Development of De Kalb's Water Works

How an old, inadequate pumping plant was replaced by modern centrifugal pumps without discontinuing service

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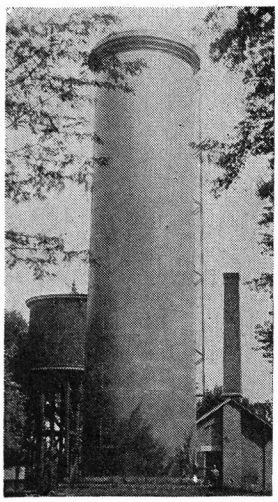


DeKalb's new tank; old tank in background.

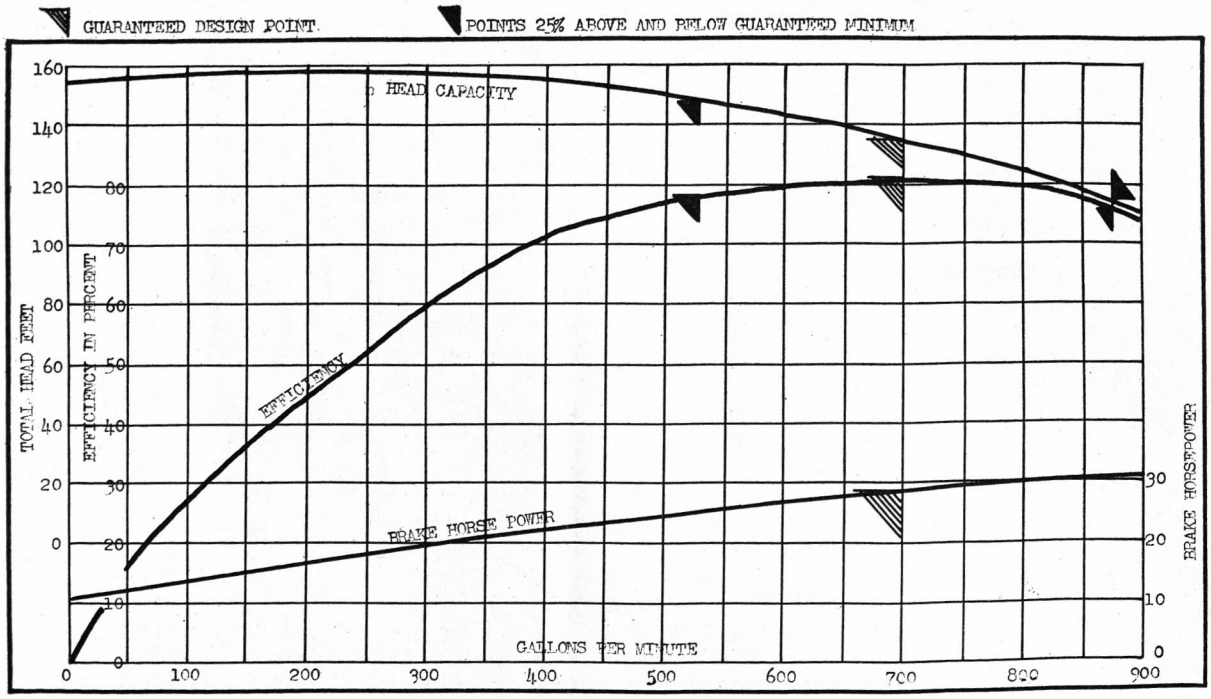
DE KALB, located in the center of a prosperous agricultural section of Illinois, contains several industrial plants and a State Teachers College. The population by the 1940 census (unofficial) is 9,155; but approximately 11,000, including the subdivisions adjoining the city, are more or less directly affected by the city's industrial, commercial and economic conditions.

Wells

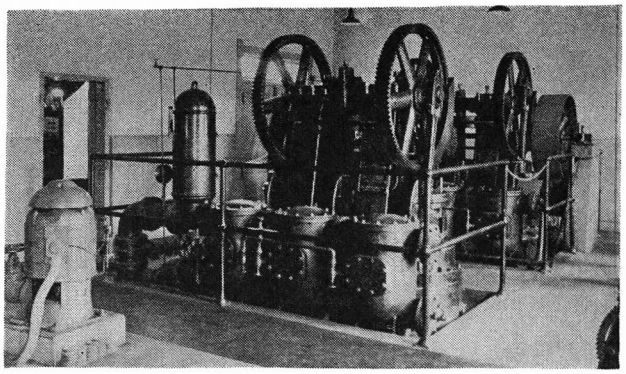
De Kalb's public water supply was installed in 1875 with the sinking of a 1,200 ft. and a 2,400 ft. well in the south side of the city, and a pumping station and wooden water tank. The last was replaced by a steel standpipe about 1890, and the two wells were abandoned about 1895 and replaced by a well in the western part of the city. At present the city is supplied from four wells.

Well No. 1 was drilled to a depth of 841 ft. in 1898 and deepened to 1,331 ft. in 1903. In 1936 the size was increased by reaming; from the 200 ft. to the 618 ft. depth the increase was from 9″ diameter to 15″ (the top 200 ft. was already 15″); from the 618 ft. to the 911 ft. depth from 7″ to 12″ diameter, and from there to the bottom from 6″ to 10″; the bore being relined at two points near mid-depth. To increase the capacity, the well was "shot" at three places —a 100 lb. shot at 725 ft., a 150 lb. shot at 1,250 ft. and a 150 lb. shot at 1,300 ft., solidified nitroglycerin being used. The enlarging and shooting increased the capacity from 200 gpm to 1,000 gpm with a drawdown of 35 ft.; a specific capacity which is still maintained.

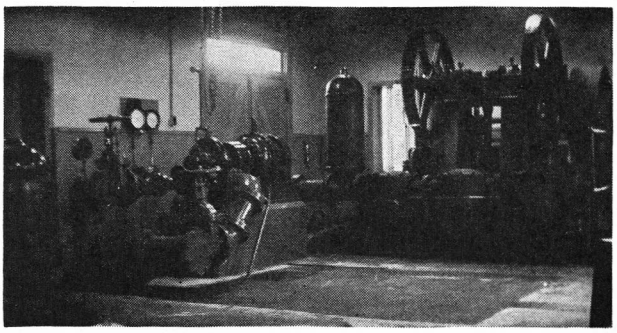
Well No. 2 was drilled to a depth of 1,306 ft. in 1912; No. 3 to a depth of 890 ft. in 1895; No. 4 to a depth of 1,320 ft. in 1926. No. 2 was quite crooked, because of which the plunger pump had to be removed frequently for repairs. To ascertain the alignment, a ring slightly smaller than the well was suspended directly above the top of it, then lowered into it and, at ten-foot intervals, the direction and amount of deflection from the vertical of the cord supporting the ring was ascertained. These gave deflections as high as 4-5/16″S.E. from vertical at 110″, shifting to 7/8″ N.E. at 180 ft., to 2″ to the S.W. at 220 ft. However, the absolute accuracy of this information can be questioned.



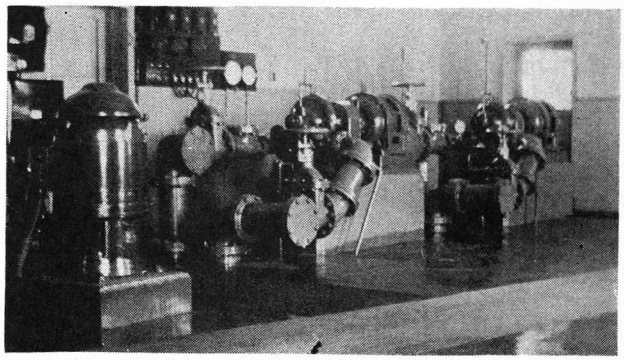
Characteristic curves of DeKalb's new centrifugal pump.



Old pumping plant—two 10 x 12 triplex pumps.



The centrifugal replacing one old pump while the other maintains service.



Both new centrifugals installed.

Well No. 4 dropped in capacity from 700 gpm to 400 gpm twelve years after completion, even with the water drawn down close to the pump bowls. It was cleaned, recased at one point, and shot in five places, using three 100 lb. shots at each of three levels and two 150 lbs. shots at each of two others. This restored the capacity to 700 gpm, increasing the specific capacity from 3 gal. to 12 gal. per foot drawdown.

Pump Installations

The first pump, in 1875, was operated by a single-cylinder steam engine; replaced later by a Dean pump with a 12″ diameter cylinder 3 ft. long. As stated, this well was abandoned about 1895.

Wells No. 1 and No. 2 were equipped with Keystone Driller Co. double-stroke deep-well plunger pumps, 10½″ cylinder, 18″ stroke. No. 3 contained air lift equipment, consisting of an Ingersoll-Rand 14¼″ x 12″ air compressor with 55 hp. motor. Well No. 4 was equipped with a deep-well turbine and discharges directly into the distribution system. Nos. 1, 2 and 3 discharge into a reservoir, from which two motor-driven Goulds 10 x 12 triplex pumps pump to the mains. A Lee 3-stage motor-driven centrifugal pump of 1,500 gpm capacity was (and still is) used as a fire pump.

The amount of water pumped increased from 165 million gallons in 1920 to more than 300 million in 1940; the revenue increasing at the same time from $25,000 to $50,000. Commercial and industrial consumption accounts for 30% of the total. Twenty percent is consumed by the State Teachers College, the largest single consumer.

In 1931 the plunger pump in Well No. 2 was replaced with a deep-well turbine, increasing the capacity from 300 gpm to 500 gpm. As stated above, this well was quite crooked, and several months after the new pump was installed, vibration in the drop pipe was observer, apparently caused by the casing pushing it slightly out of line at two points. Joint lugs at these points were eliminated by substituting longer sections of drop pipe, and the vibration ceased.

By the summer of 1935 the pumping demand required the operation of pumps 1, 2 and 4 for 24 hrs. a day. No. 3, the air-lift, had been kept as a stand-by, but it seemed necessary to bring it into regular service during the summer peak. However, its operation was uncertain and costly, and a second-hand deep-well turbine pump was rented for the rest of the summer at $75 a month, with the privilege of applying this to the purchase price of $1,200 if we decided to keep it; which we did after six months' use. This pump has a capacity of 250 gpm against a total discharge head of 350 ft., operated by a 25 hp. motor. This is still used as a standby.

The two Goulds triplex pumps previously referred to were replaced in 1939 with two American-Marsh horizontal centrifugal pumps, without discontinuing pumping service. Plans were made so that the piping below floor level did not have to be changed. We first removed the triplex pump shown in the foreground of Fig. 1, the other triplex being continued in operation. One of the centrifugals was then connected up where the old triplex had been, and when this was in operation the other centrifugal was substituted for the other triplex. The piping, four valves salvaged from the first installation, two check valves, and other fittings were installed by a local plumber assisted by our superintendent and workers at the water plant; who also assisted the electrician install the electrical units and wiring. All dimension drawings and piping diagrams were made in the office of the writer.

As the suction lift may become as great as 15 ft., two priming pumps were installed, one as an auxiliary, with tank, piping muffler and switches. The total pumping head is 125 ft., but we expect to install, in a very few years, an elevated tank with a water level 10 to 15 ft. higher than that of the present standpipe. Accordingly we obtained pumps with a flat efficiency curve, designed for 700 gpm and 1,050 gpm, respectively, against 135 ft. head; the discharges at the present 125 ft. head being 800 and 1,200 gpm, and the efficiency will remain practically the same up to 140 ft.

The cost of removing the triplex pumps was $61.80. Part of the old units was sold as junk (1,024 lb. lead cable, 69 lb. copper, 650 lb. of brass, 14.475 tons of cast iron and 2 tons of steel) for $236.33. The cost of the new equipment was: Two American-Marsh pumps, $464 and $619, respectively. Two priming pumps with accessories, $650. Piping, fittings and check valves for pumps, $481.39. Gauges, magnetic starters, switches, transformer and other fittings, $1,237.65; concrete foundations, $20.08. Total materials, $3,472.12. Labor costs were: Plumber, $66.63; welding, $13.16; electrician, $478.14; city labor, $257.20.