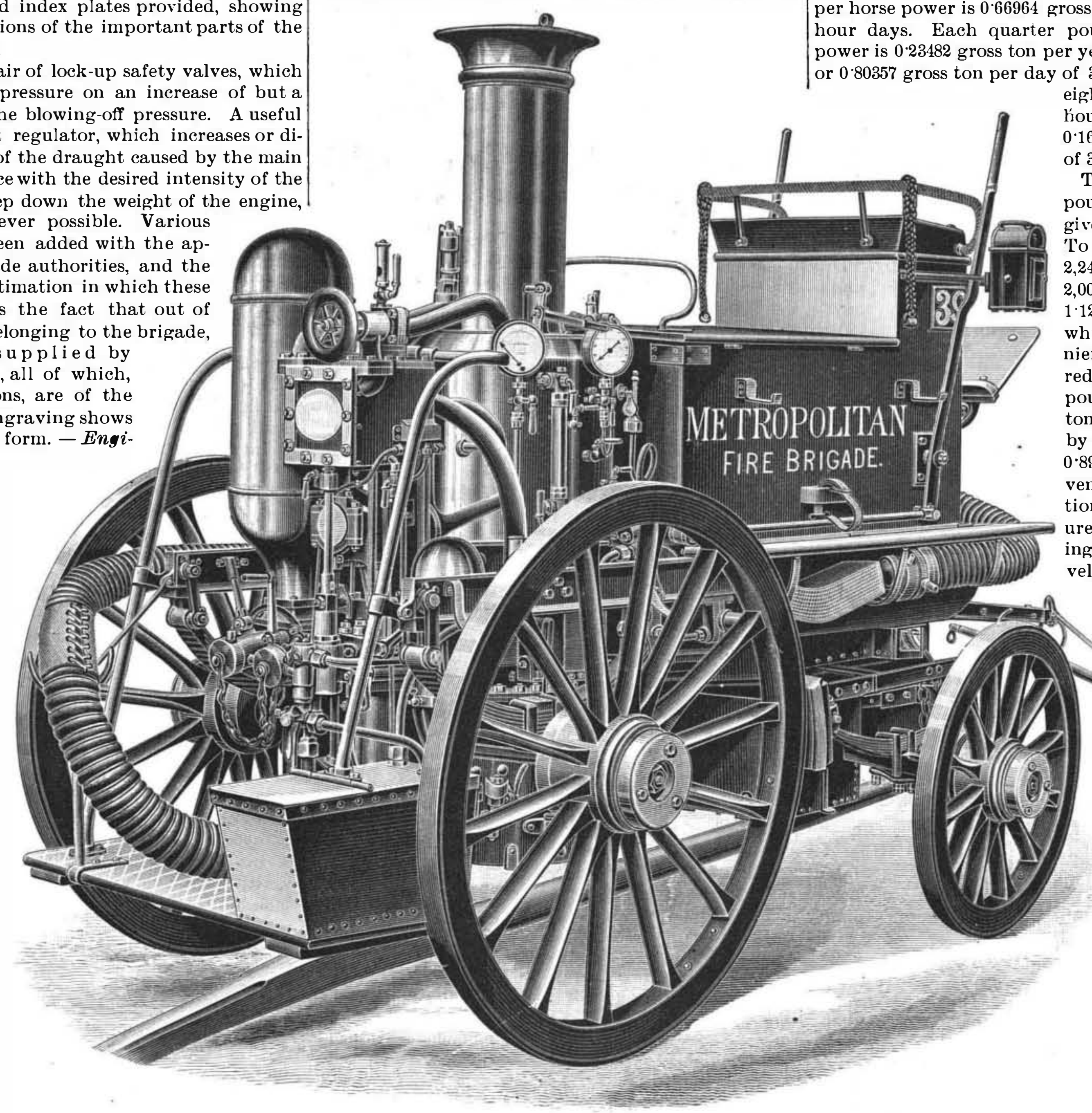
NEW STEAM FIRE ENGINE.

The illustration below represents the latest design of steam fire engine supplied by Messrs. Shand, Mason & Co. to the Metropolitan Fire Brigade, London, and combines various improvements made in accordance with the desires of the chief officer, being specially adapted to suit the many varying circumstances under which a fire engine has to work in London. The chief aim in these improvements has been to make an engine of great power, to simplify the working parts, and to add to this strength and lightness. Within the last few years these engines have been improved by increasing the area of the steam cylinder and the valve area of the pump, thus obtaining a larger delivery of water at a higher pressure. Lubricating apparatus has been added, which lubricates the whole of the working parts from one oil box. The mode of feeding the boiler by means of feed pump and injector has been simplified and improved in a manner which will probably become the standard for this important part of steam fire engines of this type. As regards the boiler, additional heating surface has been provided to suit the increased power of the engine. The boiler fittings have been entirely rearranged and index plates provided, showing the fireman the positions of the important parts of the interior of the boiler.

The boiler has a pair of lock-up safety valves, which relieve all excess of pressure on an increase of but a few pounds above the blowing-off pressure. A useful addition is the blast regulator, which increases or diminishes the power of the draught caused by the main exhaust in accordance with the desired intensity of the fire. In order to keep down the weight of the engine, steel is used wherever possible. Various other details have been added with the approval of the brigade authorities, and the best proof of the estimation in which these engines are held is the fact that out of forty-six steamers belonging to the brigade, thirty have been supplied by Shand, Mason & Co., all of which, with a few exceptions, are of the type of which the engraving shows the most improved form. —*Engineering.*



LATEST ENGLISH STEAM FIRE ENGINE.

The Severn Tunnel.

This stupendous work, which has entailed an outlay of upward of £2,000,000, was opened for the local passenger traffic between Bristol and South Wales on the 1st instant, the first through service having been deferred till the double line is completed between Pilning and Bristol. The length of the tunnel is 4¼ miles, of which 2¼ miles are beneath the bed of the river, with a minimum cover between the crown of the tunnel and the water of 45 ft., and a maximum of 100 ft. With the exception of a short length, the under river passage, which is 26 ft. wide and 20 ft. high, has been bored through hard sandstone, conglomerate, red marl, and new red sandstone, dynamite and tonite being used for the blasting, and the holes being made by rock-drilling machines worked by compressed air, the cost of this work being roughly estimated at £100 a yard. The work was carried on night and day, the electric light being used.

The tunnel throughout is lined with Staffordshire and other vitrified brick, set in cement to a thickness of 3 ft. in the crown of the arch, near the river bed depression, this thickness being graduated off to 2 ft. 3 in., as the gradient rises one in ninety on the Monmouthshire side, and one in a hundred on the Gloucestershire side. Four times have the works been flooded during the last fourteen years. In 1879 a great spring was tapped, and the whole of the workings were inundated. Sir John Hawkshaw was then appointed engineer in chief; and, acting in conjunction with Mr. Charles Richardson and Mr. T. A. Walker, who took the contract, cleared the works with heavy pumping machinery.

In 1881, when the junction between the headings was within a month or two of being made, the water came in from the river bed in a depression, and mastered the pumps. The depression was filled in with clay puddle in bags, and the junction of the headings was effected in September, 1881, the two meeting within three inches. In October, 1883, the spring which had flooded the tunnel in 1879 was again tapped, and the water poured in at the rate of 27,000 gallons per minute, and again flooded the working. Four more powerful pumps were erected, and the works were again cleared. In the same month the works on the Monmouthshire side were flooded by a huge tidal wave, which poured down the Marsh shaft, and imprisoned fifty men, three of whom lost their lives. To prepare the tunnel for the passenger traffic, a Guibal fan, 40 ft. diameter, and capable of discharging 240,000 cubic feet of air per minute, has been erected, and there is on the site pumping power sufficient to raise 26,000,000 gallons of water per day.—*Industries.*

Struts and Ties in Carpentry.

It depends entirely on the position of the pieces in respect to their points of ultimate support, and of the direction of the external force which produces the strains, whether any particular piece is in a state of extension or of compression. The knowledge of this circumstance may greatly influence us in the choice of the construction. In many cases we may substitute slender iron rods for massive beams, when the piece is to act the part of a tie. But we must not invert this disposition; for when a piece of timber acts as a strut, and is in a state of compression, it is next to certain that it is not equally compressible on its opposite sides through the whole length of the piece, and that the compressing force on the abutting joint is not acting in the most equable manner all over the joint. A very trifling inequality in either of these circumstances (especially in the first) will compress the beam more on one side than on the other. This cannot be without the beam's bending and becoming concave on that side on which it is most compressed. When this happens, the frame is in danger of being crushed and soon going to ruin. It is, therefore, indispensably necessary to make use of beams in all cases where struts are required of considerable length, rather than of metal rods of slender dimensions, unless in situations where we can effectually prevent their bending, as in trussing a girder internally, where a cast iron strut may be firmly cased in it, so as not to bend in the smallest degree. In cases where the pressures are enormous, as in the very oblique struts of a center or arch frame, we must be particularly cautious to do nothing that can facilitate the compression of either side. No mortises should be cut near to one side; no lateral pressures, even the slightest, should be allowed to touch it. We have seen a pillar of fir 12 inches long and 1 inch in section, when loaded with three tons, snap in an instant when pressed on one side by sixteen pounds; while another bore four and a half tons without hurt, because it was inclosed (loosely) in a stout pipe of iron.—*The Architect, London.*

Useful Facts for Steam Users.

The following figures, taken from the Liverpool *Journal of Commerce*, will be found of use for ready reference in calculating the amount of fuel used, saved, or wasted by an engine or boiler in the usual working year of 300 days of 10 hours each, and also in a working year of 300 working days of 24 hours each, such as is the customary run of establishments working 144 hours per week. Each pound of coal per hour per horse power amounts in 300 10-hour days to 1·33928 gross tons of 2,240 pounds each, and in 300 24-hour days to 3·21428 gross tons. Each half pound of coal per hour per horse power is 0·66964 gross ton per year of 300 24-hour days. Each quarter pound of coal per horse power is 0·23482 gross ton per year of 300 10-hour days, or 0·80357 gross ton per day of 300 24-hour days. Each eighth pound of coal per hour per horse power is 0·16741 gross ton per year of 300 24-hour days.

The gross ton of 2,240 pounds avoirdupois is given in these calculations. To reduce gross tons of 2,240 pounds to net tons of 2,000 pounds, multiply by 1·12 or divide by 0·8928, whichever is more convenient; and conversely, to reduce net tons of 2,000 pounds to gross or legal tons of 2,240 pounds, divide by 1·12 or multiply by 0·8928, according to convenience. In the application of the foregoing figures, suppose a condensing steam engine to develop 175 horse power with forty pounds initial pressure above atmosphere with a coal consumption of 3¼ pounds per hour per horse power, and that by increasing the initial pressure to 50 pounds by the gauge the work was 185 horse power, with a coal consumption of 2¾ pounds per hour per horse power, the saving per year of 300 10-hour days is 0·66964 gross ton for each horse power, or 6 66964 = 126·2834 gross tons, and the saving per year of 300 24-hour days is 160,714 × 185 = 297·32 gross tons.

The Purity of Mid-Atlantic Air.

In the course of an address on the action of micro-organisms on surgical wounds, Prof. F. S. Dennis, of New York, states that during his last trip across the Atlantic he made some experiments to test the purity of the air about 1,000 miles from land. He employed capsules of sterilized gelatine, and exposed them for fifteen minutes. One capsule was exposed in the stateroom upon the main deck of the steamer. Within 18 hours over 500 points of infection had developed. Two capsules exposed in a similar manner in a cabin on the promenade deck, where the circulation of air was free, showed five or six points of infection each ten days afterward. A capsule exposed over the bow of the ship was found to be entirely uncontaminated. These experiments are on the same lines as those of Pasteur and Tyndall upon the mountain air of Switzerland, and, so far as they go, they show the germless condition of mid-oceanic air, and also the need for much more efficient ventilation in the staterooms of even the first-class American liners.—*Lancet.*

STEEL, when hardened, decreases in specific gravity, contracts in length, and increases in diameter.