

of Messrs. Lee and Larned, of the Novelty Works, New York, are probably the most celebrated, and with good cause, as being remarkable for their strength, durability, and lightness, all being leading essentials in a successful fire engine. In these engines there is less water to heat, and the flues are extremely light, the grates are smaller than those of the Amos Keag engines, so that the time to make an effective fire is consequently greater, which is no very serious objection. The 'Minnehaha' engine (of this make) has $201\frac{1}{2}$ square feet of heating surface, having 199 tubes of $1\frac{1}{2}$ inch diameter, and $\frac{1}{16}$ of an inch thick. The most celebrated engine of this make is that known as the "J. C. Cary." It is fitted with Mr. J. K. Fisher's steam carriage apparatus, to enable it to be self-propelling. The boiler contains 114 pairs of vertical tubes, arranged annularly, or one within the other, the outer of $2\frac{1}{2}$ inch, and the inner $1\frac{1}{2}$ inch diameter, the annular space between the two being occupied by water. The steam cylinders are $7\frac{1}{2}$ inches diameter and 14 inches stroke. The connecting rods from the engines act on cranks placed upon an intermediate shaft, revolving in fixed bearings upon the frame, and operating the pump, which is one of Cary's patent rotary force pumps of the largest size; the total weight is about eight tons; the length of the frame or body is about $14\frac{1}{2}$ feet, its breadth 7 feet, and the total length of carriage $20\frac{1}{2}$ feet. Sufficient fuel for two hours consumption can be carried on the foot plate at the back of the hinder-axle. Steam can be raised to working pressure in from six to ten minutes, but it is intended that steam shall be kept up at all times so that the engine can start at a moment's notice, which can be done at a comparatively trifling cost. At a public trial on the fifth November, 1858, before Commissioner Cooper and other officials, it threw from 700 to 750 gallons of water per minute through a $1\frac{1}{2}$ inch nozzle a horizontal distance of 252 feet, and a vertical height of 160 feet.

Messrs. Shand and Mason, of Blackfriars, were the first to renew the manufacture of steam fire-engines in this country. Their first engine was constructed in 1858 for the Russian Government. A description of a public trial of this appeared in the *Times* Newspaper of October 25th, 1858. Steam was generated to a working pressure in ten minutes from the application of the match and threw jets to a considerable elevation. The engine is now in use in St. Petersburg. The second engine was tried at Waterloo-Bridge Wharf, on the 1st July, 1859; a description of it appeared in the *Times* of July 2nd, 1859. Steam was generated to a pressure of 10 lbs. in six minutes. An inch jet was thrown 90 feet vertically, and 130 feet horizontally. The third that was made was somewhat cumbrous, but was successful in working, which encouraged its makers to build another. Accordingly one was made, and purchased by the London Fire Engine establishment for their station in Waling-Street. The boiler is a vertical one of peculiar construction, with a copper fire box, and Lowmoor shell plates of one quarter-inch in thickness; there are 199 tubes in the boiler, each 16 inches long by one inch in diameter, the boiler presenting a heating surface of 91,467 square feet. The cylinders are placed horizontally, the piston-rods being connected by a cross-head slotted to admit of the crank being

actuated by its pin moving in the slide brasses. The steam cylinder is $8\frac{1}{2}$ inches diameter, and the pump cylinder 7 inches with a stroke of 9 inches. Steam can be raised to the ordinary working pressure (viz. 80 lbs. on the square inch) in fifteen minutes from cold water. The weight, including water, fuel, and hose, is 6,500 lbs. Messrs. Shand and Mason have constructed three steam fire-engines for the London and North Western Railway Company, of the same dimensions as the last mentioned, but erected on an independent sole plate; they also constructed one similar to these (but fitted of course to a common road carriage), for the London Fire Engine Establishment. These makers took out a patent for a steam fire-engine. It consists of an upright conical steam generator, or boiler, formed simply of an external cone with an annular space between. The internal cone forms both fire-box and chimney. The hinder axle of the carriage is passed through the boiler by fixing a horizontal annular tube through the body of the boiler in a suitable position, the tube forming a water space in connection with the annular water space of the boiler. There are two single acting steam cylinders, and two single acting pump cylinders connected by tie-rods; the steam and water cylinders are cast in one piece. Messrs. Shand and Mason have made three of these engines, but in practice, owing to their mechanical design and construction, they are continually breaking down either at the crank-shaft or the plates of the boiler forming the top of the fire-box burn away, owing to there being no water circulation round them. The weight is very unequally distributed over the wheels, making the stern of the engine hang heavy. In consequence of the employment of a crank motion, these engines cannot be worked below a certain speed, owing to the difficulty of getting the crank over the centres.

Messrs. Merryweather and Son are now manufacturing steam fire-engines, and they have succeeded in bringing out two very good serviceable engines, named the "Deluge" and the "Torrent." The former of these consists of a vertical boiler, with a quantity of vertical copper tubes. The steam-chest at the top of the boiler is fitted with wrought-iron tubes for carrying off the smoke and creating a draught. Over the fire-box are a series of hanging tubes in which a perfect circulation of water is carried on. There is also an outer water jacket. The boiler is fed with one of Giffard's injectors. Steam is taken from four points, and supplied direct through the valve-chest into the cylinder, in its way passing under the cylinder. The steam cylinder is 9 inches in diameter, and 15 inches stroke; no fly-wheel is used, and by the valve arrangement a uniform speed is obtained; this is a great advantage, as the pump is worked steadily, and an even column of water is delivered. The engine can be started, at any point, by opening the steam-valve, and can run at any required speed—a great desideratum in fire duty. The piston-rod is coupled to that of the pump direct, and the two guide-rods connect the pump and steam cylinder together. The pump employed is De La Hire's double acting, but the valves are placed in easily accessible chambers beneath the pump barrel. Provision is also made for completely emptying the barrel at every stroke, thus getting rid of all grit and impurities brought up through the suction.