

P. E. VAUGHAN & S. M. HALSTEAD.
WELL CONSTRUCTION.

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1,289,320.

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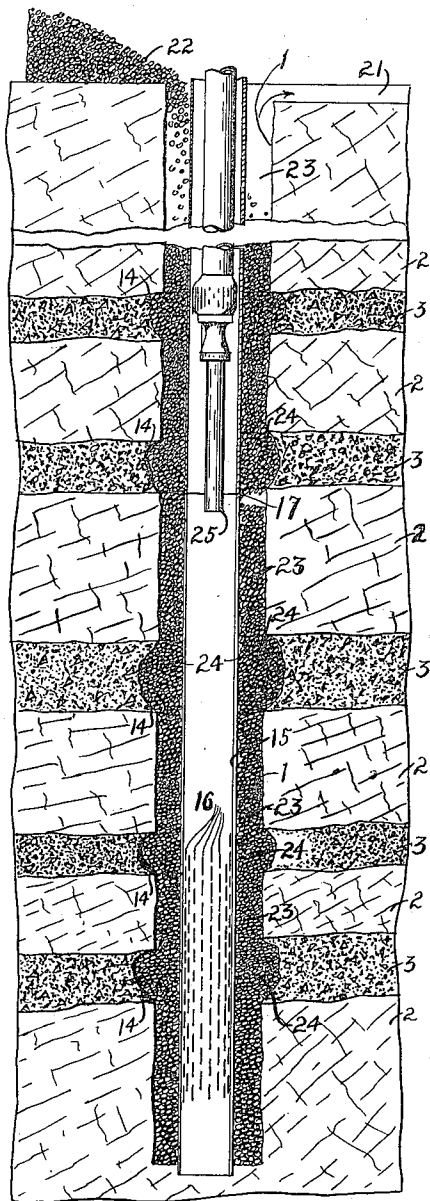


FIGURE 1

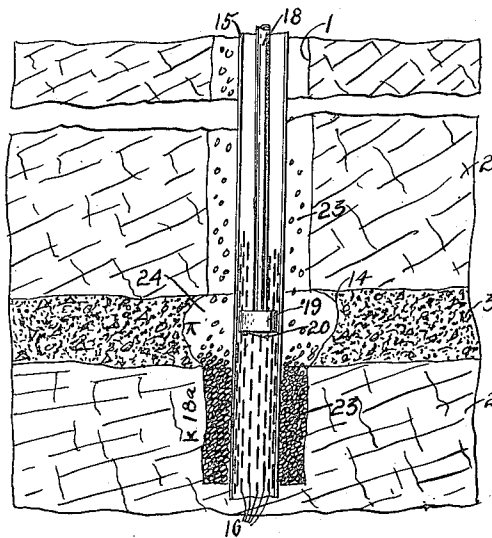


FIGURE 3

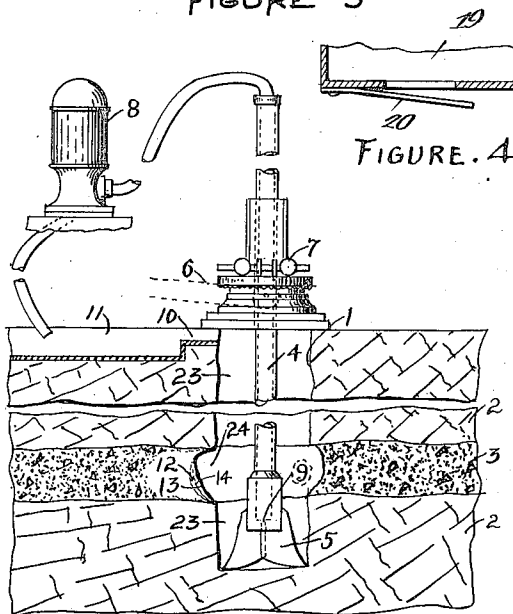


FIGURE 2

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To all whom it may concern:

Be it known that we, PERCY E. VAUGHAN and STANLEY M. HALSTEAD, citizens of the United States, and residents of San Jose, in the county of Santa Clara and State of California, have invented certain new and useful Improvements in Well Construction, of which the following is a specification.

Our invention relates specifically to a new and useful method of constructing wells preparatory to equipping the same with deep well pumps.

The difficulties attending upon the construction of deep wells, especially in those locations where the well must pass through a succession of beds of materials of widely varying qualities such as clay, quicksand, gravel, etc., are numerous and have never been satisfactorily overcome. Briefly stated, these difficulties are set forth in the following paragraph.

In one of the commonly accepted methods of constructing a well under the conditions indicated above, the well is first drilled then a casing of substantially the same diameter as the well is inserted, the sections being joined by a screw and socket joint and the casing is then perforated under-ground with various types of perforators. In this method of construction the tool used in perforating the casing frequently becomes jammed in place, and parts are dropped in the well, causing expense and delay in recovery; the perforations are imperfect and frequently improperly distributed and cannot be inspected; water can only make its way into the casing directly opposite the bearing strata; the perforations become clogged by the accumulation of clay and sand. Inasmuch as the bore must be of slightly larger diameter than the casing inserted in order to allow the coupling or collar of the casing free clearance, the danger is ever present of silt, sand and clay settling from the upper strata and clogging the perforations opposite the water-bearing strata. In irrigation wells where large volume of water is the aim sought, the velocity at which the water must enter the casing through the small number

of perforations which it is feasible to obtain by under-ground perforating precludes the use of light casing and seriously affects the lasting qualities of heavy casing, often causing collapsed wells and their attendant ills.

We are aware that various forms of screened casing have been produced that are set in bores of greater diameter than the casing itself, but these are expensive and are subject to some of the faults above set forth, for while they may be sufficiently strong and sufficiently perforated they are excessively expensive and become easily clogged when inserted under the above method. All of the forms now used require the presence of a certain amount of skilled labor and require constant supervision.

Another commonly accepted method of constructing a well under the conditions indicated above, is to use a percussive drill of some acceptable form and drive the blank casing as the well is being drilled, keeping the same at or near the bottom of the hole until the desired depth is reached, after which it is perforated under ground in the usual manner. The main draw back in this method of constructing a well is the unusual care and supervision necessary to obtain a relatively straight well through the mixed formations of hard and soft material and loose boulders. A perpendicular and comparatively straight casing is a necessity for the proper installation of a deep well pump. Another limitation of this method of constructing a well is that in ordinary practice the hole is drilled substantially smaller than the inside diameter of the casing which is being inserted, this being necessary in order to allow free access of drilling tools in and out of the casing, a shoe being provided on the bottom of the casing which will cut a small clearance for the casing proper. This limits the screening area of the finished well to the diameter of the casing itself and to the sand strata encountered immediately opposite the perforations.

It is therefore, the object of our invention to provide a method of constructing deep wells which will satisfactorily over-

come the difficulties above set forth, and to provide a method of deep well construction that will be comparatively easy and simple to install, and that will be permanent, effective, satisfactory and efficient.

By our method we decrease the velocity of inflow of water at any one point by providing a multitude of small openings, and further augment the possibilities for the inflow of water into the well by making a bore considerably larger than the casing therein inserted, and protect the walls of the bore from caving and deterioration, at the same time allowing for the free inflow of water from the different strata from a larger area.

With these and other objects in view our invention consists in the novel and useful improvements which are hereinafter set forth and pointed out in the claims and illustrated in the accompanying drawings, in which:—

Figure 1 is a vertical section through a deep well illustrating our improved method of construction, parts broken away.

Fig. 2 illustrates a preferred method of boring the well, parts being broken away.

Fig. 3 is a detail illustration showing the use of the plunger. Fig. 4 is a detailed illustration of the back-pressure valve.

Similar characters of reference refer to similar parts throughout the several views.

In carrying out our invention we first make a cylindrical bore 1 to the required depth, which may be upward of a thousand feet or more. This bore will pass through a succession of strata of various kinds, which may be designated formally as loose and fixed strata. The fixed or substantially solid portion being indicated at 2 and the loose, gravelly portion being indicated at 3. In making this bore we use a pipe 4, the lower end of which has been previously provided with a bit 5 of suitable size for making the bore in question, this pipe being provided with a suitable mechanism for turning the same in a horizontal plane indicated in a formal way at 6 and 7, and any suitable lowering mechanism to keep the bit 5 in contact with the formation encountered and not shown in the drawing. When this drilling mechanism is in operation water under pressure is forced into the upper end of pipe 4 in any suitable manner as by a pump 8, of which the operating mechanism is not shown, and out through orifice 9 in bit 5 in the usual manner, and in contending to equalize passes upwardly and discharges at the top as at 10.

As the erosive action of the water and the rotative action of the bit combined wears the formation away this water is caught in some suitable receptacle, as 11, at the top of the ground and, after allowing the coarse particles to settle, is used over and over again. A continuation of this process through thick-

nesses of varying formation tends to keep the liquid a great deal thicker and heavier than water, and owing to the pressure and weight of the liquid under normal working conditions, it penetrates unconsolidated strata to a depth as at 12 in Fig. 2, sufficient to hold up the walls long enough to finish the bore and insert the casing 15 therein. The erosion effected by this liquid is naturally very uneven; it affects the more solid parts, as 2, but little, but the looser formations, as 3, are excavated more rapidly. Assuming that one of the beds is composed of quick-sand, as 3 in Fig. 2, this would of course first fall away around the edge by force of gravity as indicated at 13, then the moving liquid cuts it away slightly as indicated at 14. Since the liquid is carrying more or less of the more cohesive materials such as clay and fine sand as the wall 14 ceases to wear away it gradually receives a more or less thick covering of said clay like material and fine sand which serves to establish a more stable wall than would otherwise be secured.

We now have a series of enlarged reservoirs which we utilize in the following manner. The casing 15 having been previously perforated as at 16, and of considerable less diameter than the bore 1 in which it is placed and having the joints of the several abutting ends of the sections welded as indicated at 17 or riveted or otherwise connected so as to provide substantially smooth joints, it is then lowered into the bore in the usual manner. Then a pipe of smaller diameter than the casing 15, as 18, having a plunger 19 with a suitable back-pressure valve arranged on the lower end of the same, is inserted in the casing 15 to a point at or near the bottom of the well. Water under pressure is then forced into the upper end of pipe 18 in any suitable manner and is forced through the perforations 16 in casing 15 below the bottom of the plunger, and in seeking an outlet passes upwardly and discharges at the top as indicated at 21. The erosion effected by this flowing water is comparatively small unless the pipe 18 is agitated. This action tends to keep the space between the casing 15 and the bore 1 free and open except in a space at or near the plunger 19.

When the water discharged from the top of the well indicates that the proper time has arrived, that is the liquid is not too thick to prevent the gravel from working down through it, or so thin that the gravel does not meet with enough resistance to cause it to move slowly, or that the unconsolidated portions of the walls of the bore may start to cave, then a continuous stream of coarse, clean gravel as indicated at 22 is fed into the top of the bore 1 around casing 15. The upwardly moving fluid assists in working

this gravel down throughout the full length of the casing to the bottom of the bore where it fills the voids formed as above described. The narrow space surrounding the casing 15, such as 23, is of course easily filled but it is found that this process alone is insufficient to entirely fill the larger chambers 24 where a considerable amount of loose material has been washed away. In order to fill these spaces satisfactorily, we utilize the plunger 19 and pipe 18 to which it is attached and which is operated intermittently within the casing 15. Upon dropping the plunger a distance, as 18^a, water is forced violently out through the orifices 16 and consequently agitates the surrounding water and its contents. This agitation breaks down the clay solution previously deposited as at 12, and carries the gravel into these spaces until filled.

Assuming that water has been found in the various strata, the well drilled and the casing positioned, and the gravel deposited substantially as indicated in the drawing. The gravel envelop around casing 15 being continuous the water is enabled to make its way upwardly until it finds its level and to flow into the perforated casing throughout that whole distance. A light pipe may be used because the gravel is deposited uniformly around it and throughout its length thereby subjecting it to a substantially uniform pressure, and at the same time preventing the caving in of the heavier bodies of surrounding formation. The enlarged chambers 24 permit the passage of a larger amount of water than small chambers because of their greater area of discharge surface, the filling of gravel offering but little obstruction to the passage of the water.

While we have herein described in detail specific methods of effecting our invention, it is conceivable that other methods of satisfactorily placing the gravel around the casing may be devised, and the use of the plunger not always found necessary, and the casing might even be perforated after being placed in position but the methods described are considered by us to be the most desirable. The word "gravel" as used in this specification is intended to include any material of the proper character to perform the function set forth. It is conceivable that other forms or types of casing, other than the type herein taken for an example, could be satisfactorily used in combination with this method, such as wood pipe, corrugated pipe, steel tubing with substantially smooth exterior, etc. At 25 is indicated the lower end of the pump proper operatively positioned in the well.

We claim:—

1. The method of constructing a well through strata of varying density, which

consists in drilling the well, positioning therein a casing of less diameter than the well, forming chambers in the strata of least density by hydraulic means, and finally filling said chambers and connecting spaces with gravel.

2. The method of constructing a well through strata of varying density, which consists in drilling the well, positioning therein a casing of less diameter than the well, providing orifices in said casing, forcing water into the well through said casing and thence out of the well on the exterior of said casing, agitating said water by means operated within said casing thereby forming chambers in the strata of least density, and feeding gravel into the space between said casing and the wall of the well and into said chambers while said water is being agitated.

3. The method of constructing a well which consists in drilling the well, inserting therein a perforated casing of less diameter than the well, forcing water into the well through said casing and thence out of the well on the exterior of said casing, and simultaneously introducing gravel to fill the space surrounding said casing while said water is flowing and agitating said water at successively ascending intervals substantially corresponding with the rising level of the gravel.

4. The method of constructing a well which consists in drilling the well, positioning therein a perforated casing of less diameter than the well and having a substantially uniform exterior surface, removing excess material from the exterior of said casing by hydraulic means, and filling the space between said casing and the wall of the well with gravel and settling said gravel by agitating the water in which it is placed.

5. The method of constructing a well which consists in drilling the well, positioning therein a casing of less diameter than the well and having a substantially uniform exterior surface providing orifices in said casing, removing excess material from the space surrounding said casing by hydraulic means, and filling said space with gravel and simultaneously operating a plunger in said casing to agitate the water in which said gravel is placed.

6. A deep well construction comprising a substantially cylindrical and vertical bore having enlarged chambers formed in the water bearing strata through which said bore passes, a perforated casing of less diameter than said bore positioned therein, and an envelop of gravel deposited in the space between said casing and the wall of said bore, and in said chambers, and substantially filling the same.

7. The method of constructing a well

which consists in drilling the well and forming enlarged chambers in the water bearing strata through which said well passes, by hydraulic means, inserting in said well a casing of less diameter than said well, and
5 filling the space around said casing, and said chambers, with gravel, the said casing having orifices formed therein to permit the

passage of water therethrough, and operating a plunger in said casing during the placing of said gravel.

Signed at San Jose, in the county of Santa Clara and State of California, this 6th day of March, 1918.

PERCY E. VAUGHAN.

STANLEY M. HALSTEAD.