

NEW 110-MILLION-GALLON PUMP AT THE CHAIN OF ROCKS, ST. LOUIS*

By L. A. Day

IN order to meet an increased demand for pumping capacity at the low-service pumping station of the city of St. Louis, a contract was awarded for a new De Laval turbine-driven centrifugal pump having a maximum capacity of 110,000,000 gallons per twenty-four hours. This will bring the total capacity of this station up to 290,000,000 gallons per twenty-four hours, which will be adequate for some time to come. The new pump will be located in the centre pit, there being three pits in all. There are at present two 30,000,000-gallon turbine-driven pumps in this pit. Room was made for the 60-inch suction valve on this pump by channelling off 3 feet of the ledge on the east side of the pit for its entire length north and south. This also provides enough room in the pit for the location of the necessary auxiliaries used in connection with the new pump. The ledge was cut from solid limestone. It was also necessary to tunnel a 60-inch suction line through the limestone for a distance of 40 feet to the suction well which is common to all engines in this station. In addition to the 60-inch suction valve which is located within the pit, stop logs are provided in the wet well for making repairs on the suction valve if needed. The operating floor of the pump pit is 12 feet above the bottom. An automatic push-button electric elevator is used to reach the turbine operating floor from the ground level of the pumping station, which is 45 feet above. The pump will be required to operate under varying heads as the river rises or falls. The average total discharge head will be 60 feet with a minimum of 45 feet and a maximum of 65 feet.

Against Head of 45 to 65 Feet

The discharge pipe will be 60-inch diameter and will drop below the floor and then rise vertically, paralleling the west pit wall. The pipe will be enlarged to 72 inches from a flanged Y, which is 60 inches by 72 inches by 42 inches, due to the north 30,000,000 centrifugal pump discharging its water through the same pipe. The new unit will be provided with a 60-inch hydraulically operated discharge valve close to the Y and the old unit with a 42-inch hydraulically operated valve close up to the 45 degree leg of the Y. The 72-inch line will be extended to the delivery well, which is a common discharge well for all pumps in this station. A 72-inch cast iron Venturi meter tube with a 36-inch throat diameter, the largest cast iron Venturi tube ever built, will be installed just outside of the pumping station.

The pump will deliver from 80,000,000 to 110,000,000 gallons in twenty-four hours against any head varying from 45 to 65 feet. This range of flexibility could not be met entirely with governor adjustment, but will be obtained by opening or closing hand-operated valves on the turbine; the speed of the unit thus obtaining will be further controlled by an automatic governor. This governor will be of the oil relay type, designed to permit of adjustment while the unit is in operation to any point within the required range of speed, and after being adjusted will maintain the required speed within 2 per cent. variation above or below.

*One of a series of four papers on St. Louis Water Works presented before the convention of the American Water Works Association held recently in that city.

The maximum brake horse-power of the turbine will be 1,550 and the maximum water horse-power required, including all pipe friction, will be 1,250; the speed of the turbine under these conditions will be 3,717 r.p.m. When the pump is delivering 80,000,000 gallons of water in twenty-four hours under a total head of 45 feet the turbine will run at 2,946 r.p.m. The pump speed will be lowered by means of reduction gears to 352 r.p.m. when delivering 110,000,000 gallons under 65 feet head, and to 279 r.p.m. when delivering 80,000,000 gallons under a 45-foot head. The guaranteed pump efficiency will be slightly above 80 per cent. under all of the specified head and capacity conditions. The suction and discharge openings to the pump will be 48 inches and the 60-inch suction and discharge piping will be gradually reduced near the pumps to this diameter.

Multi-Stage Impulse Type Turbine

The turbine is of the multistage impulse type and will operate with 125 pounds gauge pressure and 75° superheat. Provision will be made for bleeding 1,500 pounds of steam from one of the low-pressure stages for heating feed water. Bleeding this amount of steam will increase the B.t.u. duty of the unit approximately 3 per cent. The bleeder outlet will be provided with an automatic valve set to carry a pressure of 5 pounds gauge on the exhaust line at all times. The dry vacuum pump is of the horizontal crack-and-flywheel type designed to operate at a speed not to exceed 115 r.p.m. The condensate pump will be turbine-driven, connected to a centrifugal pump by means of reduction gears. The circulating pump will be direct connected to the main unit shaft, and will take its water from the 60-inch suction; after passing through the condenser the water will be discharged back into the main suction pipe. The condenser will be of the water-tube type placed directly under the turbine. Water for circulating purposes only will pass through the condenser, as an excessive amount of friction would have been obtained by passing all of the water pumped by the unit through the condenser, this being the usual waterworks practice. In order to drive as much heat as possible out of the exhaust steam going to the condenser a primary heater will be placed in the condenser and all the condensate from the condenser will be pumped through this heater before going to the hot well or open feed-water heater. The total condenser surface will be 2,825 square feet of seamless drawn brass tubes No. 18 B.W.G., 1 inch in diameter and 12 feet long.

Bidder's Guarantees

The unit was bought on the bidder's guarantees of duty per million B.t.u. consumed by the unit, including auxiliaries and bled steam, with the provision that the total amount of exhaust steam from the auxiliaries, plus the steam bled from the unit, should not exceed 2,200 pounds per hour.

The successful bidder's guarantees were as follow:—

100,000,000-GALLON			
Head in feet	45	60	65
50 circulating water	113.5	120	122
80 circulating water	106.5	113	115
80,000,000-GALLON			
Head in feet	45	60	65
50 circulating water	107	113.75	115
80 circulating water	101.5	108.50	109.5
110,000,000-GALLON			
Head in feet	45	60	65
50 circulating water	114	120.75	121.5
80 circulating water	107	113.50	114.0