slopes in again with ½ to 1 slopes for a depth of 3 ft., forming a key into the clay.

The most interesting feature of the whole work is the installation of some very large Humphrey explosion pumps to deliver the water from the River Lee above the diversion into the reservoir. There will be five of these pumps, and in order to take advantage of sudden floods they will have a total capacity of 180,000,000 gallons of water per day, a quantity that is equal to two-thirds of the daily water supply of London. Four of the pumps will each be capable of delivering 40,000,000 gallons of water per day, while the fifth will have a capacity of 20,000,000 gallons. In normal circumstances the small pump only will be used. The fuel for the pumps will be producer gas, and they will, of course, work on the internal combustion principle with the explosion in direct contact with the water to be lifted. In the larger pumps the combustion chambers and valve boxes are both 7 ft. in diameter with a 6 ft. play-pipe. The vertical towers at the other end of the pipe are in the shape of an inverted cone and are 15 ft. in diameter at the top which is 58 ft. from the bottom of the tower. On each explosion 10 tons of water will be forced into the tower, from which it will flow into the reservoir by gravity. With anthracite at 22s. a ton delivered the guaranteed cost is 0.0196 penny per 1,000 gallons delivered into the reservoir, and the guaranteed consumption is 1.1 lb. of coal per actual water h.p. hour. It is expected that in practice the actual cost will be still lower, or 0.016 penny per 1,000 gallons.

This type of pump is of comparatively recent introduction, and in designing it, the inventor, Mr. H. A. Humphrey, has stated that his object was to produce a pump of great simplicity and strength in which the explosive force is exerted directly upon the water, and in which no fly-wheel, solid piston, connecting rod, crank, bearings, or glands of any kind are required. (See The Canadian Engineer of December 21st, 1911). When the explosion occurs there is a full bore passage from the combustion chamber to the final outlet; some of the water pumped to a high level by the energy of the explosion is allowed to return again in order to compress a fresh combustible charge. When sudden changes of velocity occur in masses of a heavy and incompressible liquid such as water, difficulty is found in controlling the movement of the liquid; all such difficulties, however, are removed in this pump by allowing the movements of liquid to control the pump and by causing the mass of liquid moved to be sufficiently large so that the velocities are never excessive. The mass of water forms a pendulum which swings between the high and low level, and, by its movement alone, serves to draw in fresh water, to exhaust the burnt products, to draw in a fresh combustible charge, and to compress the charge previous to ignition. With the movements of the liquid quite unrestrained by any of the usual mechanical appliances the result is a pump which works with freedom from shock and noise and requires very few working parts. The arrangement consists essentially of a horizontal pipe connected by two bends at its ends with a vertical closed combustion chamber and the open water tower. The parts thus connected are nearly full of water forming a heavy mass or column of liquid which is made to oscillate under the action of the explosion. This oscillation is free and occurs in such a manner that the movement of the water causes the intake of a fresh combustible mixture, the compression of the mixture, the explosion and expansion which give the power stroke, and the exhaust. There are thus four primary movements of the water during each cycle, two being from the combustion chamber towards the tower and two in the opposite direction. The success of the arrangement is due to the use of the momentum acquired by the moving mass of water, for it is this momentum which enables the outward swing of the water under the action of the explosion to continue after the expansive force of the gases has finished and thus to draw in scavenging air and to cause the intake of fresh water from the low level, or supply, during the first outward stroke. On the first inward stroke which takes place under the head to which the water has been lifted, the column of water is allowed to acquire velocity and momentum while merely exhausting the burnt gases, and then the momentum is utilized to compress a cushion scavenging air imprisoned in the top of the combustion chamber above the exhaust valves. Energy is thus stored in the compressed cushion, and the cushion expands giving the second outward stroke and also the momentum which is relied on to carry the water column far enough to draw in behind it a fresh mixture of gas and air. The second return stroke takes place, and the explosive mixture is compressed; once more, owing to momentum, the compression pressure far exceeds that which would be due to the static head of the liquid, and permits a high thermal efficiency. The admission valves for combustible mixture and the exhaust valves for burnt products are placed in the combustion chamber, and the valves for admitting fresh water are placed circumferentially round a vertical valve box situated between the combustion chamber and the bend which connects the horizontal pipe.

Some of the castings for these pumps at Chingford weigh upwards of 20 tons each. The contract price for the pumps and producer plant is £19,388, and they are being built by Messrs. Siemens Brothers' Dynamo Works, Limited. It is expected that the installation, which is the largest of its type undertaken up to the present, will be completed in December and that a test under actual working conditions will then be carried out. The contract has been accepted subject to a fine of £1,000 for every 0.1 lb. of fuel consumed in excess of the guarantee.

COMPETITION FOR MINERS' LAMPS.

Under the auspices of the Acetylene Unions of the different countries, a competition for acetylene lamps for mines not containing fire-damp is opened from now under the care of the International Committee of Carbide of Calcium at Geneva. The prize or prizes will be awarded to the lamp or lamps which most completely fulfil the following conditions: Simplicity and regularity; cheapness; strength and lightness; easiness of upkeep; convenience in cleaning and refilling; resistance to upset; ease of handling and capability of being carried in the hand or being hung on the walls; solid material, light, durable, and unaffected by dampness or the results of the decomposition of the carbide; strong burner of long duration, and placed or arranged so as to avoid extinction from dripping water or by mine violences; production of gas as constant as possible, rational generation from the point of view of purity of the gas as well as the yield of the carbide; utilization of the present sizes of carbide intensity of 5/10 candle power as far as possible; duration of charge as long as possible. The competition will be divided into two categories: (1) Portable lamps for carrying by hand, duration of charge 8 to 12 hours; (2) portable lamps for carrying on the forehead, of extreme lightness, and a duration of at least 4 to 5 hours. At the discretion of the jury either one or two prizes may be awarded; of a total of 5,000 francs, which may be granted if two prizes are awarded, as to 3,000 francs for the best portable lamps for the hand, and as to 2,000 francs for the best portable lamps for the forehead. The models, with description, price of re-sale, &c., must be forwarded before March 20, 1913, to the International Committee of Carbide of Calcium, 5 Rue des Granges, Geneva. The jury will be composed of competent delegates from the different countries nominated by the respective Acetylene Unions.