larger diameter, in case a greater quantity of water may be required. The length of stroke is 9½ inches diameter, and being double acting, a steady and continuous stream is obtained from them. Each pump has eight suction and eight delivery valves of india-rubber working upon gun metal guards, offering an effective water way of fifteen square inches (in four valves), or very nearly two-thirds the area of the piston for the contents of one pump. The largeness of the water ways, combined with the peculiar stop at the end of each stroke, which is a main feature of the slide valve motion, causes the almost instantaneous closing of the valves, and the pumps run free from concussion or vibration at any practicable velocity. The net area of the suction opening is 16 square inches, and, having a continuous stream passing through it, the hose remains steady and quiet, when the pumps are running at their highest velocity; moreover, advantage is taken of the hollow spaces of the hand railing to connect them with the suction valve chamber, so as to form a suction air vessel. The engine is hung upon a wrought-iron framing, forged entire. Fisher's busk springs, as offering the greatest elasticity and lightness, are employed, with relieving screws for locking them out of gear when working. The nett weight of the engine is 3 tons 2½ cwt. Steam has been raised in five minutes.

Having received Mr. Hodges' directions to design a steam fire-engine, I carefully examined the plans of all the steam fire-engines that have been made. I came to the conclusion that Lee and Co.'s pumps were practically the best but was not prepared to say their boiler was. I designed the engine as shown in the diagram on the wall. The plan of the boiler I am not at present prepared to make known, and it will be seen that I use a springing fore-carriage, composed entirely of one flat spring, fastened at one end, and allowed to play at the other. I use by preference four 3 inch deliveries, and one 6 inch suction. The steam cylinders are 8¾ inches diameter by 9 inches stroke, and the pump cylinders 5 inches diameter by 9 inches stroke. On the top of the pumps is arranged a box for carrying hose and other implements, serving at the same time as a seat for the driver and two firemen, and behind, a standing room for three firemen, whilst the stoker and engine driver will ride on the foot plate behind.

I now come to a description of steam fire-engines used for service on the water, and here Mr. Braithwaite was also the first to advocate their use for he designed a floating engine, and submitted it to the London Fire Engine Establishment. Previous to the year 1852, the most powerful fire engines in London, were two floating ones on the river, belonging to the London Fire Engine Establishment. The largest of these was worked by 120 men, and, when well manned, was a very effective machine. The great increase, however, in the size of the dock and water side warehouses, led in that year to an alteration in this engine, whereby the apparatus for manual power was removed, and steam power substituted, doubling the power of the engine. The advantages accruing from this proceeding were so manifest that, in 1855, the Directors of the London Fire Engine Establishment caused an entirely new floating steam fire engine to be constructed. This was accordingly designed and constructed by Messrs. Shand and Mason, and has at various large fires performed efficient service. The steam fire engines propel the boat by means of two stern jets of water, thrown by a centrifugal pump; they are nominally of 80 horse power, but are frequently worked up to double that amount. It has two steam cylinders, each 14 inches diameter, and water cylinders of 10 inches, with a stroke of 18 inches. Two donkey engines are erected on the sides, to supply the boiler with water.

At the great fire in Tooley-street, this engine worked 384 consecutive hours. The London Fire Engine Establishment have recently had alterations made in the mode of propelling this boat, which may I think be termed most unsatisfactory. The propelling jets are now projected above the water, and against the air only. Action and reaction being in all cases equal, and the resistance of water being greater than that of air, it is manifest that the alteration just made, at a very considerable expense, is an injudicious one. I witnessed a trial of her powers, and the conclusions I formed were, that her speed was diminished, and the supposed improvements made her sluggish at the stern, taking over five minutes to turn round. Messrs. Merryweather and Son constructed two very efficient steam fire engines, which are fixed in the tug boats on the river Tyne. They were designed by Mr. Edward Field, C. E. They are fixed in the fore part of the tug boats, and connected to the ordinary boiler used for propelling. The steam being always kept for shipping emergencies, it will be seen that these engines are ready at a moment's notice. Each engine consists of two inclined steam cylinders, each 16 inches diameter and 12 inches stroke, both working direct on to one crank, from which the piston rods of the pump are worked. The pumps are of gun metal, and are 9 inches diameter by 10 inches stroke. The usual working speed is from 60 to 80 revolutions per minute, with a steam pressure of but 17 lbs. per square inch. These engines have been found to deliver continuously a steady stream of 1¼ inches in diameter to a distance of 163 feet, and a one 1¼ inch stream to a distance of 134 feet. For fire duty two ¾ inch nozzles are generally used, and are found very effective. They were designed to occupy a very small space, being only 8 feet long by 2 feet 6 inches wide. Working with a higher pressure of steam these engines would, of course, give greater results.

Mr. Wm. Roberts has fixed in the tug-boat *Lucy*, belonging to the West India Dock Company, a steam fire engine, in which he uses his patent pumps.

In bringing my paper to a close, I can only assure you that it was with considerable diffidence I approached a subject of such magnitude; but feeling the great importance of it to a great commercial community, and having had practical opportunities of making myself acquainted with the subject through all its minute details and workings, I was desirous of addressing this Society and, through it, the public generally. I trust my labour has not been in vain. Should there be in any portion of the paper any errors, either of detail or judgment, I am open to conviction from the gentlemen who will take part in the discussion, if