Feb. 6, 1940. G. A. ZEIDLER, JR 2,188,936

METHOD OF DEVELOPING WELLS

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Fig. 1.

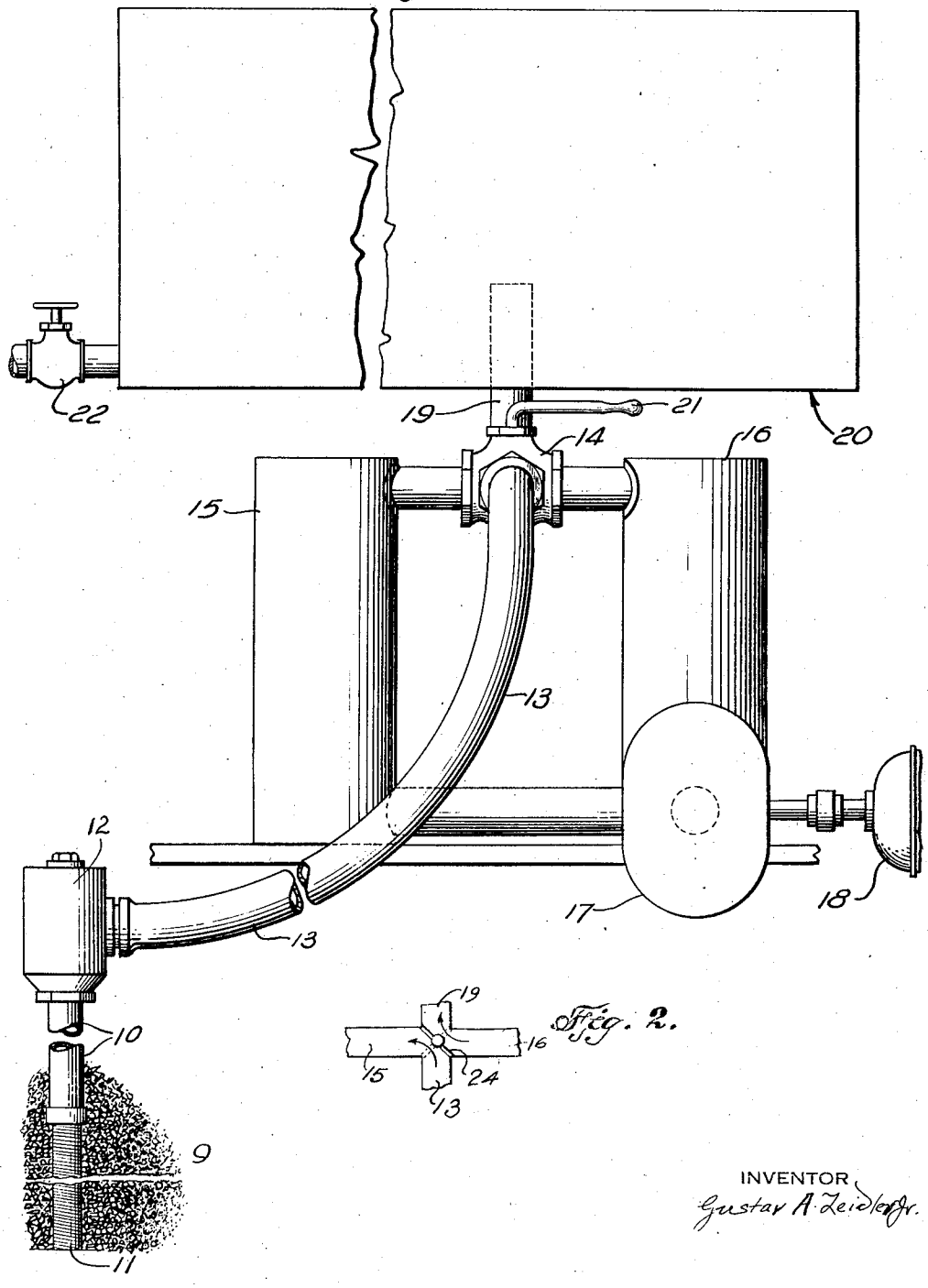


Fig. 2.

INVENTOR
Gustav A. Zeidler Jr.

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METHOD OF DEVELOPING WELLS

Gustav A. Zeidler, Jr., Medford Station, N. Y.

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1 Claim. (Cl. 166—21)

The present invention relates to well drilling, and more particularly to an improved method of and means for finishing and developing wells using well screens or well strainers in sand or gravel.

When sinking wells for the purpose of obtaining a supply of water or other liquid from a natural underground water or liquid bearing sand or gravel formation, it is customary to cause one or more well pipes or casings to penetrate through the formations overlying the water or liquid bearing sand or gravel stratum and into the water or liquid bearing sand or gravel stratum. A well screen or well strainer of any suitable design or type is then caused to be exposed to the water or liquid bearing sand or gravel below the pipe or well casing by means of driving, bailing, jetting, pull-back or other suitable methods and is attached to the well pipe or casing by means of pipe threads, welds, rivets, packers or other suitable joints or seals. The bottom of the well screen or strainer is plugged by any suitable device or method which will prevent infiltration of granular particles from the liquid bearing formation into the well.

In accordance with the present invention, the amount of water or other liquids which can be withdrawn from a well of a given depth and dimension is increased through the forming of a natural gravel pack around the well screen or well strainer when in position in the well. This invention accordingly contemplates the provision of a method of and means for building or creating such a natural gravel pack around the well screen or well strainer to an extent sufficient to increase the proportion of void spaces to solid material in the granular structure surrounding the well screen or well strainer, the greatest proportion of interstitial spaces to solid material being found in the area immediately surrounding the well screen, this proportion being gradually decreased outward from the well screen to the outer edge of the development area. In this manner more space is provided to be occupied by the water or liquid, larger screen openings can be used, and stabilization of the granular particles in the development area is effected against greater liquid velocities. These factors result in increased and more permanent well capacities.

The above and other objects and novel features of this invention will be apparent from the following description taken in connection with the accompanying drawing in which Figure 1 diagrammatically illustrates one embodiment of apparatus which may be used when practising the invention, and Fig. 2 diagrammatically illustrates the four-way value shown at 14 in Figure 1.

In the drawing there is shown a well casing 10 comprising at its lower end a screen 11. The well casing is connected by means of member 12 to a pipe 13 leading from the casing to a four-way valve 14, that is, a valve connected to the four pipes 13, 15, 16 and 19 by which the adjacent pairs of pipes may be made to communicate. This valve may be of any known type such as a conventional butterfly or four-way valve, shown schematically in Figure 2. When the lever 21 of the valve is in the position shown, the valve vane 24 establishes communication between pipes 13 and 15 on the one hand, and pipes 16 and 19 on the other hand. When the handle 21 is rotated to the left, the valve vane 24 will assume the position indicated in dotted lines and communication is established between pipes 19 and 15 on the one hand, and pipes 16 and 13 on the other hand. The valve 14 is interposed between the two vertical pipes 15 and 16 of a pipe system which comprises, as a means for causing a flow of water therethrough, a centrifugal or rotary pump 17 which is driven by means of a suitable driving mechanism such as an internal combustion engine or an electric motor, shown schematically at 18. The valve 14 also establishes communication, by means of the vertical pipe portion 19, with a reservoir or tank 20 which is provided with discharge means such as a valve shown at 22.

In the practice of the present invention, the well casing 10 is sunk a suitable distance in the liquid-bearing stratum 9. The well screen 11 is set in proper position in said liquid-bearing stratum, either subsequent to the driving of the well casing, or the screen may be formed integral with the casing and lowered simultaneously therewith. The liquid, such as water, for example, is then pumped from the liquid-bearing stratum by means of the pump 17, the valve 14 being set in a position to conduct the water upward through pipe 13, downward through pipe 15, through the pump 17, upward through pipe 16 and into the tank 20. After a suitable head of water has been formed in the tank 20, the valve lever 21 is rotated to the left to close the communication between conduits 16 and 19 and establish communication between conduits 19 and 15 on the one hand and 16 and 13 on the other hand. Clearly in this manner, the flow of water in the pipes 13 and 19 is reversed, the water being

forced down under pressure by the pump 17 which is now used as a force pump, through pipe 13 and well casing 10 into the water-bearing stratum 9. The impact of the water with the constituents of the water-bearing stratum 9 results in a considerable turbulence and agitation of these constituents, whereby the finer portions such as sand are dislodged and loosened and caused to settle around the apertures of the screen 11. After this portion of the cycle, the lever 21 of valve 14 is reinstated to its initial position whereby the pumping action of the system is resumed. Along with the water, the fine material such as sand thus finds its way through the openings in the walls of the screen and is carried out by the outgoing stream of water and deposited at the bottom of the settling tank 20. The gravel and other mass of the constituents of the water-bearing stratum which are too coarse to pass through the openings of the screen will, as the fine particles are withdrawn with the pumped water, arrange themselves around the walls of the screen, thus increasing the proportion of cavities of the water-bearing stratum. By rotating lever 21, the water of the settling tank will again be caused to flow through pipes 19, 15, pump 17, pipes 16 and 13, well casing 10, into the water-bearing stratum in a manner to temporarily increase the proportion of fine material to coarse material in the zone of the water-bearing stratum which surrounds the screen 11. In this manner, by repeatedly alternating the functions of pumping from and into the well by means of changing the position of lever 21 the fine material will be eliminated from the liquid-bearing formation surrounding the well screen or well strainer, thus causing the coarse sand or gravel particles in the liquid-bearing formation to form around the well screen and in this manner increase the capacity and life of the well.

Numerous modifications of the present invention will readily suggest themselves to those skilled in the art. For example, where the liquid-bearing formation does not contain in its natural condition sufficient gravel or coarse constituents, such gravel or constituents may be introduced into said formation by conveying the same through suitable means to the bottom of the well.

A typical illustration of the invention as applied to the drilling of a new well may be found in the sinking of so-called fire wells. This type of well is characterized by the fact that from its very nature and purpose, its use is contingent upon the occurrence of a fire, and if used at all, such a well will be employed only at infrequent time intervals. However, a well of this type, while it will generally be a relatively shallow well, must be capable to yield, at any time, a considerable amount of water. The present invention, therefore, represents a considerably improved and valuable method of and means for developing and/or conditioning such wells.

The following is illustrative of the invention when applied to a well which, although in operation, has decreased in yield to a fraction of the original yield. Among the causes of such well deterioration are the presence of free iron or other metals which are corroded away from the well casing or screen and redeposited in the water bearing stratum surrounding the screen, thus forming impervious coatings. Other common causes of well deterioration are the infiltration of fine particles of sand and/or silt into the region adjacent to the well screen in a manner such as to clog the perforations thereof; further, the deposition of the solid products of electrolytic corrosion of the well casing or well screen, as well as the deposition of free lime or other solid substances, in the form of incrustations, around or upon the well screen. In accordance with the present invention, these obstructions are removed by the alternate cycles of pumping water into and from the well, as described, whereby the coatings or deposits are broken up into fragments of which the smaller particles are removed, and the coarse constituents are arranged around and about the well screen in the manner described. In many instances, where the proportion of the incrustations or other deposits is found to be high, it has been found advantageous, in accordance with this invention, to introduce into the well water a material which will react with the incrusting or corrosive constituents thereof to form a precipitate which will be more readily removed. Such materials are sodium carbonate, or sodium phosphate, in proportions of between about 0.5% to 8% or more by weight; finely ground flaked graphite may be used to restore the supply of water to wells whose water is used primarily for purposes other than human or animal consumption, such as is the case with fire wells, for example.

I claim:

The method of developing wells which comprises sinking a well-casing a suitable distance into the liquid-bearing stratum, setting the well screen in said stratum at the bottom of the casing, pumping a portion of the liquid together with a portion of the finer constituents of said stratum from the liquid-bearing formation, temporarily storing said mixture of liquid and fine particles near the surface of the well, in order to enable the separation of the liquid from the fine particles, forcing said liquid down into the liquid-bearing stratum under pressure to cause it to impinge through the screened end thereof into the liquid-bearing formation, whereby the finer particles of said formation are loosened and caused to settle in the vicinity of said well screen, reversing the flow of liquid in the well casing to withdraw another portion of the liquid together with the suspended particles, and repeating this operative cycle until the fine particles of the formation surrounding the screen section of the well casing have been removed to the desired extent.

GUSTAV A. ZEIDLER, Jr.