

cast iron, having large man-holes for inspection of suction-valves. The suction-valves are so arranged that they may be fished and withdrawn through the rising main if necessary. At the top of the working barrels are strong iron boxes, or what may be termed door-pieces, having man-holes for convenience in inspecting and removing the pump-buckets. All the flanges are strongly ribbed, and the man-hole mouthpieces have wrought-iron hoops shrunk around the flanges. The suction-valves are made of gun-metal of double-beat type; the seatings are fitted into tapered seats in valve-boxes. The valve-wings are set to give the valves a screw lift. The pump-buckets are made of gun-metal, fitted with delivery-valves of double-beat type, having a screw lift. Each bucket is to be packed with three gun-metal packing-rings, turned larger in diameter than the bore of the pump-barrel, cut on circumference, and sprung into place, stop-pieces being fitted on to each ring. The plunger-pumps are 25 in. in diameter, with a stroke of 6 ft., the pump bodies being of cast-iron, and strongly ribbed at all flanges, with hoops shrunk on all openings, and fitted with strong sludge-doors and -cocks. Strong brackets are cast on pump body for attachment to supporting girders. The plungers are of hard close-grained cast iron, truly turned and solid. Automatic shifting-valves are placed on the top of the plunger-pump barrels. Cast-iron air-vessels are also fitted between the delivery-valve boxes and the rising main, to withstand the same head- and test-pressure as the pumps. The air-vessels have long narrow necks, and are provided with an approved arrangement for replenishing and maintaining the air in the vessels. Each pair of plunger-pumps delivers into one rising main of 20 in. internal diameter, made of cast iron of sufficient strength to withstand the pressure they have to sustain, each pipe being in 12 ft. lengths. They are all coated with Dr. Angus Smith's preparation, and are tested to withstand a hydraulic pressure of 250 lb. per square inch. The branches from the delivery-valve boxes of the plunger-pumps are connected together and to the rising main by strong cast-iron pipes, upon which the air-vessels are seated. These branch pipes are sufficiently strong to withstand the pressure due to a water-head of 327 ft. The spear-rods are on the road out from England, made of iron, 10 in. in diameter; but it is questionable whether these will be used. The company here prefer to use spear-rods made of kauri, having strap-bolts, brackets, and connections, which will be constructed here. The top of each spear-rod will be fitted with gun-metal steps, skeleton straps, gibs, and cotters, with all necessary plates and bolts for connecting the bearings to the top spear-rods. These rods will be made of such a strength to resist a strain sufficient to raise 2,000 gallons of water from a depth of 2,000 ft. Wrought-iron girders are being constructed to support the pumps in shaft. This was not included first in the contract, but the engineer who drew the detailed plan at Home considered that these would be preferable to beams made of timber, and would give more room in the shaft. A hand-power travelling-crane is to be fixed on supporting columns in engine-house for the purpose of erecting and overhauling the different parts of the engine. This crane is sufficiently strong to lift and readily handle a load of 12 tons, and is placed on timber gantries supported on cast-iron columns, being 30 ft. from centre to centre of longitudinal rails, fixed at a height suitable for a lift of 18 ft. clear from the engine-house floor, the gantries running transversely across the engine-house from wall to wall, and the crane is arranged for hoisting and travelling longitudinally and transversely; all motion to be capable of being put into gear independently or at the same time, and actuated from platform on the main crane girder. The pumping-engine is to be utilised to drive a dynamo to supply power to work a forty-stamp battery, having an electric motor in the stamp-mill. The dynamo to be series wound, and to develop 55,000 watts at a speed of 700 revolutions per minute, the electro-motive force of the dynamo being from 300 to 500 volts, according to the distance through which the power has to be transmitted to the milling plant. The magnet limbs of the dynamo are to be either made of soft wrought iron or a special quality of cast steel, as made by Edgar Allen and Co., Sheffield. The armature is built up of soft wrought-iron plates insulated from one another by paper or varnish, and mounted on a strong gun-metal hub, which is securely attached by keys to the shaft, there being no bolts through the armature core-plates, but they are held together by end pressure. The wire has a conductivity of 98 per cent. of pure copper, and insulated with double cotton, well protected from all contact with the body of machine. There are six brushes mounted on a brush-holder capable of rotating round the bearing-end, with suitable means of fixing it in position when the right lead is obtained—i.e., whether the pole-pieces are at each side of the armature or at the top and bottom the brushes will touch the commutator in a horizontal line. The commutator is to be constructed so as to have a high conductivity of solid-drawn copper bars, insulated with mica and fixed in the commutator brush. The spindle is of the best mild Siemens-Martin steel, with provision made for securing the armature hub. All the bearings are of cast iron and bushed with phosphor-bronze, with all necessary oil-cups and means of lubrication. The bed-plate is made of strong cast iron, and extended to take a third bearing, with suitable attachments for the belt striking gear, complete with side-rails, tightening-screws, &c. The motor is in all respects similar in design to the dynamo, with the exception that there is no loose pulley and striking-gear, and is capable of giving out 68 brake horse-power at the motor-shaft with 55,000 watts at the terminals at a speed of 650 revolutions per minute. Dynamo and motor are fitted with eye-bolts screwed into magnet yoke for lifting purposes. The switchboard is constructed of ample strength, and contains volt and ammeter, the ammeter being provided with a cut-out plug of negligible resistance. All cables are of sufficient strength for carrying the current at more than 1,000 amperes per square inch density. The countershaft for dynamo is driven from the main pumping-engines when the engines are working below their power, and is arranged so that the dynamo can be stopped for a short period when required, leaving the whole line of shafting and straps running.

An electric-lighting plant is provided, having a separate engine of 10 brake horse-power when working at 100 lb. per square inch. This engine drives a dynamo, compound wound, of sufficient capacity for 2,000 candle-power and 75 16-candle-power, the speed of the dynamo being from 1,250 to 1,350 revolutions per minute. It is provided with one spare armature and six spare brushes.