water pumps. The storage capacity should be for sufficient air to wash one-quarter of the filters in succession. The required air pressure is easily obtained by loading the tank with concrete.

A combined wash water and air tank, as described above, is used at the Montreal Water and Power Co.'s plant. In fact, this was the first combined air and wash water tank ever constructed and the outfit as installed is satisfactory.

Controlling, Operating and Indicating Devices.—It is necessary to control the effluent from the filters to a desired quantity of water, or desired rate of filtration. This is done by placing on the effluent line from the filter a controller. There are a number of different makes of controllers that operate satisfactorily. Most of them are of the venturi type and the operation of controlling is actuated by the velocity head through the throat of the meter. The writer is more familiar with the Simplex Valve & Meter Co.'s type of controller than any other, and finds that this controller can be set to deliver the desired quantity of water and that it will maintain this quantity very closely. It apparently is unnecessary, after a controller is once set, to readjust it at all. Like any other machine having moving parts, the packing around the spindle of the controller must be kept in condition and oiled so as to produce the minimum amount of friction.

The operating valves for the filters may be either hand-operated or hydraulically operated. On units of a capacity of one million gallons or more, hydraulically operated valves must be used in order to get efficient operation. It is probable that on beds of this size it will be necessary to use valves as large as 12 ins. and 14 ins. and you can understand that it requires considerable time and labor to operate these valves by hand. On the smaller plants, hand-operated valves are entirely satisfactory, and all that are necessary. Where hydraulic valves are used, operating tables are necessary. These tables are preferably constructed of marble and on the top of the table is arranged the levers for operating the several valves. The levers operate a pilot valve, which directs the water under pressure to the bottom or the top of the hydraulic cylinder on the valve. An indicator is attached to a spindle on the top of the hydraulic valve, by wire and chain and through an arrangement of gears indicates the movement of the valve, on the table. The operating table is usually placed directly in front of the filter. It is not necessary that it be placed in this exact position.

The only other accessory necessary in connection with the filter, is the loss-of-head gauge. This gauge serves the purpose of indicating the loss of head on the filter; that is, as the filter begins to collect the matter being removed from the water, it requires that more pressure be released by the controller to drive the water through the bed, or through the collected matter on the surface of the bed. This pressure is termed loss of head. The gauge is usually arranged with two float tubes; one connected directly to the filter and the water level in this tube coincides with the level of the water in the filter.

The other tube is connected to the effluent controller and the water level in this tube varies according to the pressure in the effluent main. The difference in level between the water in the two tubes is transferred from floats by cords to the mechanism of the gauge and is indicated by a pointer worked over a graduated dial. It is necessary to know what the loss of head on a filter is, for in this way the proper time for washing the filter is ascertained. There is arranged on the gauge an electric alarm which will advise the operator when the bed is run out. These gauges may also be of the recording type, but the writer believes an indicating loss-of-head gauge is to be preferred over a recording loss-of-head gauge. An indicating loss-of-head gauge is more simple in construction and requires less attention. By manually instead of automatically keeping the records of the loss of head on the filters, the operator is required to pass through the operating room and to each filter every hour. If the operator does this, it is assurance of more efficient operation. On the other hand, with a recording loss-of-head gauge, it is not necessary for the operator to go to the filters every hour and for this reason the tendency is to neglect frequent inspection of the filters in operation. It has occurred, after washing a filter and placing it in operation again, that through a blunder, the influent gate lever has been moved. This means that no water is coming to the filter and that the filter will run dry. With the recording loss-of-head gauge, not requiring the operator's presence in the operating room, this filter could stand dry for several hours. A visitor to a plant might move the levers on the operating tables and throw the filters out of operation and for these reasons, as above stated, a device requiring the operator to take records every hour is preferable.

Clear Water Basin.—The clear water basin must necessarily be located, as to elevation, below the filters, and it is good designing to keep the high-water mark in the clear water basin below the level of the pipe gallery floor. The outside lines of the basin should, if possible, be worked in to make the whole plant symmetrical or to coincide with the lines of the outside of the filters and operating room. The capacity of the basin should be designed to meet local conditions. In a direct pumping system, it should be sufficiently large to take care of a normal fire draft, after being drawn down to take care of the hourly daily variation. It is not necessary to provide against the contingencies of the filter plant being out of commission. With duplicate low lift pumping machinery or reasonable assurance of getting raw water to the plant, the possibility of anything happening within the plant to put it out of commission is very remote. Extensions to the clear water basin outside of the limits of the plant are often made, where increased capacity is desired. It is necessary in a clear water basin to be sure that the design will permit of circulation through the basin. The downdraft tubes from the several filters will greatly assist in the circulation, but in large basins it will probably be necessary to install circulating baffles.

Some engineers, and some state boards of health in the United States, require that the clear water basin be a separate structure and well removed from the coagulating basin, influent flume, pipes conducting raw water, or the drain for wash water. This means that they would not permit of a clear water basin being constructed adjacent to the coagulating basin, with only a wall between. In designing, it is often convenient to place the clear water basin so that the coagulating basin wall forms one wall of the clear water basin. Care must be taken, however, that this wall be watertight and the design often calls for an extra thickness of concrete at this point. Experience indicates that this is good practice. It is not necessary to provide a drain from the clear water basin, nor is it necessary that there be an overflow. Automatic equipment can be placed on the filters that will shut them off when the basin is full. It is believed, however, that a high and low-water alarm and a suitable indicating depth gauge is all that is necessary.

General.—The arrangement usually adapted in the layout of a filter plant has been to construct the filters on