Fig. 1.

Fig. 4.

Note:

- No load water level at 18'
- Water level at 260 Gal. per min. 37 feet.

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This invention relates to deep well pump settings of the type in which water is withdrawn from water bearing sand strata and the like by centrifugal pumps and it has for its main object to simplify the construction of the entire pump arrangement, to reduce the expense due to the upkeep, and to eliminate drawbacks connected with long periods of inactivity.

More particularly the invention has for its object to eliminate the danger of freezing in those parts which are potentially exposed to freezing temperatures. This object is realized by means of suitable connections only, and the construction according to the invention does not materially increase the costs of erecting the pumping station, while on the other hand the fact that the pumping house may remain without heat reduces the expenses of erecting the building and the costs of operation very materially.

The invention will be understood in detail when referring to the following detailed specification and to the accompanying drawings describing and illustrating one embodiment thereof. It is, however, to be understood that the pumping arrangement is illustrated and described by way of example only, in order to be able to explain the principles on which the invention is based. The example is therefore not limitative and it will be clear to the experimenter that application of the same principles to other known pumping arrangements will result in mere modifications of the invention as illustrated and described. Such modifications do not necessarily, therefore, constitute a departure from the invention.

The invention is illustrated in the accompanying drawings in which:

Figure 1 is a graph diagrammatically illustrating the relation between the water level in the water bearing strata and the output of the pumping arrangement.

Figure 2 is a sectional elevational view through the plane of symmetry of the pumping arrangement indicated at 2—2 in Figure 3.

Figure 3 is a sectional plan view, the section being taken along line 3—3 in Figure 2.

Figure 4 is a diagrammatic sectional elevational view the section being taken along line 4—4 of Figure 3.

Figures 5 and 6 are sectional elevational and plan view respectively of the strainer.

The principle on which the invention is based will be best understood by referring first to the graph shown in Figure 1 which shows the relation between the output of the pump in gallons per minute and the location of the water level in the stratum or strata from which the water is withdrawn. The chart indicates the scales for these two factors along the abscissa and on the right side of the diagram along the vertical line. On the left side the pumping head is indicated. The full line a indicates the change of the water level, the curve b indicates the head capacity of the pump and therefore also the performance of the pumping arrangement. The curve c shows how the water level which is originally at eighteen feet (no-load-water level) when the pump is at rest, drops with increasing output of the pump. With the falling of the water level the pumping head increases as indicated on the pumping head scale.

When the level of the water in the water bearing stratum or strata drops, water is replaced by air and when the pump stops the air will again be driven out by the rising water level.

The pumping arrangement itself comprises a centrifugal pump 10 of a well known type which is arranged within the main casing 11 in the customary manner. The arrangement moreover comprises the two gravel pack casings 12, 13, arranged for packing the water bearing strata with gravel; this construction again is of a well known or customary type, the drawing showing by way of example an arrangement such as described in Patents No. 2,052,317 or 1,748,589 granted to Thomas W. Thorpe. At the end of the main casing 11 a strainer or screen 14 is arranged which projects into the gravel pack 13. The strainer is shown in detail in Figures 5 and 6. This gravel pack is formed in a stratum of water bearing sand around said strainer or screen 14 in order to facilitate the flow of water in the region near the center of the inflow. The water in this case may be pumped from the well in considerable quantities without running short of water. Such a shortage would occur without the gravel pack, as fine sand would otherwise be deposited all around the strainer or screen, which would constitute a great frictional obstacle, and which moreover, would partly pass through the strainer.

Once the gravel pack has been formed by means of the two gravel pack casings 12, 13 it has to be kept active. This is necessary, because the gravel pack, when dormant for some considerable time has a tendency to get clogged by incrustation and by organisms such as algae.

The pump 10 is located at a suitable spot above ground, as shown, and is a conventional pump, for instance of the centrifugal type. It delivers into the delivery pipe 16 leading to the tank (not shown) which enters an outlet and valve pit 20 arranged below ground level in the example.
shown. The delivery pipe is controlled by a delivery valve 21. Near the valve 21 a branch connection piece 22 is arranged, which has a main outlet 23 inclined towards the axis of the branch connection piece. This outlet is connected with outlet pipe 40 leading to the outlet end of pump 10. A smaller outlet 24 is connected with one of the Y-piece 25 of the two branches which are connected with the casings 11, 12, 13. The branch 26 of the Y-piece is connected with the central or main casing 11 by pipe 29 while the other branch 27 is connected with a pipe 39 which in its turn leads to a further Y-connection 28 of the two branches 32, 33 of which are connected with the gravel pack pipes 12, 13 respectively.

The Y-piece 25 also contains a further valve 31 in the branch leading to the gravel pipes 12, 13. The two valves 21, 31 are operated from without and their spindles 34, 35 are therefore extending upwardly through stands placed on the cover plate of the pit 20 and are carrying hand wheels 36, 37, respectively.

The pit 20 is accessible through a manhole 38 which is usually closed.

The operation of the pump in general will be clear, as this operation does not differ from that of known arrangements.

As will be clearly seen merely the head of pump 10 and pipe 40 are exposed to the outside temperature. This pipe 40 is now automatically drained by the arrangement shown according to the invention.

As has been stated air will be replaced by water and water will be replaced by air through the medium of pipe connection 29. This pipe connection 29 will allow the casing air to replace water in the outlet pipe in the piece 22 where the pipes 29 and 40 are joined. This results in the draining of the line 40 and of all those parts of the installation which are exposed to freezing temperatures. This draining occurs as soon as the pipe 29 is filled with air from the air rising in main casing 10 upon failure or stoppage of the pump. The penetration of air into the piece 22 allows the water contained in pipe 40 and the head of pump 10 to siphon back into the well. No water will therefore remain in the pipes exposed to freezing temperatures.

This fact makes it necessary to construct a special heat insulating house for the pump and to head said house long as freezing temperatures prevail.

It is to be understood that the specific known pumping arrangement shown is merely an example and that other pumping arrangement may be substituted without affecting the invention. I claim:

1. A deep well pumping arrangement for pumping fluid from a fluid bearing stratum comprising a centrifugal pump having a pump head above ground, a main casing and further casings, a laterally extending delivery pipe below ground, a downwardly inclined pipe partly above and partly below ground, connecting said pump head above ground with the delivery pipe below ground, means for automatically emptying the pump structure above ground and the pipes connected with it upon stoppage of the pump, said means including a laterally disposed Y-shaped pipe system with a plurality of pipe branches, one of said pipe branches being connected with the delivery pipe near its point of connection with the downwardly inclined pipe, a connection pipe leading from a further pipe branch of the Y-shaped pipe system to the main casing and further pipe branches leading from a third pipe branch of the Y-shaped pipe system to the said further casings in order to drain the discharge pipe and the pump structure above ground when the water is replaced by air ascending in the casing upon stoppage of the pump.

2. A deep well pumping arrangement for pumping fluid from a fluid bearing stratum comprising a centrifugal pump, having a head above ground, a main casing and two gravel pack casings leading downwardly into the fluid bearing stratum a laterally extending delivery pipe arranged below ground level, a downwardly inclined pipe partly above and partly below ground level, leading from the pump head above ground to the delivery pipe, a lateral junction pipe section with a plurality of outlets, one of said outlets being connected with the delivery pipe, a further lateral outlet of said junction pipe being connected with said downwardly inclined pipe leading from the pump head, a laterally disposed Y-shaped pipe system with three pipe branches, one of said branches being a central branch pipe connecting with one of the outlets of the lateral junction pipe section, another branch of the Y-shaped pipe system being a lateral branch connected with the main casing, and a second laterally disposed Y-shaped pipe system, having a central branch pipe connecting with the third branch pipe of the first-named Y-shaped pipe system and two further branch pipes in said second Y-shaped pipe system, each connected with one of the gravel pack casings, said Y-shaped pipe system being located in substantially the same level to permit emptying of the pump structure above ground and of the pipes connected with it upon stoppage of said pump.

3. A deep well pumping arrangement for pumping fluid from a fluid bearing stratum comprising a centrifugal pump, having a head above ground, a main casing and further casings extending downwardly into the fluid bearing stratum, a laterally extending delivery pipe below ground, a downwardly inclined discharge pipe, partly above and partly below ground, connecting said pump head above ground with the delivery pipe, and means for automatically emptying the water from the pump structure and the pipe sections above ground and from the discharge pipe upon stoppage of the pumping operation, said means including a laterally extending connection pipe between the discharge pipe at the point of connection of the downwardly inclined discharge pipe with the main casing and a second laterally extending connection pipe system connecting the downwardly inclined discharge pipe at the point of connection with the delivery pipe with said further casings.

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