A Green 144-tube economizer is used to heat' the boiler feed water.

The water is pumped from Spot Bond to the Fells and Bear Hill reservoirs. From these reservoirs it is distributed to the higher portions of the northerly part of the district. The daily average quantity pumped in 1916 was 7,106,000 gallons, against an average lift of 129.06 feet. The cost of pumping was \$5.8289 per million gallons.

The northern extra high service pumping station is located in Arlington and pumps water from the low service system for the supply of the higher parts of the town of Arlington and for the entire supply of the town of Lexington. The pumping plant consists of one Allis-Chalmers cross-compound crank and fly-wheel engine and one Blake compound duplex engine used as a reserve pump. Both have a daily capacity of 1,500,000 gallons.

There are two 54-inch horizontal tubular boilers in brick settings.

The daily average pumping in 1916 was 797,000 gallons; the average lift was 281.7 feet; and the cost per million gallons pumped was \$36.42. This was partly due to expensive repairs to the Allis-Chalmers engine and more extended use of the low duty Blake pump.

The southern extra high service pumping station is located in the Hyde Park district of Boston, and pumps water from the southern high service mains for the supply of elevated territory in the southern part of the district.

The station contains two 3,000,000-gallon crosscompound crank and fly-wheel engines built by the Laidlaw-Dunn-Gordon Co., and two 54-inch horizontal tubular boilers in brick settings. The daily average pumping in 1916 was 655,000 gallons; and the cost per million gallons pumped was \$30.31.

The five pumping stations are operated under the direction of the superintendent of pumping stations, Arthur E. O'Neil, who reports to Mr. William E. Foss, chief engineer of waterworks. The men work in eighthour shifts, and are allowed one day off in seven and a vacation with pay.

Coal and lubricating oil are purchased under specification and are regularly tested at a laboratory at the main office of the board in Boston. In addition to the laboratory tests of fuel, special boiler tests are made from time to time, especially when changes in the brand of coal used are contemplated. In this way much information regarding the actual working of the coal is obtained, which is not shown by the calorimeter or other laboratory tests.

Synopsis of Coal Specifications.—The coal shall be of good quality, free from dirt and excessive dust, a sample of which when dried at 221° F., hereinafter called dry coal, will approximate the following standard of heat value and analysis:—

British thermal units	14,800 per pound.
Volatile matter	18 to 20 per cent.
Ash	7 per cent.
Sulphur	I per cent.

Coal which when dry contains less than 14,300 British thermal units per pound, more than 23 per cent. of volatile matter, more than 9 per cent. of ash, or 1.50 per cent. of sulphur may, at the option of the chief engineer, be rejected, and if rejected shall be removed by and at the expense of the contractor.

Payments.—For each 50 British thermal units or fraction thereof in the dry coal in excess of 14,800 the price per ton shall be increased one cent, and for each 50 British thermal units or fraction thereof less than 14,700 the price per ton shall be decreased two cents.

For each $\frac{1}{2}$ of 1 per cent. or fraction thereof of ash in the dry coal in excess of 8 per cent. the price per ton shall be decreased one cent.

When the analysis of the coal shows moisture in the coal as received in excess of 3 per cent., the amount of weight due to moisture in excess of 3 per cent. shall be deducted from the total weight of the coal, and the net weight so determined shall be taken as the amount of coal to be paid for.

Coal for the pumping stations has been purchased on the heat unit basis since 1908, the board having been one of the pioneers in adopting this method of buying coal.

The specifications as outlined above have given general satisfaction and are fair to both dealer and consumer, which is an important point.

Fuel suited to the type of boiler, as well as draft and load conditions, is obtained and any loss of efficiency due to a poor lot of coal is compensated by the reduction in price.

Limiting the volatile matter is of considerable importance where vertical internally fired fire tube boilers are in use, as it is difficult to obtain complete combustion of a high volatile coal before the gases strike the heating surfaces of the boiler.

The limitation of sulphur is desirable, as the element in combination with iron and other constituents of the ash is apt to form bad clinkers, and also from the fact that the presence of 2 per cent. or more of sulphur is in most cases a very good indication that the coal is liable to spontaneous combustion. While it is well known that this action is due to absorption of oxygen by the coal, both sulphur and moisture seem to play an important part in starting the trouble, although some coals low in sulphur heat badly while others high in sulphur do not.

As the greatest opportunity for economy is commonly found in the boiler room, particular attention is paid to this part of the plant. Care is taken to see that the method of firing and depth of coal on the grates is suited to the fuel and load, that the tubes and heating surfaces and other parts of the boiler are kept clean, and the boilers are washed out at regular intervals. Particular care is taken to keep the lower tube sheets of the vertical boilers free from scale to avoid overheating the tube ends. The brick settings of horizontal boilers require careful watching to avoid infiltration of air through cracks or porous masonry.

Recording steam gauges have a considerable moral effect on the firemen, and in connection with log charts giving the hourly readings of instruments in the engine and fire rooms keep the superintendent informed of what goes on in the plant during the entire 24 hours.

An apparatus for the continuous determination of CO_2 is installed at pumping station No. 2, but has not proved very satisfactory in operation as, owing to its delicate and complicated construction, it is liable to get out of order, and requires more expert attention than it is practical to give.

Leaks in steam pipe lines are promptly repaired, as it is astonishing how much loss may be caused by an apparently insignificant leak.

There are four fuel economizers in service, but the conditions are not favorable for large savings owing to the steady load and large proportion of heat absorbed by the boiler heating surface, with consequent low flue temperature. The economizers do, however, act as settling reservoirs and to a limited extent as feed water purifiers, and as steam-driven auxiliaries are scarce in the Metro-