Telephone 15 Middlewich. Telegrams: "Murgatroyds."

Murgatroyd's Salt Works Co.,

MIDDLEWICH,

CHESHIRE.

Pump Operation

Deep well pumps run around 20 strokes per minute for a pump of this size. When the bucket descends, the column of brine in the barrel between the bottom of the piston and the foot valve is unable to return, it passes through the valve in the piston. The column of brine from the foot valve to the discharge point does not alter; it is the piston which changes position. On the downward stroke the displacement piston descends into this standing column of brine and displaces its own volume of brine out of the discharge port. On the upward stroke the ascending piston evacuates the barrel by a volume equal to the stroke times the cross-sectional area of the barrel. This immediately fills with brine through the foot valve. The piston lifts a volume of brine equal to this less the volume displaced by the displacement piston on the downward stroke. Thus, the pump ejects brine on both upward and downward strokes. This effect gives these pumps a volumetric efficiency of about 93%.

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Raw brine as raised at Middlewich was pumped directly into a head tank which served as the supply tank to the two booster pumps used to transfer the brine to Elworth. The tank also serves as a deaeration stage (removal of air molecules) for the brine which rapidly loses the majority of its dissolved air on being reduced to atmospheric pressure. The two booster pumps were usually used alternately but occasionally in parallel, are Gwynne's horizontal split casing K type driven by a 20 Horse Power motor. The capacity of each pump is 18,000 Gallons per Hour against 100ft.head.

These pumps were housed in an asbestos shed situated next to the brine head tank on top of the brick annexe on the North East side. The switch gear was housed in the room beneath the head tank

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The position of the **working barrel** in relation to the surface level is purely a matter of the standing level of the brine and economics. When the pumps were first put into the shaft the standing level of the brine was known. The pumps were expected to last 20-40 years. At what rate brine would be pumped in a few years time and to where the standing level would fall, was not known so a position was chosen which would allow brine to be pumped even if the standing level dropped 150 ft. Having fixed the distance of the working barrel at 200ft below the surface and now finding that the working level is 100ft below the surface, one might be tempted to think that the working barrel could be raised, say, 50ft. Nothing would be gained as the energy required to raise the brine to the surface is purely a function of the working level. At each upward stroke a column of brine the length of the rising main, plus 36", the stroke of the pump, is raised.

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The original timber pump head gantry, constructed in 1889, is still on site. This was reinforced with mild steel cross-bracing in about 1952. It stood 55 ft in height, is 8ft square at the base and tapers to 6ft square at the top. This was used during maintenance and repair work on the pumps whenever it was necessary to withdraw the pump bucket, pump rods or rising main.

During the restoration work, the timber gantry was too decayed to re-use as a whole. A new gantry was made from the same wood type, pitch pine, around 100 years old. Some of the metal and wood were salvaged from the original, using 1950's technical drawings, the gantry was remade identical to the first which lays to the rear of the building.

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Brine is raised to the surface by means of four pumps. Three are reciprocating deep well pumps; two operating the shaft and one in the borehole. The fourth pump is a submersible 3 stage centrifugal operating in the shaft. The two deep well pumps in the shaft have a working barrel or cylinder of 9½" borehole and 36" stroke. The rising main is shorter at 133 ft with 120 ft of 8" bore Mild Steel suction pipe. The long tail pipe reaching deep down into the brine serves two purposes, it draws brine from the lowest possible level where the brine is densest and unaffected by surface water and it allows for considerable variation in working level.

A typical deep well pump comprises: 1. Rising main with header carrying stuffing box and delivery branch 2. Working barrel with foot valve. 3. Suction pipe or tail pipe 4. Piston or bucket 5. Piston rods 6. Displacement piston. 7. Head gear and drive to raise and lower piston