time, which requires a pressure of from 50 to 56 lbs. per square inch in ordinary full work. The total head against the spring water pump is about 50 feet, and the total head against the soft water pump is about 190 feet. But during the daily performance of the extra duty already referred to, the pressure is increased by about 40 feet. The performance of the engine will be best illustrated by the following indicator diagrams, figs. 260 and 261, which were taken when pumping against the increased head, but in other respects under quite ordinary circumstances. It will be noticed that the vacuum side is excellent; pressure in boiler 64 bs., revolutions per minute 34, average 54 horse-power. The engine is fitted with a mercurial steam gauge, vacuum gauge, counter, and all ordinary appliances. The cylinder is coated with Leroy's composition, afterwards with felt, and finished with a polished mahogany case.

Steam Boilers.—There are two steam boilers. A transverse section is shown in fig. 1, plate 46, and a longitudinal section in fig. 5, plate 46. Each boiler has two safety-valves, which are weighted to 70 lbs. on the square inch. Pipes to carry off the waste steam from these are taken out through the roof in order to prevent any escape into the hot-room over the boilers. In addition to the ordinary feed-pipes from the beam-engine each boiler is connected with the soft-water main, from which it can be supplied at any time. The boilers are coated with Leroy's composition, and to show that the heat is well retained, it may be mentioned that the pressure does not fall more than 2 or 3 lbs. from the time of leaving off at night until starting again next morning. Diaphragm plates are fitted inside each dome, with a large number of cast-iron balls about 1 inch diameter on the top, to assist in the prevention of priming.

Main Pumps.—A section of the pump barrels, showing buckets, suction valve, plunger, guides, rods, &c., of the spring-water pump is shown in fig. 1, plate 48. Two buckets are shown in this view; the upper one, 15½ inches diameter, is the temporary bucket, used for the purpose of drawing the springs and clearing the water, which after such deep borings is at first very chalky. The lower one, or regular working bucket, is 14 inches diameter. The suction valve shown immediately below the 14-inch bucket is fitted into a conical seating, having recesses turned for whipcord soaked in tallow. The top of the suction-valve for spring-water pump is specially made to receive the apparatus for raising and lowering it. The apparatus for lowering it consists of a sufficient number of rods, on the lower end of which are four arms which fit into the recess of the chamber at the top of the suction-valve ; these arms have springs attached to them, and are so arranged that, when relieved of the weight by the valve fitting into its seating, they contract, and can then be drawn up through the hole in the top of the chamber. The apparatus for raising it has four arms at the bottom, with springs attached, which act in a contrary direction, namely, to press the arms outwards, and when introduced into the top chamber of the suction-valve the arms fly out or expand into the recess, and thus hold the valve, which can then be drawn. The rods of both raising and lowering apparatus are kept concentric in their passage down the pump barrels by large wooden balls, which act as guides. The soft-water pump, shown in figs. 3, 4, 5, and 6, plate 48, has a 15½-inch bucket and 18 inches stroke. The suction-valve of the soft-water pump can be easily put in its place or removed by taking off the cover of the suction-valve box, shown in fig. 4, plate 48, lugs, A A, having been provided for the purpose. The original bucket and suction-valves of both pumps were similar to those illustrated by figs. 123 and 125; but these were afterwards replaced by double beat metallic valves, which act exceedingly well. It will be specially noticed that the buckets of both pumps, also the glands round the plungers, are all fitted with metallic packing, no hempen packing whatever being used in any part of them. The metallic packing is composed of rings of gun-metal turned and fitted, with best red rubber rings between, the rings being accurately adjusted by means of set screws. Each pump has a large air-vessel which is fitted with a gauge-glass and gauge-cocks, also a pipe from the small air-pump of the engine, so that it can be supplied with air if required. A small copper seamless tube is carried down the bore-pipe outside the spring-water pump barrels, for the purpose of containing a copper float, which is connected with a long index fixed in the well-house, by which means the level of the water in the bore-hole may be observed. There is also another index placed in the engine-room, communicating with the soft-water suction well, which shows the level of the water in the latter; by means of this index the engineman is informed, without leaving the engine-room, when each depositing reservoir is sufficiently empty, the sliding pipe having arrived at its lowest position.

Small Blowing Engine.—This is used for mixing the lime-water by means of jets of air. It is a small horizontal non-condensing engine, with both steam and blowing cylinders, bolted to the same bed-plate, the piston-rod of the steam cylinder being firmly connected with the piston of the blowing cylinder. It is fixed in the workshop on a brick in cement and stone foundation, with a thin layer of oak between the bed-plate and the stone. The steam cylinder is 9 inches diameter, and the blowing cylinder 12 inches diameter; the stroke is 10 inches. It is worked at about 100 revolutions per minute, and is supplied by a 1½-inch steam pipe from the same steam-boilers as the beam engine. A small pipe from the soft water main is led to the blowing cylinder, so that a