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DESCRIPTION OF IRRIGATION PLANT IN OPERATION ON A BUNDABERG SUGAR PLANTATION.

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Previous to 1902 water was known to exist under the Fairymead Estate, and had been obtained by the old method of well-sinking. These wells, being partly for domestic and partly for mill use, were only sunk to a depth of about 15 feet, at which depth a plentiful supply was struck, at any rate, sufficient to meet the requirements for the time.

In May of that year (1902) an experimental pipe was prepared, and after having been driven to a depth of 25 feet, and cleared of mud, etc., was connected at the top with a small duplex pump, which was driven by steam obtained from a portable boiler. The pipe was 2in. diameter, and the pump delivered about 2,500 gallons per hour; this was kept steadily at work for a fortnight, during which time there was no decrease in the amount of water delivered.

Five 2-inch pipes were then driven to the same depth and connected to a duplex pump, with a 4-inch suction, which was kept going during the daytime for about two weeks, delivering 8000 gallons per hour. This water was used to irrigate a large garden, but the amount delivered was small, owing to insufficient boiler power. However, the success of these experiments warranted the proprietors in putting down a plant to irrigate part of the cane lands, and the following description of the scheme may be of interest ;—

Each pumping plant is on the "gang well" or driven tube system as used in America; the screen at the bottom end of each pipe is two feet in length, and is itself part of a pipe. It has 250 drilled holes of 7/16in. diameter, and is covered over with a fine copper gauze having about 200 perforations to the square inch. A socket is arranged, both below and above the screen, so that the pressure of earth or sand does not tend to disturb it when being driven, and a short piece of pipe, about 8 inches long, is drawn down at one end to a point to form a driving shoe, the other end being screwed into the socket below the screen, and when completed is as shown in Plate IV., Fig. 2.

No. 1 Station is a 20 pipe plant, in which an 8 inch Robison centrifugal pump is driven by a 6 N.H.P. Marshall engine. This being the first station put down, it was placed on the top of a rise, and the height the water has to be lifted is greater than the height to be forced, which is a mistake, and has been remedied in each plant subsequently laid down.

The pump delivers into a reservoir having a capacity of 1,500,000 gallons, and after running almost continually day and night (Sunday excepted) for a period of seven months, and delivering 55,000 gallons per hour the level of the underground supply was not reduced more than 2 feet 6 inches, and regained its original level in a few days when the pump was stopped. This area supplied by this pump is about 160 acres, and the cost of the installation, without the reservoir, was about £500. This plant, being on a rise, has to lift the water about 10 feet.

No. 2 Station consists of 36 pipes of 2 inches diameter, connected to a 10in. Hett pump (centrifugal) driven by a vertical engine and boiler of 10 N.H.P. This station having been arranged on very low ground, alongside one of the main flood drains and close to the highest ground it has to water, the lift of the pump is not more than 4ft., and the force

about 12ft. The pipes are arranged as shown on Plate III., Fig. 1. They are of cast iron in the main; the joints are all flanged and faced, and the pipes diminish from 8in. diameter at the centre, or pump seat, to 3in. diameter at the extreme ends; the branches are curved in the direction of the flow, and are of 2½in. diameter, thus dispensing with any square elbows.

In the driving of the pipes, the first four feet pierced consists of black soil, then, as a rule, about 10 feet of clay, then fine sand for 7 or 8 feet, then coarse sand next, and below that the gravel, which is the desired strata, and is usually found at from 24 to 32 feet under the surface.

The C.I. pipes and W.I. pipes connected to them are all kept about 3 feet below the surface, so that the ground can be deeply cultivated and the crops allowed to grow over the system. This system has the advantage of the work being made easier, as the lift is lessened, and as no part of the piping is above ground the area lost to cultivation is only that occupied by the portable engine, centrifugal pump and driving belt.

The water is forced up through a tapered or expanding pipe (which reduces friction) into a tank directly above the pump—the tank being at such a level that it commands the whole area to be watered—and a retention valve is arranged on the top of the expanding pipe to enable the pump to be primed. From the tank fluming is led to the various blocks (the flume in one instance being over 2000 yards long), with expansion joints arranged at intervals so as to prevent the fluming being torn asunder in very hot weather. Outlet boxes with stopping doors are arranged wherever necessary, and as these boxes are made wide they take up some of the expansion.

The fluming is made of 24 gauge plain galvanised iron, in sheets 6ft. x 3ft., which form a semi-circle of about 2ft. wide x 1ft. deep; these are bolted together and carried

on brackets of 4in. x 2in. hardwood, supported on posts every 10 feet, the brackets being connected by 4in. x 3in. hardwood under the flume, and 4in. x 2in. hardwood side rails to which the flume is clouted. To increase the depth of the flume a felt joint is inserted between the iron and side rails, and close clouted every 4 inches. (Plate IV., Fig 1, shows the construction of brackets.) The fall given to the fluming is determined by the quantity of water required: if of 60,000 gallons per hour it is of $\frac{1}{2}$ inch to the chain, but not less than $\frac{3}{4}$ inch is necessary for a flow of 90,000 gallons.

The average cost of fluming, including all material and labor, is about 2s. per foot; but this, of course, is influenced by the height of posts used. Wherever practicable, a reservoir is arranged, so that the pump can be driven day and night, and the watering done in the day time only, night watering not being very satisfactory.

No. 3 Station has 24 pipes, which lead to an 8 inch Robison pump, delivering 65,000 gallons per hour, and driven by an 8 N.H.P. Ruston Proctor portable engine. This pump was formerly driven by a 12½ B.H.P. oil engine, but as the power was deficient the steam engine was substituted. The usual vacuum obtained on a pump is 25 inches for a flow of 65,000 gallons through 24 pipes; whereas, with a 36 pipe station, delivering 80,000 gallons, the vacuum is about 17 inches, and it decreases as the velocity of water through each pipe is lessened.

No. 4 and 5 Stations are similar to No. 3. No. 6 was also the same, but was dispensed with when No. 10 was put down, as that station commands the area No. 6 used to supply.

No. 7 Station is of 40 pipes, leading to an 8 inch Morris centrifugal pump (the suction is 10 inch), driven by a 10 N.H.P. Ruston Proctor compound portable engine. This station was the hardest at which to obtain water, as much fine

sand existed, and apparently no gravel, and it was noticed that the clay passed through was of a yellow colour, instead of blue as on other parts of the estate. The amount of water delivered is 75,000 gallons per hour, but it takes a vacuum of 25 inch, even with 40 pipes.

No. 8 Station consists of 36 pipes, an 8 H.P. Ruston Proctor engine, and a 10 inch Robison pump delivering 80,000 gallons per hour at a vacuum of 17 inches.

No. 9 Station is the largest, and consists of 48 pipes. It supplies injection water for the mill, and can deliver 100,000 gallons per hour, which, after being used for condensing purposes, is delivered through fluming to the fields for irrigating. The plant has an 8 inch Kingsford pump (10in. suction) driven by an 8 N.H.P. Ruston Proctor engine, and will supply the above amount of water at a vacuum of 20 inches.

No. 10 Station has 40 pipes connected to a 10 inch Burton pump, driven by an 8 H.P. engine. It delivers 80,000 gallons per hour, and is placed in a very advantageous position, with the flumes running east and west from the pump, and each about the same length. Where roads intervene, a U pipe of 16in. diameter, is arranged under the roadway, the pipe having a head of 3 inches on the ingoing side.

No. 11 Station has 36 pipes, a 10 inch Robison pump, and delivers 80,000 gallons per hour.

In some parts of the estate, immediately under the black soil, a heavy bed of fine sand is met with, and as this contains very little water it must be driven through before the clay is met with, which has also to be pierced before reaching the gravel. In easy driving, as many as eight pipes have been sunk in a day, each to a depth of 27 feet, and it is not uncommon, by using a hand pump, to have a plentiful supply of water one hour after starting driving.

In putting down a pumping plant, the excavation is made

to the required depth, usually 4 feet; wide bed logs are then laid to support the pump seat, pump and tank stand, and as the cast iron pipes are laid and jointed up they are supported on wide cross slabs, as the ground being of clay is not adapted to carry any heavy weights.

After the cast iron pipes are laid, the 2in. W.I. pipes are driven at a distance of 7 feet from the centre of the main, and after being cleared of mud by a hand pump and a good flow obtained, the bends are screwed on, and the connecting pipes cut and screwed to meet the flanged branches on the main. All the joints are carefully made with lead putty, as the slightest leak vastly impairs the efficiency of the pump, and, further, the C.I. main, and also the cross W.I. pipes are laid with a slight rise towards the pump (about ⅛in. in 10ft. 6in.), thus preventing any air traps in the system.

At some of the stations the pump can be started on a Monday morning (after having been at rest during the Sunday) without the use of the ejector.

The yield of cane from the estate last season—when only a portion had been under irrigation, and much of it had only had the benefit of the water for a few months—was 30 tons per acre, in spite of the season having been an exceptionally dry one.

The best yield over the whole estate in any previous year had been 20 tons, so that even with the limited acreage under irrigation the result was fairly satisfactory. For this season (1904) it is estimated that a yield of 42,000 tons will be obtained from an area of 1200 acres, being equal to the rate of 35 tons per acre. These figures are only approximate, and include plant cane, 1st and 2nd "ratoons," but none of the plant cane will be over 20 months old when cut.

The total area watered by the pumps is about 1800 acres, but only 1200 are available for this season's crop, the remainder being newly planted or under green manure.

The following summary gives the size and capacity of the pumps installed at the various stations, the acreage supplied, length of fluming, etc.:—

No. of Station.	Size and Make of Pump.	Water deliver'd per hour.	Acreage supplied.	Cost of plant not including fluming or reservoirs.	L'gth of flume in chains	Date when pump was started.
1	8" Robison	55,000	160	Average Cost, £750 each.	None.	August, 1902
2	10" Hett	80,000	260		2	Sept., 1902
3	8" Robison	65,000	130		16	October, 1902
4	8" Robison	65,000	135		43	Novem., 1902
5	8" Robison	65,000	130		31	Decem,, 1902
7	8" Morris	75,000	200		24	Feb., 1903
8	10" Robison	80,000	220		55	April, 1903
9	8" Kingsford	90,000	210		62	May, 1903
10	10" Burton	80,000	200		92	June, 1903
11	10" Robison	80,000	140		40	August, 1903
12	10" Kingsford		Not yet at work.			