Rocket

The Rocket was entered by George and Robert Stephenson and Henry Booth. It was built at Stephenson's works at Newcastle. George Stephenson is usually given the greater part – and sometimes all- of the credit for this design but this should rightly go to his brilliant son Robert, for when the engine was under construction George was pre-occupied with railway construction.

Henry Booth also influenced the design considerably, for he claimed to have suggested the use of a multi-tubular boiler. This was probably thought of independently, but by 1829 it had been 'invented' by at least three other people, the best known of which was the Frenchman, Marx Sequin. There is no reason to suppose that Booth knew of the other inventions. George Stephenson never admitted that Booth's suggestion was of any value to him in designing Rocket's multi-tubular boiler and external firebox.

The Rocket was the first locomotive to be designed with single driving wheels (the use of which saved weight and expense), though at the Trials the 'Novelty' also ran as a single-driver, having dispensed with the arrangements initially provided for coupling the axles. Rocket had direct connection between cylinder and wheel – a feature also of Sanspareil. Such direct connection, in conjunction with a multi-tubular boiler, was to endure under the appellation of 'the Stephenson form' which persisted as long as the steam locomotive.

Rocket's steeply inclined 8 in by 17 in cylinders drove onto the leading axle through crankpins with spherical bi-end bearings. The cylinder layout was similar to that of 'Lancashire Witch', built by Stephenson's for the Bolton and Leigh Railway in 1828, but the stroke was reduced on Rocket; the driving wheels, now but on pair, were increased in diameter and coupling roads were not required – all design features consistent with attaining higher speed.

The valves of Rocket were operated by slip-eccentrics.

The driving wheels were 4ft8½ inches diameter and the trailing wheels 2ft 6 inches, The wheelbase was 7ft2inch.

The boiler, which held 13 cwt of water had a barrel of 3ft 4 in diameter, measured outside, and was 6ft long. It housed 25 copper tubes of 3 inch diameter. The total heating surface was about 134 ft² and the grate are 6 ft². The firebox was of very unusual form, in that it had a dry throat plate and backhead. That part of it that constituted a water jacket, the water space being about 2.5inch deep. The tubes were not expanded into the firebox front plate but into a separate plate which formed the barrel end. The front of the firebox, below the tube nest, was lined with firebricks, as was also the back, as protection for the driver against the heat.

Following the success of Rocket in the Trials, some generally similar locomotives were ordered by the L&MR. The design developed rapidly and the firebox soon disappeared into the barrel and became totally water-jacketed. As boilers went, that

of the Rocket was good thermally, 11.7lb for coke sufficing to evaporate 1ft3 of water. This compared with 18.34lb for earlier locomotives.

At the front end, the small external smokebox soon assumed in later engines the diameter of the boiler barrel. In its original form, tube cleaning must have been difficult. A most significant alteration made to Rocket and embodied in subsequent developments of the Rocket class locomotives, nine of which were built for the L&MR up to the end of 1830, was in the disposition of the cylinders. It mush be remembered that the builders of the engines appearing at Rainhill were pioneering, and pioneers learn a lot the hard way.

True of the Stephensons, by the standards of the times were very experienced and possibly had had more than their fair share of good luck – particularly in their selection of those ratios which are all important in locomotive design – but previous practice for comparatively low speed operation did not necessarily produce good results at h higher speeds which were attained for the first time at Rainhill.

This applied forcibly to the position of the cylinders. Inclined, high up and at 35°, and located at 5ft 7¾ in centre the reaction must have produced an incredibly rough ride at speed, which combined nosing, rolling and galloping to such an extent that the driver must have hung on grimly to the reversing shaft. There was nothing else to which he could conveniently hold, for there were no side sheets, the footplate was very narrow, and the bars staying the back buffer beam to the boiler were too low to function also as handrails.

The replica, build by Robert Stephenson & Co in 1929 for Henry Ford's museum in America was steamed, but briefly at Darlington, but even so the flange wear was very pronounced having regard for he short distance it ran. Small wonder then that in 1831 the cylinders were lowered and in the inclination reduced to 8°. In the original form, the valves were below the cylinders, when lowered the cylinders are changed, side for side, the valves then coming on top. As the cylinders were initially fixed to brackets bolted on the boiler, the change to a low position, in which the brackets were attached to the frame, must also have benefited the boiler considerably.

The frames were wrought iron bars, 4 in by 1in. Unlike the bar frames used later by Bury, the axle guards were on cast iron.
It has been suggested that the coincidence of the gauge and driving wheel dimensions could have resulted from the aim to attain 10mph form every revolution/second of those wheels.

In working order the weight was 4 tons 5cwt, of which 2 tons 12 cwt 1qtr was on the leading wheels and 1 ton 12 cwt 3qtr on the trailing wheels. The ending weight was rather heavier that originally estimated, which was probably due to the difficulties experienced in meeting the boiler test requirements.

The exhaust was discharged into the chimney, though two separate pipes, unprovided with nozzles. Having regard to the length of the chimney there would have been no difficulty in filling it. Rocket and Sanspareil had induced draught, whereas in the case of Novelty, draught was forced,. All of these engines must have benefited considerably from the draughting arrangements, for despite the fact that none of the competing engines had valves with lap – and angular advance of the eccentrics was not provided -they all seemed to have steamed relatively freely in the

conditions prevailing – and coke, is not the easiest of fuels to burn. The Rocket's consumption over the 70 mile course was 579 gallons water, and 1, 127lb coke. As French locomotives of the period – or at least some of them – were provided with lap it would seem that in that respect British practice was behind.

For many years doubts prevailed on the original form of the Rocket's firebox. Illustrations, including the contemporary on in Mechanics magazine show it with a chamfer – sometimes very pronounced – at the top of the back. The form was definitely established when research was undertaken in connection with the replica. Rastrick's notebook does not show it exactly how it was – perhaps because he couldn't see inside. It had a double ogee section.

The Stephenson had the considerable advantage that they were able to test the Rocket before the Rainhill Trials; not only was the track available at Killingworth, but engine was finished in time to enable tests to be conducted. After these tests Robert Stephenson expressed the view that 'on the whole the engine is capable of doing as much – if not more – than set forth in the stipulations. In the case of Sanspareil there was a track that of the S &DR - but only limited time – in fact it was surprising that the engine was finished by the deadline. In the case of Novelty, the builders had neither track no time.

After Rocket was tried at Killingworth, and such alterations had been shown by the trial to be desirable has been carried out the engine was dismantled and sent by road to Carlisle. There it was placed on a lighter in the canal basin and later placed aboard the Cumberland steamer for Liverpool, where it arrived on 18th September - the journey from the factory having take six days. The engine was reassembled at the L&MR workshop at Crown Street.

The Rocket was directly descended from the Lancashire Witch, particularly in the cylinder arrangement. Rocket's stroke at 17 in was 7 inches shorter and the driving wheels, at 4 ft 8½inches, 8½ larger in diameter. These alterations, plus the use of single driving wheels which eliminated the use of coupling rods are indicative of the higher speed which was being aimed at.

Rocket, after the Trials and following its purchase by the L&MR for £550 worked on the construction of the line, between Chat Moss and Salford. It continued in use on the L&MR until 1836 when it was sold for £300 to Mr James Thompson, of Carlisle, and worked on the Midgeholme Railway until 1844. In 1834 it was intended to fit the engine with Lord Dundonald's rotary engine, but he idea was given up. Timothy Hackworth, to quote one of his apprentice's, was also 'very fond of dabbling with rotary steam engines.'

Rocket went to the Patent's Office Museum, later to be known as the Science Museum, at South Kensington in 1862, where it still is as the most famous of all locomotives. According to the catalogue for that museum, it ran 4 miles in 4.5 minutes – equivalent to 53mph – some years after the trials. If true this would appear nothing short of foolhardy, for it must be remembered that no balancing was provided and fishplates did not come into use until 1846.

The tender was made entirely at Liverpool. It was been claimed that, for the first time on a railway vehicle, it used outside bearings but a letter in the Railway Times of 1842 stated that this had been done by George Stephenson in 1827. Be this as it

may, it would certainly seem that this was the first use of such bearings on the L&MR, which was the first railway to adopt them generally for tenders and carriages.

The water capacity was 300 gallons and there was space for 5 cwt of coke. In working order the tender weight was about 3.25 tons.

Roberts Stephenson's already mentioned opinion that the engine which had a tractive effort of 960lb, was capable of doing more than called for by the Stipulations, was endorsed about two weeks after leaving the works, when Rocket, drew 40 ton at an average of 14mph and later 18 tons up 1 in 96 at 8mph.