April 15 , 1924. 1,490,280

M. E. LAYNE

WELL APPARATUS AND METHOD OF INSTALLATION

Filed Oct. 3, 1921

Fig. 2

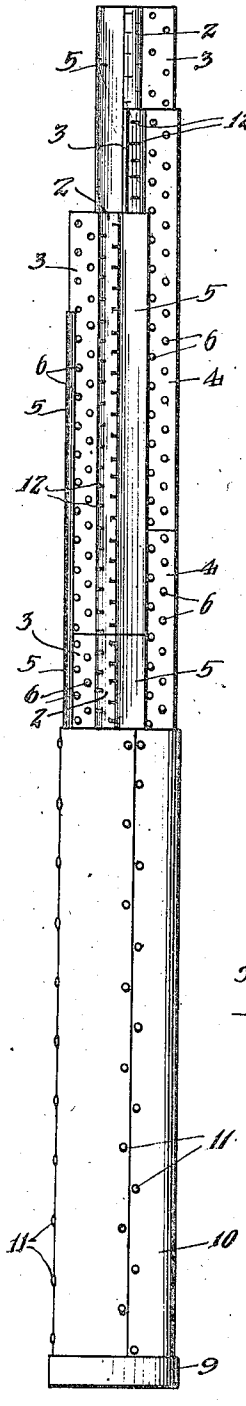


Fig. 1

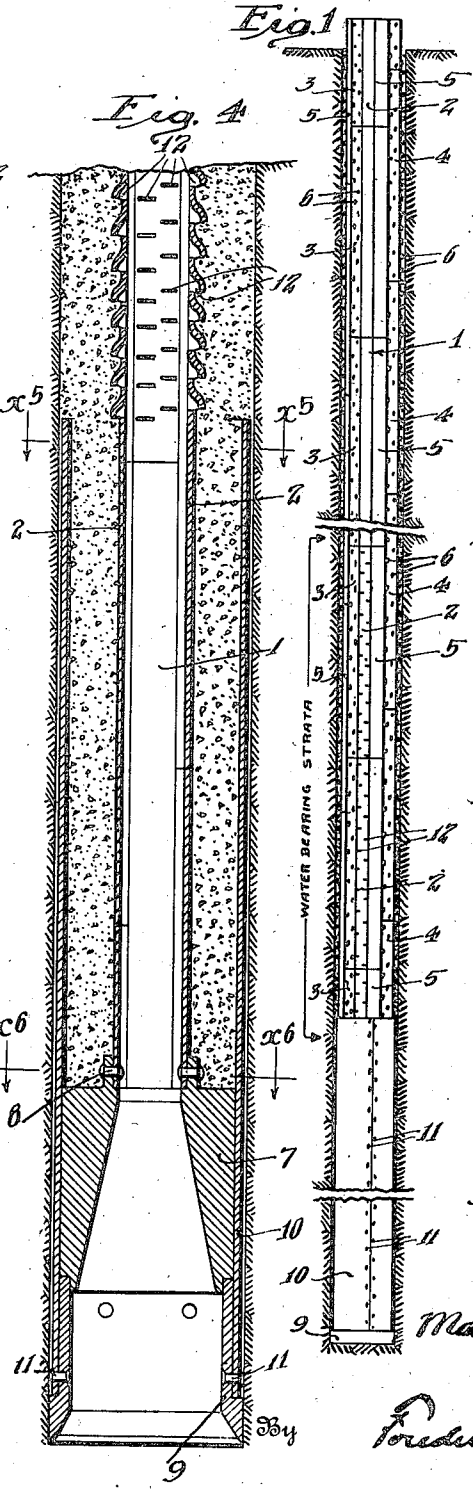


Fig. 4

Fig. 3

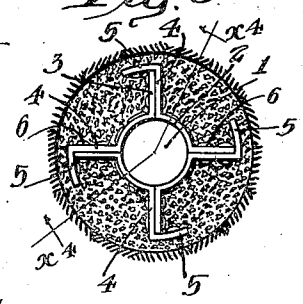


Fig. 5

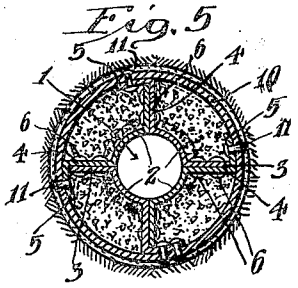


Fig. 6

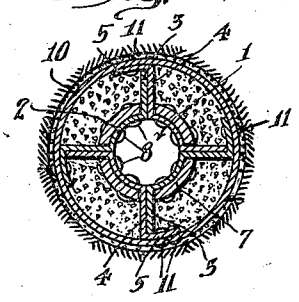


Fig. 7



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UNITED STATES PATENT OFFICE.

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WELL APPARATUS AND METHOD OF INSTALLATION.

Application filed October 3, 1921. Serial No. 504,929.

To all whom it may concern:

Be it known that I, MAHLON E. LAYNE, a citizen of the United States, and a resident of South Pasadena, in the county of Los Angeles and State of California, have invented certain new and useful Improvements in Well Apparatus and Methods of Installation, of which the following is a specification.

This invention relates to well apparatus and the method of installing same and is particularly directed to the general type of apparatus referred to in my Patents Nos. 1,062,717, issued May 27, 1913, and 1,088,078, issued February 24, 1914.

The general object of the invention is to provide a well apparatus including disintegrated screening material and to provide a simple and effective method of installing such apparatus in a well bore.

A further object is to provide a method for treating the screening material to improve its operation in sinking the well.

Another object is to provide in a well apparatus a well tube which may be manufactured in segmental sections capable of being nested together for transportation and subsequently assembled in tube formation as required.

Another object is to provide a well tube constructed of a plurality of segmental sections assembled in longitudinal abutting engagement and relatively staggered circumferentially so as to break the continuity of the transverse joints whereby a tube of maximum strength is provided.

Another object is to provide a well tube constructed of segmental sections joined together by means entirely exterior of the tube whereby the joining of the sections may be quickly and easily accomplished without the insertion of devices or tools into the tube.

Another object is to provide a well apparatus having a tube portion provided with longitudinal radial flanges which are adapted to engage the walls of a well bore to maintain the tube centrally alined within the well bore, and dividing the space between the tube and said walls into longitudinal conduits or channels to receive gravel or other disintegrated screening material with the flanges assuring a positive circular positioning of the gravel and maintaining it against circular displacement.

Another object is to provide in a well apparatus a well tube having a screen portion and combined with means maintaining the tube centrally alined in a well bore and forming longitudinal channels around the tube to receive gravel or other screening material.

Another object is to provide a device having a tubular portion of uniform diameter and a guide sleeve of larger diameter joined together by a cutting shoe having a bore extending upwardly from the cutting edge to register with the bore of the tube and providing an approximately smooth unbroken inner wall surface.

Another object of the invention is to provide a well apparatus having a central tubular portion and a cutting shoe of larger diameter secured to its lower end with a guide sleeve extending upwardly from the shoe and surrounding the lower portion of the tube, there being means permanently joining the walls of the tube and the sleeve to afford a rigid unitary structure capable of withstanding severe transverse strains incident to the driving of the screen into the earth, the extended guide sleeve also overcoming any tendency of the lower end of the screen to be deflected laterally during the driving operation.

Various other objects and advantages of my invention will be more fully apparent from the following specification, and from the drawings which disclose a preferred embodiment of the invention.

Of the drawings,

Figure 1 is a section through a well bore showing the apparatus in position therein;

Figure 2 is an elevation of the lower portion thereof, showing the staggered relation of the segmental sections;

Figure 3 is an enlarged top plan view of Figure 1;

Figure 4 is an enlarged section of the lower portion of the apparatus in the well bore, taken on line x^4—x^4 of Figure 3;

Figure 5 is a plan section on line x^5—x^5 of Figure 4;

Figure 6 is a plan section on line x^6—x^6 of Figure 4;

Figure 7 is an end view of several of the segmental sections as nested for transportation.

Well apparatus of the general type herein referred to comprises a well tube constructed of tubular sections joined together with one or more of the sections near the lower end of the tube being perforated to

provide a screen to be positioned in the fluid bearing strata, and a cutting shoe of larger diameter attached to the lower end of the tube.

In driving such well apparatus pressure is applied to the top of the tube to force the tube into the earth, the cutting shoe forming the well bore and the dirt being removed through the tube by any suitable means as the tube descends. As the tube is sunk sections are added to the top of the tube and gravel or other disintegrated screening material is placed around the tube to serve the purpose of preventing a caving of the wall of the well bore, to prevent a clogging of the screen perforations and to assist in the filtration of the fluid to be pumped, the weight of the gravel also assisting in the driving of the tube.

Tubes of this character are usually of the well known "stovepipe formation" in which the end of one section telescopically engages within the end of the adjacent section and is riveted thereto.

This type of well apparatus and method of installation as heretofore employed has many objectionable features which it is the object of the present invention to overcome, and in presenting the advantages of my improved mechanism and method it is thought advisable to first direct attention to some of such objectionable features so that a clear understanding of the present invention may be had.

First, with the ordinary type of "stovepipe" well tubing the major portion of the driving pressure is assumed by the rivets joining the tube sections and it is well known that sometimes these rivets shear off and the tube sections telescope under heavy driving pressures. With the ordinary form of tube having no strengthening provisions this weakness is exceedingly objectionable, especially in deep wells where the removal of a damaged tube entails a large expense. Further, in joining the sections of the ordinary form of tubing, it is necessary to insert the rivets from the inside of the tube and to employ riveting tools within the tube. This method of riveting frequently entails a loss of the rivets and of the tools by dropping down into the well, where they may seriously interfere with the successful operation of the well.

Secondly, with the ordinary tubing, it is exceedingly difficult to apply the gravel evenly or uniformly so that the tube may be kept in true central alinement in the well bore and due to encountering cavey or very soft formations or to cavities in the wall of the bore into which the gravel will flow, the gravel will slew around to one side of the tubing, causing a transverse strain and frequently a bending of the tube. With only a slight degree of such bending of the tube, the heavy driving pressure will cause the tube to buckle and become set or wedged in the well bore.

Thirdly, in the use of dry gravel in well mechanism of this character, the gravel has a tendency to hang up on any projections or uneven areas of the wall of the well bore and prevent a free downward flow of the gravel. Further, such dry gravel has a tendency to become bridged or wedged between the tube and the well bore. This bridging tendency is especially objectionable after the mechanism is in use, for the reason that in pumping fluid from a formation of very fine sand a certain amount of such sand will be pulled through the gravel and screen with the fluid, causing openings or cavities in the strata adjacent the gravel, and as it is desired that in such cases the gravel slide down and refill such openings or cavities it will be evident that any bridging of the gravel at higher elevations will prevent such refilling.

From the above it will be evident that it is very advantageous and desirable to provide a well apparatus in which the rivets are relieved of heavy shearing pressures and by which it is possible to apply and secure the rivets entirely from the exterior of the tube; to provide means for positively maintaining a true alinement of the tube within the well bore; to so construct the mechanism as to prevent a slewing or shifting of the gravel around the tube; and to provide a construction in which the entire weight of the gravel bears downwardly upon the tube. Further, it is very desirable and advantageous that the gravel be kept entirely loose from the wall of the well bore so as to prevent bridging or wedging thereof and so that the entire tonnage of the gravel will be exerted in assisting the tube driving operation.

All of the above mentioned advantageous and desirable features of construction, function and method of installation are inherent in the apparatus and method of the present invention, and in the preferred form of embodiment which will now be described.

Describing the structure in detail, 1 designates the central tube portion, which is smaller in diameter than is the well bore and which is formed of segmental sections 2 each forming a part of the circular wall of the tube. Each of the segmental sections 2 has a radially disposed longitudinal flange 3 projecting outwardly from one of its longitudinal edges and projecting outwardly from its opposite longitudinal edge is a similar radial flange 4 having a segmental foot or circularly extended portion 5 (see Figure 3). The abutting flanges 3, 4 are riveted together by rivets 6 which by this arrangement are positioned entirely exteriorly of the central tube portion 1. This is of particular advantage for the reason that as ad-

ditional sections are applied to the tube at intervals as it is being driven, said sections may be riveted together without applying any rivets from the inside of the tube and without having to insert any tools into the tube where they may drop into the well. By applying and riveting all of the rivets entirely from the outside the sections may be quickly and easily assembled and the inner surface of the tube will be perfectly smooth and devoid of projecting rivet heads.

In the specific form illustrated, the tube 1 is formed of four segmental sections 2 each forming a quarter of the circular wall of the tube, but it will be readily understood that the tube may be formed of three sections, each forming a third of the circular wall, or it may be formed of various other numbers of sections combined to total a complete circular tube.

A member 7 in the form of a massive thimble is attached to the lower end of the tube 1 by rivets 8 and abuts against the upper edge of a circular cutting shoe 9, it being evident that the shoe 9 and member 7 may be constructed of a single piece of material if desired. The bore of the member 7 tapers upwardly to register with the bore of the tube 1 and provides an approximately smooth unbroken inner wall surface.

Attached to and extending upwardly from the shoe 9 is a guide sleeve 10 which surrounds the lower portion of the tube 1 and which is joined to the arcuate portions 5 of the segmental sections 2 by rivets 11 (see Figures 2 and 5). The thimble 7 has a solid wall extending from the shoe to the lower end of the tube 2 and its outer, cylindrical face lies against the inner face of the sleeve. It is preferably a casting. This sleeve, by preventing a lateral deflection of the lower end of the tube, insures a straight driving of the tube and by its attachment to the portions 5 provides an exceptionally strong and rigid means of attaching the cutting shoe to the well tube.

By an inspection of Figure 2 it will be noted that in assembling the segmental sections 2 they are positioned out of transverse alinement with the ends of each section extending beyond the ends of the circularly adjacent section and with the flanges 3, 4 of the several sections engaging each other in overlapping relation circularly. The sections throughout the length of the tube are of uniform length excepting those at the top and bottom ends of the tube which are of suitable lengths to provide straight tube ends.

A portion of the tube 1 has a plurality of perforations 12 forming a screen, such perforations being in the form of horizontal slits or of any other desired shape or size.

The perforations 12 are disposed along that portion of the tube exposed to the water-bearing strata (see Figure 1), and the remaining portion of the tube not exposed to water-bearing strata being left unperforated.

A well tube of this construction is transported to the well site in "knock-down" form and during the driving of the well the segmental sections are assembled as the depth of the well increases.

As the tube is forced into the ground, gravel or other disintegrated screening material is placed around the tube between the flanges, this gravel assisting in the filtration after the screen portion has been positioned in the water bearing strata, and the weight of the gravel assisting in the operation of forcing the tube downwardly. During the driving of the tube and after the tube has reached its final position the longitudinal flange portions 5 serve to maintain the tube centrally alined in the well bore and the flanges provide means whereby the gravel is definitely positioned around the tube and maintained against slewing around the tube and piling up on one side thereof in such a manner as to force the tube transversely out of true central alinement.

In tubes of this character the gravel performs several important functions during the driving of the tube and also after the tube has reached the desired depth.

In positioning the tube the gravel in inserted as the tube moves downward and as the dirt is removed from the interior of the tube. The weight of the gravel thus inserted assists the downward movement of the tube, and serves to prevent the soil around the tube from caving in, the advantages of this general type of construction being pointed out in my Patent No. 1,062,717, referred to.

In overcoming the previously mentioned objections incident to the use of dry gravel, the invention contemplates a treating of the gravel with a lubricating fluid, preferably oil. It is well known that a lubricant treated gravel will flow more readily than gravel in a dry state and in the use of a lubricant treated gravel as an element of the well mechanism herein described the lubricating of the gravel will tend to lower the tendency of the gravel to become bridged or wedged between the tube and well bore permitting the gravel to exert a greater load pressure to assist in the driving of the tube. Further, the lubricant will permit the gravel to more readily fill in such voids and soft formations as are encountered and will lubricate those portions of the tube flanges as contact the wall of the well bore.

In the construction illustrated in the drawings, the entire length of the tube is strengthened against flexure, by the radial flanges, and with the ends of the sections 2 including their respective flanges 3, 4

abuttingly engaging the companion edge of the adjacent sections, a structure is provided which will resist great longitudinal strains without any liability of telescoping or bending, it being pointed out in this connection that by such abutting engagement the major portion of the longitudinal strains are absorbed by the walls of the tube sections without putting any appreciable shearing strain upon the connecting rivets.

Many wells having an ordinary perforated casing have been abandoned by reason of the fact that the water or other fluid was contained in sand so fine that the sand would be drawn into the casing in such quantities that the well would soon cave in and become inoperative. In such abandoned wells the mechanism herein shown and described may be used to advantage, the gravel acting as a filtering medium to prevent the fine sand feeding into the tube.

It will be apparent from the above that the present invention has a plurality of independent aspects. It is adapted for the provision of a well tube or of a complete well apparatus having the several characteristics previously described, and independently thereof is adapted for the construction of a well screen per se suitable for use in connection with any of the common forms of well mechanism.

The invention also provides a sectional structure of "knock-down" construction with the sections capable of being nested together for transportation to the well site and of being subsequently riveted together by rivets positioned entirely exterior of the tube or screen.

Further, the invention provides a method of installation which increases the speed of the driving operation and which eliminates many of the objectionabe features heretofore encountered in the driving of wells of a like character.

While the form of structure disclosed herein is admirably adapted to fulfill all the objects primarily stated, such structure is susceptible of various changes and modifications, all of which come within the scope of the following claims.

I claim:

1. In well apparatus, the combination, with a central tube, of a cutting shoe attached to the lower end of the tube, and a guide sleeve extending upwardly from the cutting shoe and surrounding the lower portion of the tube, the tube having longitudinally extending radial flanges extending throughout the length of the inner tube disposed within and joined to the sleeve.

2. In well apparatus, the combination, with a central tube, of a cutting shoe of larger diameter attached to the lower end of the tube and having a central bore registering with the bore of the tube, and a guide sleeve extending upwardly from the shoe and surrounding and spaced from the lower portion of the tube, the tube having longitudinally extended integral radial flanges with segmental feet riveted to the inner face of the sleeve.

3. In well apparatus, the combination, with a central tube having longitudinally extended radial flanges maintaining the tube centrally disposed within a well bore and providing longitudinal channels to receive screening material, of a cutting shoe attached to the lower end of the tube, and a guide sleeve extending upwardly from the shoe and surrounding the lower portion of the tube with the flanges of the tube joined to the sleeve, the tube having perforations providing a screen portion.

4. A well tube formed of a plurality of segmental sections longitudinally alined in abutting engagement and having radially extended longitudinal flanges with the flanges of each section connected to the flanges of the adjacent sections, said flanges having integral curved feet operating as means for engaging the well bore to maintain the tube centrally alined within the same.

5. A well tube formed of a plurality of segmental sections having radial flanges extended longitudinally throughout the length of the tube and having arcuate feet at their outer ends to maintain the tube centrally alined within a well bore, said flanges operating to provide longitudinal channels throughout the full length of the tube.

6. A well tube formed of a plurality of segmental sections adapted to be nested together for transportation and subsequently assembled in circular arrangement to form a well tube, each section having two radial flanges adapted to engage the companion flanges of the adjacent sections, and an arcuate foot integral with one of the flanges of each section.

7. A well tube formed of a plurality of segmental sections circularly arranged, each section having flanges extended from each longitudinal edge with the flanges of each section engaging the flanges of the adjacent sections and one flange of each section having a circularly extended portion at its outer edge and fastening devices joining the abutting flanges.

8. A well screen formed of a plurality of perforated segmental sections circularly arranged and having radially extended flanges with the flanges of each section engaging the flanges of the adjacent sections and one flange of each section having a circularly extended portion at its outer edge, and fastening devices joining the abutting flanges.

9. In well apparatus, the combination, with a central tube adapted to be positioned in a well bore, of means between the tube

and the wall of said bore defining a plurality of longitudinal channels, and disintegrated screening material positioned within said channels.

10. In well apparatus, the combination, with a central tube adapted to be positioned in a well bore, of means between the tube and the wall of said bore defining a plurality of longitudinal channels, and lubricant treated disintegrated screening material positioned within said channels.

11. In a method of installing a well apparatus, the steps consisting of lowering a well tubing into the well bore, treating disintegrated screening material with a lubricant and filling the space between the tube and the wall of the bore with said material as the tube descends.

12. In a method of installing a well apparatus, the steps consisting of assembling segmental sections to form tube sections, lowering the tube into a well bore and attaching section upon section as the tube is lowered, treating disintegrated screening material with a lubricant and filling the space between the tube and the wall of the well bore with said material as the tube descends.

13. In well apparatus, the combination with a central tube adapted to be positioned in a well bore, of a lubricant-treated disintegrated screening material within the well and disposed around the central tube.

14. In well apparatus, the combination of a central tube adapted to be positioned in a well bore, a shoe of relatively larger diameter and constructed to cut its way downwardly through the earth and form the bore of the well, a cylindrical sleeve attached to the shoe and extending upwardly, so as to envelop the lower portion of the central tube, and a thimble secured to the lower end of the central tube, and carrying the shoe, said thimble having a cylindrical face engaging the inner face of the sleeve, and having a substantially conical opening therethrough, having its large end disposed toward the shoe and its small end disposed adjacent the central tube.

Signed at South Pasadena, California, this 23d day of September, 1921.

MAHLON E. LAYNE.

Witnesses:
S. N. HALL,
WESLEY M. MASON.