No. 731,130. PATENTED JUNE 16, 1903.

M. D. ROCHFORD.

METHOD OF WELL CONSTRUCTION.

APPLICATION FILED AUG. 4, 1902.

NO MODEL. 4 SHEETS—SHEET 1.

Fig. I

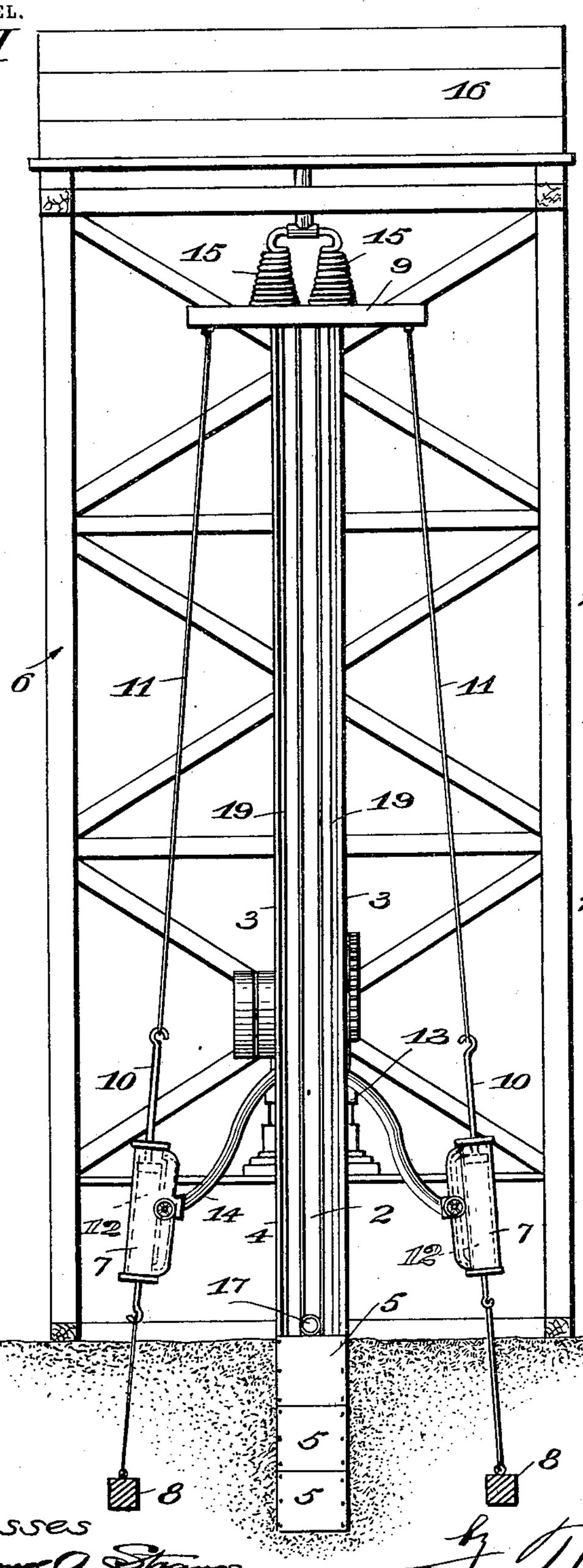
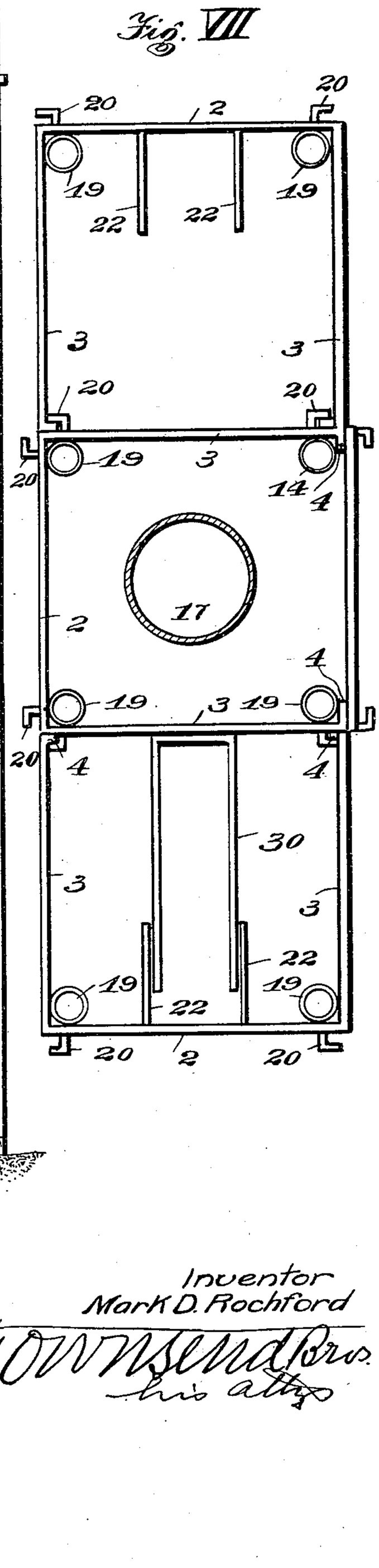


Fig. VII



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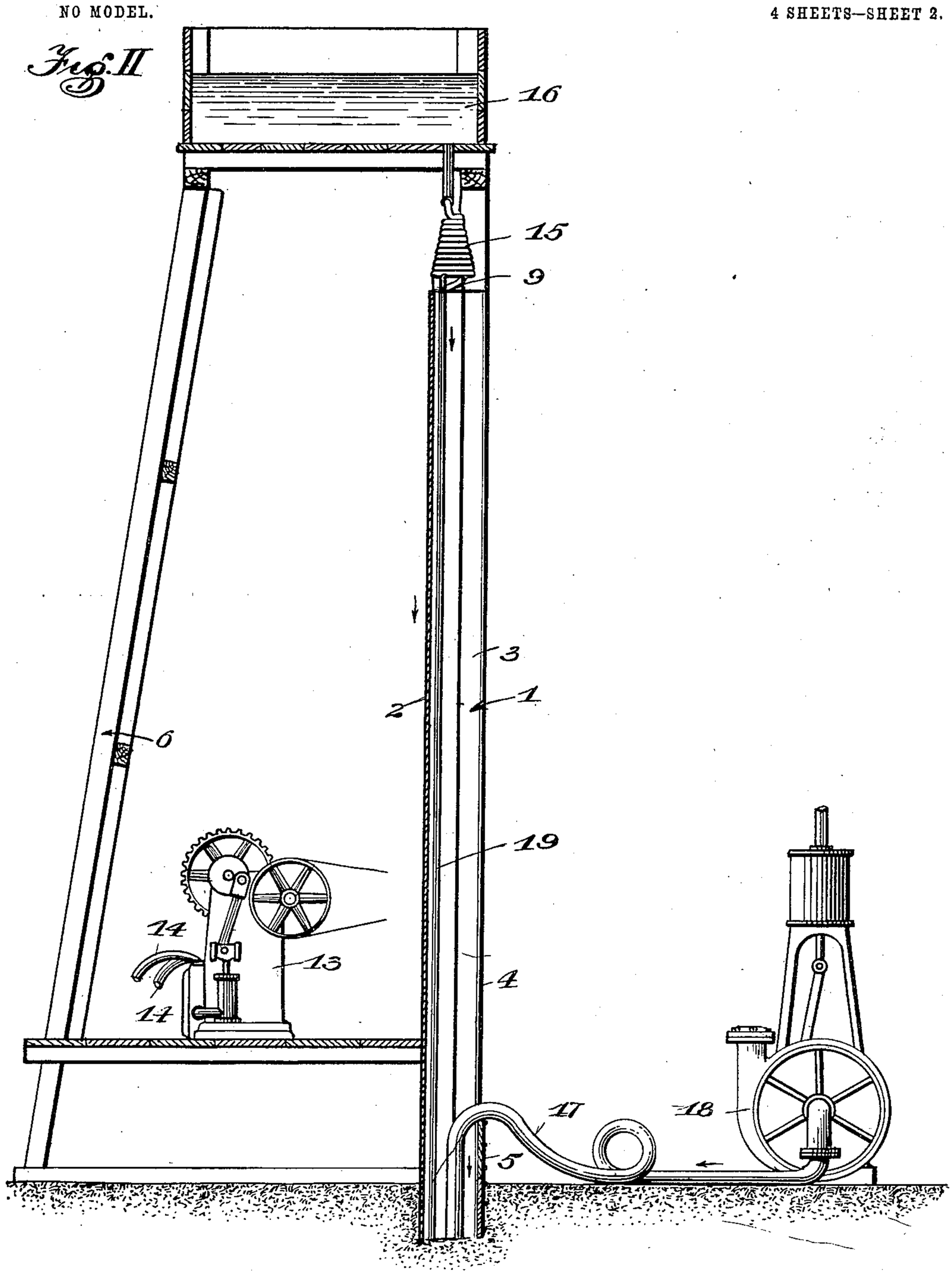
NO MODEL. 4 SHEETS—SHEET 2.

Fig. II



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NO MODEL. 4 SHEETS—SHEET 3.

Fig. III

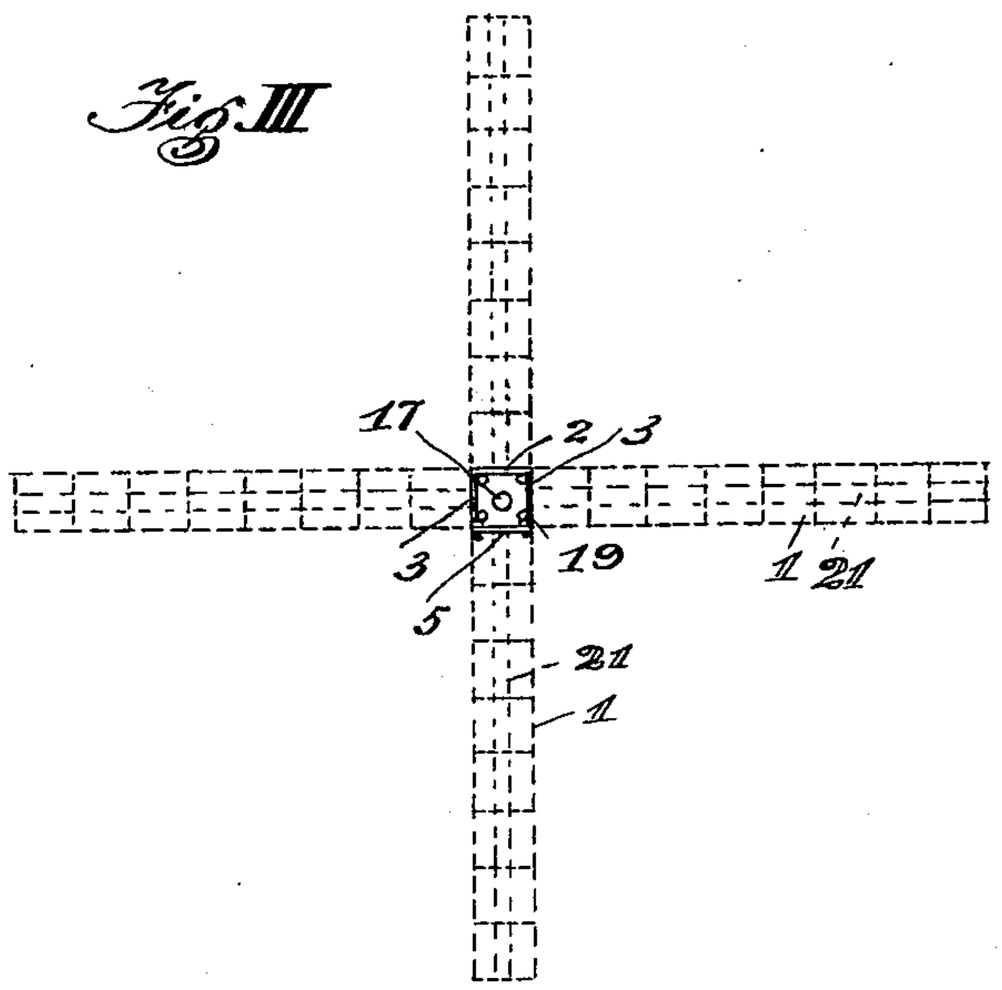


Fig. IV

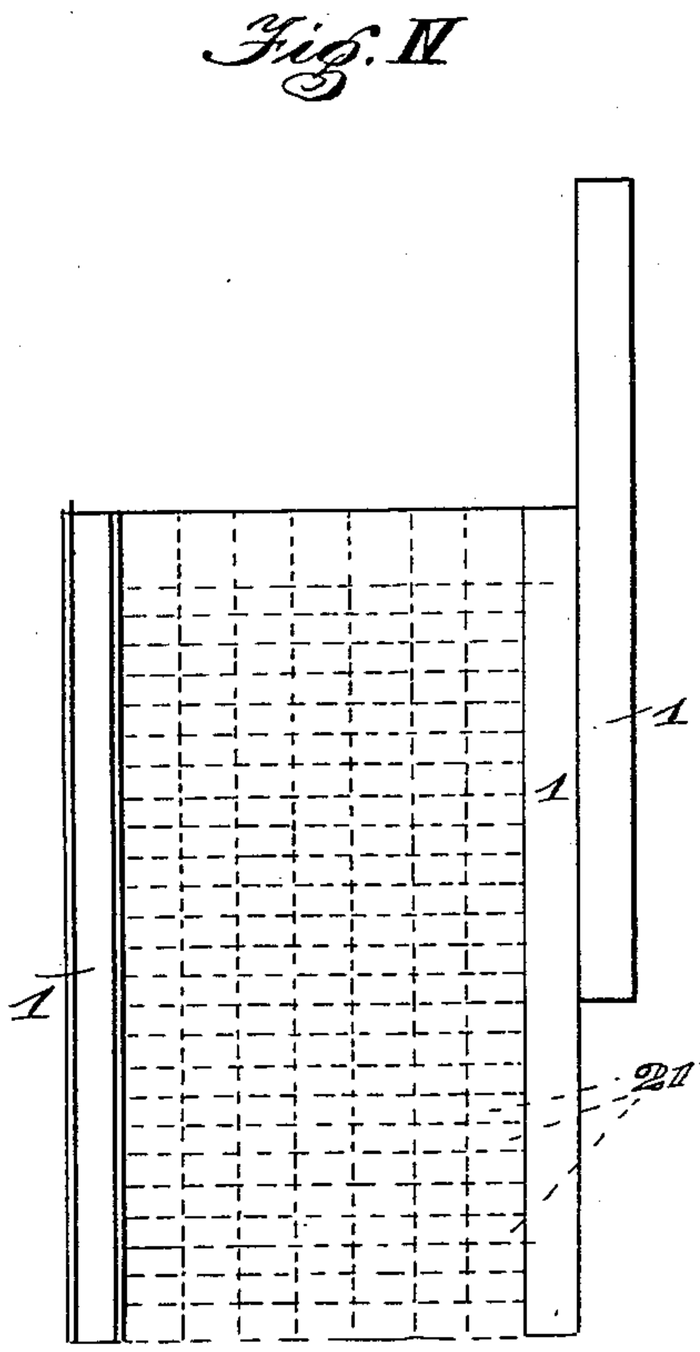


Fig. V

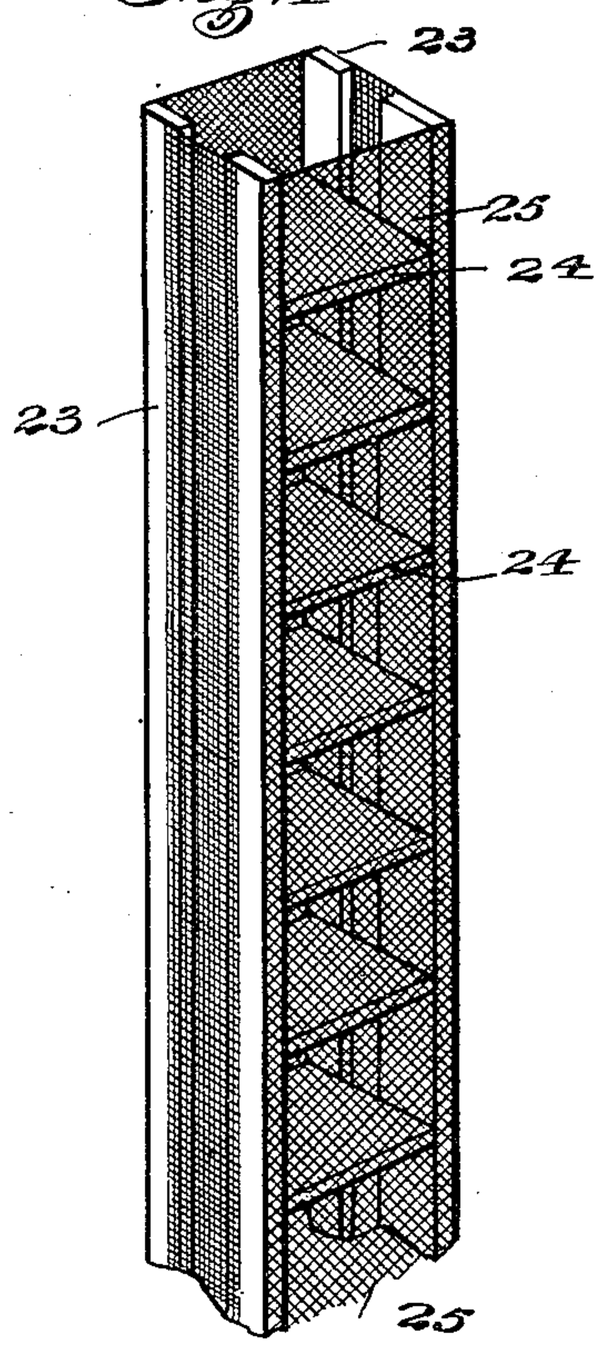
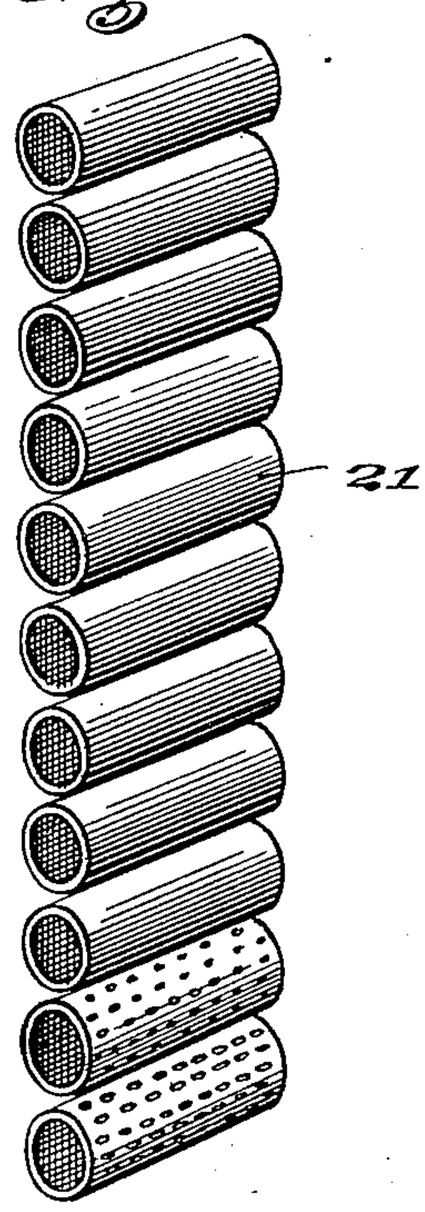


Fig. VI



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No. 731,130. PATENTED JUNE 16, 1903.

M. D. ROCHFORD.

METHOD OF WELL CONSTRUCTION.

APPLICATION FILED AUG. 4, 1902.

NO MODEL. 4 SHEETS—SHEET 4.

Fig. IX

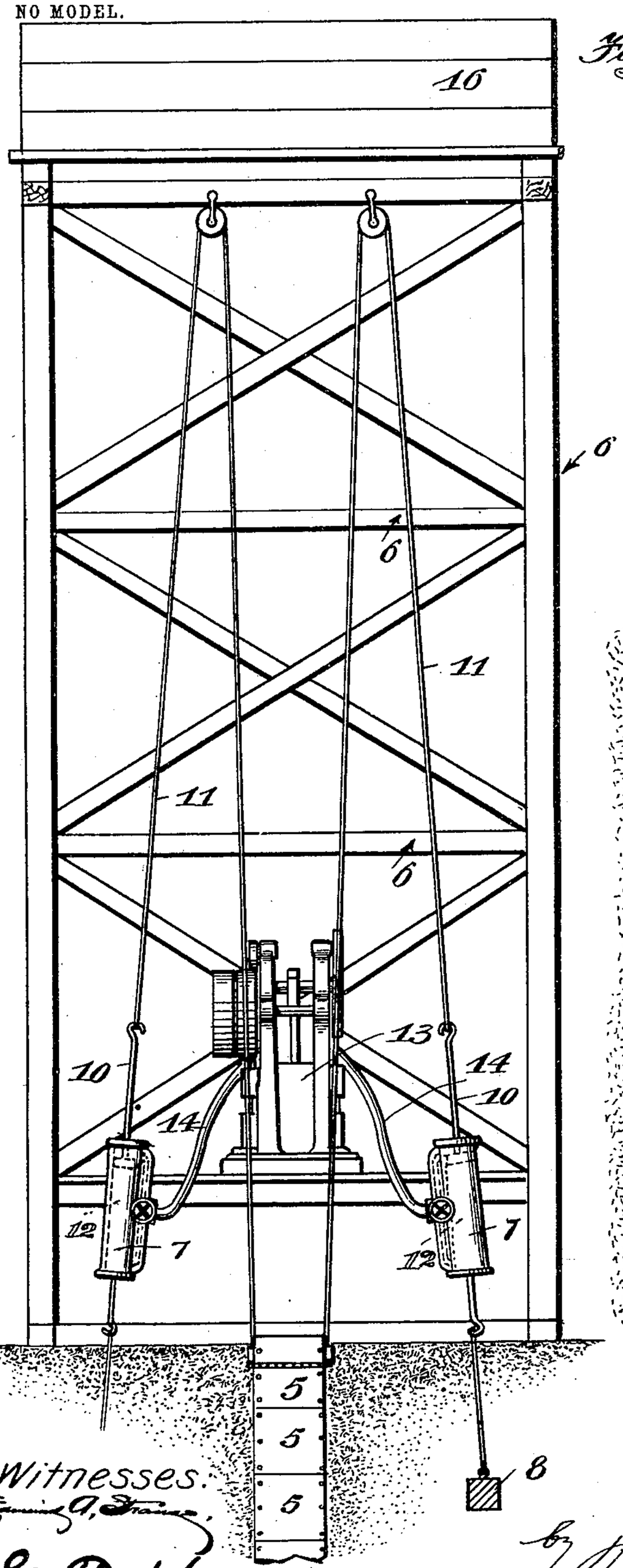
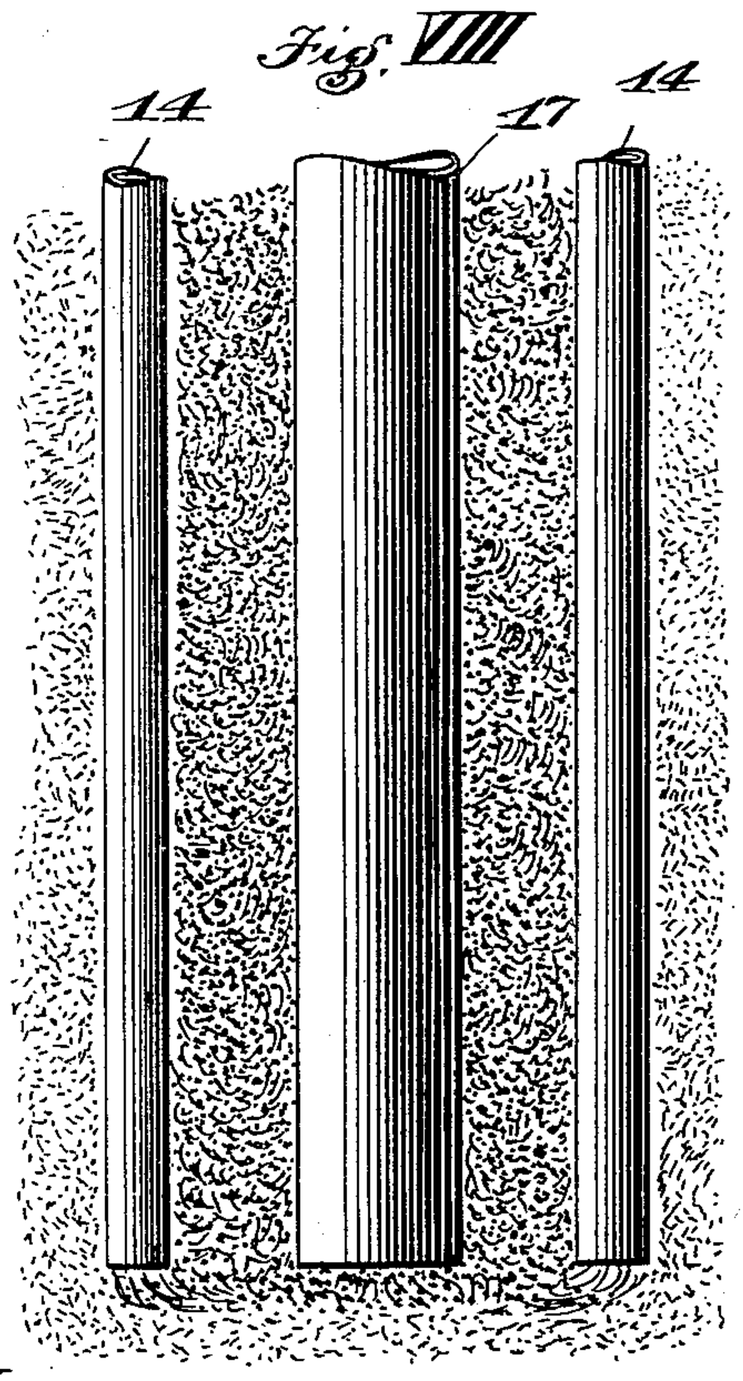


Fig. VIII



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No. 731,130. Patented June 16, 1903.

UNITED STATES PATENT OFFICE.

MARK D. ROCHFORD, OF LOS ANGELES, CALIFORNIA.

METHOD OF WELL CONSTRUCTION.

SPECIFICATION forming part of Letters Patent No. 731,130, dated June 16, 1903.

Application filed August 4, 1902. Serial No. 118,400. (No model.)

To all whom it may concern:

Be it known that I, MARK D. ROCHFORD, a citizen of the United States, residing at Los Angeles, in the county of Los Angeles and State of California, have invented a new and useful Method of Well Construction, of which the following is a specification.

My invention relates particularly to a method for constructing wells in sandy soils, in such places, for instance, as in river-bottoms.

The particular form of well which may be produced by this construction is shown in a previous application of mine executed July 30, 1902, and filed August 4, 1902, Serial No. 118,399.

One object of my invention is to provide a method whereby the well may be constructed with facility in a comparatively short time and at a comparatively low expense.

The drawings illustrate one form of apparatus which may be used in carrying out my method.

Referring to the drawings, Figure I is a front elevation of the apparatus with the earth being shown in section. Fig. II is a side elevation of part of the main portion of the apparatus with the earth portion in section. Fig. III is a plan view illustrating various steps in the process. Fig. IV is another view in side elevation, illustrating various steps of the process. Fig. V is a perspective of one form of conduit. Fig. VI is a perspective of a series of conduits of another form which may be used. Fig. VII is a plan view showing the arrangement of portions of the apparatus in the initial steps of the method. Fig. VIII is a sectional view showing the manner in which the earth is loosened and then removed from within the casing. Fig. IX is a view showing the manner in which the casing may be removed from the earth.

The method consists in forcing a casing into the water-bearing strata, removing the earth from within the casing, then inserting a suitable percolating substance, such as coarse or fine gravel or conduits, within the casing, and then withdrawing the casing and continuing the operation with consecutive steps through the adjacent water-bearing strata.

Referring to the drawings, more particularly to Figs. I and II, 1 designates a casing which may comprise a back 2 and side walls 3, the casing being open in front. The side walls 3 are provided with inturned flanges 4. 5 designates plates which may be bolted to the flanges 4 as the sinking of the casing progresses.

In constructing a well which extends vertically into the earth the casing 1 is placed in a vertical position over the water-bearing strata and is held in position by means of a derrick 6, which may be of any preferred form, that shown in the drawings being a convenient one. The casing is forced into the earth by means of pressure being applied at its upper portion, and a convenient way of applying this pressure is by hydraulic pressure. A pair of cylinders 7 may be anchored to the earth by suitable anchors, as 7, while a plank 9 may rest upon the upper end of the casing and be connected with the piston-rods 10 of the cylinders 7 by means of suitable connections 11. The piston-rods 10 are actuated by pistons 12, while a hydraulic pressure is obtained by means of a pump 13, which is connected to the cylinders by means of pipes 14. I have not deemed it necessary to show in detail the construction of the cylinders 7, as such devices are well known and the action of the same will be readily understood. By operating the pump 13 the pistons 12 may be forced down, thereby drawing down the connections 11, and thereby forcing the casing into the earth. By introducing a stream of water or other available fluid into the interior of the casing and directing the stream against the earth at the bottom of the casing the earth may be loosened up and the casing forced in with less power than would be required to force the casing into the water-bearing strata without loosening the earth. I preferably direct several streams into the casing through a series of relatively small pipes 19, which may be placed in each corner of the casing, as shown in Fig. VII. These pipes may extend to the bottom of the casing and discharge in close proximity to the earth at the bottom of the casing. The upper ends of the pipes 19 may be connected by suitable hose 15 with a water-tank 16, which may be

supported on the top of the derrick. To further facilitate the loosening of the earth at the bottom of the casing, I place a relatively large flexible pipe 17 within the casing, one end of which extends to the bottom of the casing, while the other end of the pipe is connected with a centrifugal pump 18. The pipe 17 may be of sufficient length to reach the bottom of the casing when the casing is driven its entire length into the water-bearing strata. In order to prevent the sand around the outside of the casing from caving in and also to provide a means for confining the action of the water to the earth within the casing or at the bottom of the casing, I attach the plates 5, as shown in Fig. I, as the sinking of the casing proceeds. The plates need only extend to about the level of the ground, so that the pipe 17 may be readily introduced into the interior of the casing, so that the loosened sand and earth within the casing may find an outlet when forced from the casing. Water flows through the pipes 19 against the earth at the bottom of the casing and loosens the same, as shown in Fig. VIII, while water is also forced in a large stream through the central pipe and out at the bottom toward the sides of the casing, which serves to loosen the sand, the casing being gradually forced down step by step by the hydraulic pressure on the pistons within the cylinders 12, and as the casing is driven down more plates 5 are secured to the flanges 4. After the casing is sunk by continually forcing water into the bottom of the casing the mixture of sand and water gradually becomes clearer as the mixture is continually being forced to the surface and fresh water pumped into the bottom of the casing. As the mixture comes to the surface of the earth it discharges over the top of the upper plate 5 and flows off. The continued action of the pump finally expels all of the sand or earth or other solids from within the casing, so that eventually nothing remains but water. When the casing has been driven its entire length or to a depth which has been found to be sufficient for the purpose, the usual perforated casing may be inserted and surrounded by gravel or suitable material to prevent the sand from entering the casing, as shown in Fig. IV. After the first casing has been driven, as just described, another casing similar to the first one is placed against the first casing—that is to say, the end of the second casing is placed in a position so that when being driven the second casing will follow down contiguous to the first casing.

20 designates lugs on the back and sides of each casing and also on the plates 5 for the purpose of serving to guide the casings, which are driven down subsequent to the placing of the first casing. The lugs cause the casing which is being driven to hug the driven casing, so that the casing being driven will be held from canting or switching off from its proper course.

Fig. V shows a form of conduit which is constructed of wood, having open side walls 23, the openings being covered with a screen and suitable partitions 24 being placed between the two side walls to form conduits, the ends of which may be covered with a screen 25 to prevent sand from getting into the conduit.

Fig. VI shows conduits in the form of short tiles, which may be inserted in the ground. If desired, the tiles might be perforated, as shown in two or three of the lower tiles in the figure. The casings are sunk one after the other and a channel formed which extends from the perforated pipe. The channel is then filled with gravel or a series of conduits and gravel to carry water to the perforated pipe. When the channel has been extended a sufficient distance from the perforated pipe, another channel may be formed in another direction from the perforated pipe, as shown in Fig. III. It is desirable that the first casing sunk be left in position until all the channels have been formed, as it forms a central point from which to work. Fig. IV shows a series of rows of conduits. The conduits being shown in dotted lines at the extreme right of the figure, a casing is shown as being driven in the first casing at the central point, being shown at the extreme left.

Fig. VIII illustrates the manner in which the sand or other water-bearing strata is mixed up and the sand forced up gradually to the top of the casing.

It is evident that while the casing is being sunk that the pressure upon the outside will be considerable, and the equalizing of this pressure is one of the advantages of employing the center pipe 17. As the water issues from the pipe 17 it is discharged with great velocity toward the earth at the bottom of the casing and is deflected toward the sides of the casing and fills the interior of the casing with water under a heavy pressure, which serves to counteract against the pressure caused by the surrounding sand on the outside. As the casing 1 is driven in the pipe 17 is lowered gradually, so that its lower end will be in proper position to give the most effective results from the discharge of water from its mouth. After the first casing has been sunk the derrick is moved into a position to support the second casing, and the second is driven down in a manner similar to the first casing, the back wall of the first casing in this instance taking the place of the plates 5, which were secured to the first casing which was sunk, and the sand and other earth is discharged from the second casing over the top of the first casing, which may be covered with planks to prevent the mixture from running down the first casing. After the second casing has been placed in position and the earth removed from the interior thereof, so that nothing but water remains, a series of conduits 21 are placed within

the casing, and gravel may then be placed around the sides of the conduits to prevent the sand from entering the conduits or percolating media, after which the first casing, if desired, may be withdrawn. Another casing is then driven next to the second casing in a manner similar to that which has just been described and the operation repeated, and after this third casing is in position the second casing may be pulled out from the ground, as shown in Fig. IX, and used again and again, so that only a few casings are necessary in sinking the entire well. In order to guide the conduits 21 into position, the casings which are driven in after the first casing may be provided with a pair of oppositely-arranged walls 22, which extend into the interior of the casing, and the conduits 21 may be placed between the walls, the open ends of the conduits being adjacent the back walls of the casing.

In constructing a well, using gravel as the percolating media, I employ a small auxiliary casing 30, (see Fig. VII,) which may be substantially U-shaped in cross-section. The side walls of the auxiliary casing may be spaced apart a distance sufficient to enable the casing to be positioned between the walls 22. The walls 22 serve to guide the auxiliary casing 30 into position and hold the same while gravel is being thrown in. The auxiliary casing is easily placed in position, as the casing 1, which has been driven, is filled with water only. After the interior of the auxiliary casing 30 has been filled with relatively coarse gravel the space exterior of the auxiliary casing and within the casing 1 may be filled with gravel which is relatively finer. After this operation the auxiliary casing 30 may be withdrawn in a manner similar to which the casing 1 is withdrawn, as hereinbefore described. This operation is repeated as often as desired to make a suitable length of channel. This method of construction provides a channel having a core or central portion comprising relatively coarse gravel which forms the percolating media, which is lined on both sides with bodies of relatively finer gravel which prevents the adjacent sand from entering and mixing with the main percolating media or gravel. The auxiliary casing 30 may also be of assistance in placing the tiles or conduits in position, although in some instances it may be found more convenient to dispense with it, and I do not limit myself to the employment of the auxiliary casing. In this method any preferred form of conduits or percolating media may be used. Under some conditions it may be found preferable to construct the well with gravel as the percolating media. Under other circumstances it may be found preferable to use conduits in place of gravel, and it is obvious that any kind of conduit may be used which is shorten enough to be placed within the casing.

While I have shown one form of apparatus which may be used in carrying out my method, it is obvious that other forms of apparatus may be used which might be of equal efficiency.

Having described my invention, what I claim, and desire to secure by Letters Patent of the United States, is—

1. The method of well construction consisting of forcing a casing into the earth and removing the earth from within the casing, then inserting conduits or percolating media within the casing, and then withdrawing the casing.

2. The method of well construction consisting of forcing a casing into the earth, directing a stream of fluid into the interior of the casing and loosening the earth within the casing and forcing out the loosened earth, then inserting conduits or percolating media within the casing, then withdrawing the casing.

3. The method of well construction consisting of forcing a casing into the earth, removing earth from within the casing and equalizing the pressure on the inside and outside of the casing, and inserting conduits or percolating media within the casing, then withdrawing the casing.

4. The method of well construction consisting of forcing a casing into the earth and removing earth from within the casing by directing a stream of fluid longitudinally through the center of the casing against the earth toward the bottom of the casing; simultaneously directing streams of fluid along the sides of the casing and toward the bottom of the casing, thereby loosening and forcing the earth out of the casing, then placing percolating media within the casing and withdrawing the casing.

5. The method of well construction consisting of forcing casings into the earth one after the other and adjacent each other, removing the earth or sand from within the casings, then placing conduits or gravel or other percolating media within the casings and afterward withdrawing the casings.

6. The method of well construction consisting of forcing casings into the earth, pumping water into the casings and forcing out the earth from within the casing, and forming channels in the earth which diverge from a central point, filling the channels with gravel or suitable percolating media, then withdrawing the casings.

7. The method of well construction consisting of forcing a casing into the earth and removing the earth from within the casing, then placing a perforated casing in the cavity and surrounding the perforated casing with gravel or other percolating media, then forming channels in the earth which diverge from the perforated casing, and filling the channels with conduits, gravel or other percolating media.

8. The method of well construction consisting of forcing a casing into the earth and removing earth from within the casing, then placing an auxiliary casing within the first-

mentioned casing filling the space within the auxiliary casing with percolating media, then filling the space within the first casing exterior of the auxiliary casing with a relatively finer percolating material, then withdrawing the casings.

In witness whereof I have signed my name to this specification, in the presence of two subscribing witnesses, at Los Angeles, in the county of Los Angeles and State of California, this 30th day of July, 1902.

MARK D. ROCHFORD.

Witnesses:
G. T. HACKLEY,
JAMES R. TOWNSEND.