper bars and the wire was minimal.

The picture below shows an early 3 phase 2 collector locomotive of the BTB -note it had front and rear collectors which would proceed and trail the locomotive.

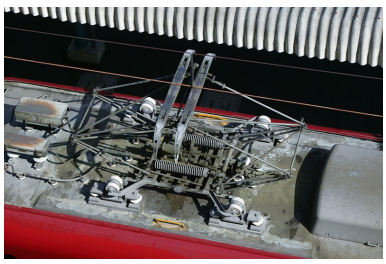
This type of collector remained common until about 1910 when it was superceeded by the most recognisable type -the diamond pantograph. This arose because of the need to collect more current and to have the ability to be lowered. Prior to this a length of varnished bamboo pole was used to pull the collectors from the wire. The diamond type was normally lifted into position with compressed air and the now familiar “double bow” shape arose, not because of electrical contact -but for the requirement to knock icicles off the wires. The addition of “horns” to the double bow was the protect the bow from objects (tree limbs etc) that would invade the loading gauge of the locomotive.

The shot below shows a “JungFrau” locomotive with twin diamond pantographs -one for each phase.



You will note that there are coupler cables at the joints of the diamond, these are purely for the mountain terrain -as ice is non conductive. These would be abscent in a “low land” design. This can also be seen to be a very high voltage design note the extensive use of porcelin insulators.

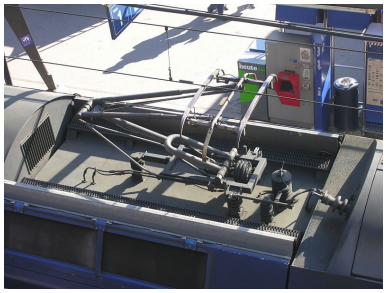
The diamond design held sway for several decades as it was extremely robust and had good current carrying capacities. The design was used mostly in DC traction from 1930's to the end of the 1980's. The main distinctive feature of a DC pantograph to an AC one is the type of insulator used. DC was at most 3,000 Volts, simple glass, ceramic, or even rubber insulators could be used.



These are DC pantographs.

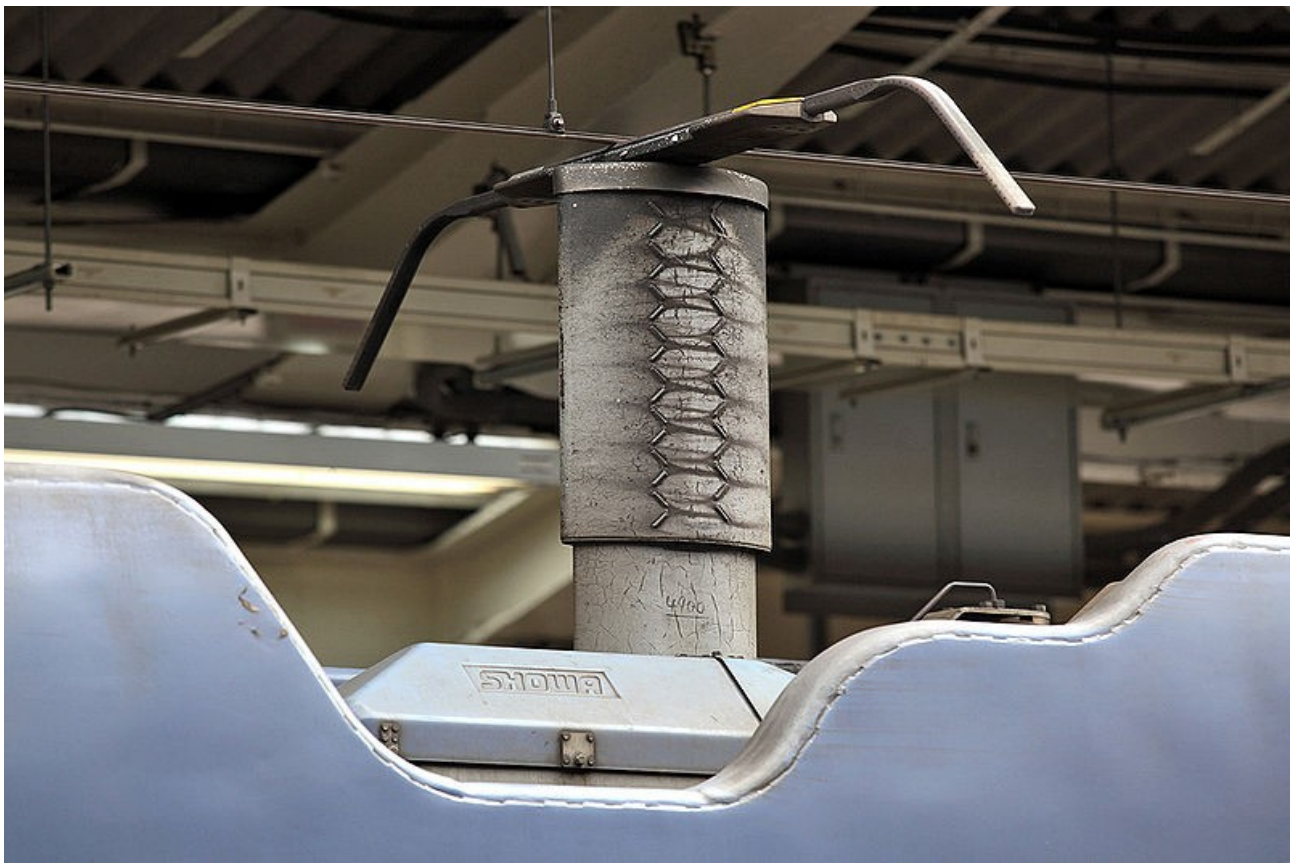
With high voltage AC Porcelain insulators have to be used -these have the familiar “ribbed”

shape. Due to the higher voltage less current was taken through the collector of the pantograph -hence they look rather more “flimsy” than their DC counterparts. Higher speeds meant that the shape of the pantograph changed, it lost half of the diamond to become a “Z” pantograph.



The shot above left shows a classic Z arm panto on a Swiss loco of the SBB, and shot above right the top of a GNER Class 91. This has the “fuse” located just forward of the off set Z arm. The ribbed porcelain insulators are quite obvious.

The Z arm pantograph is capable of quite high speeds and has good tracking capabilities -however it is **not** the ultimate in pantographs....



This is though. This is the aerodynamic profiled pantograph for a Japanese “Bullet Train”.