June 9, 1925. 1,541,111

G. A. BUVINGER ET AL

PUMPING APPARATUS

Filed March 19, 1923 5 Sheets-Sheet 1

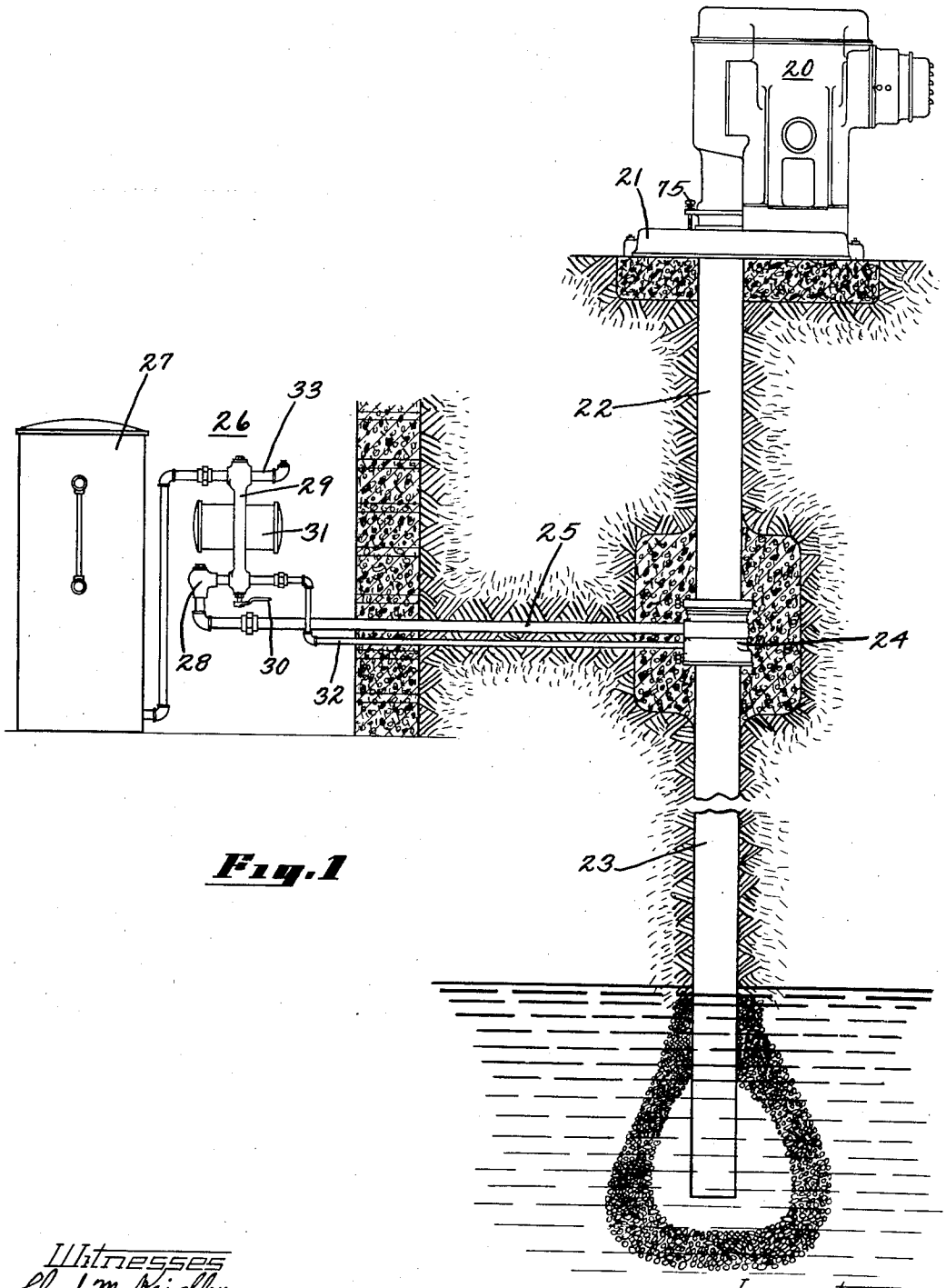


Fig. 1

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PUMPING APPARATUS

Filed March 19, 1923 5 Sheets-Sheet 2

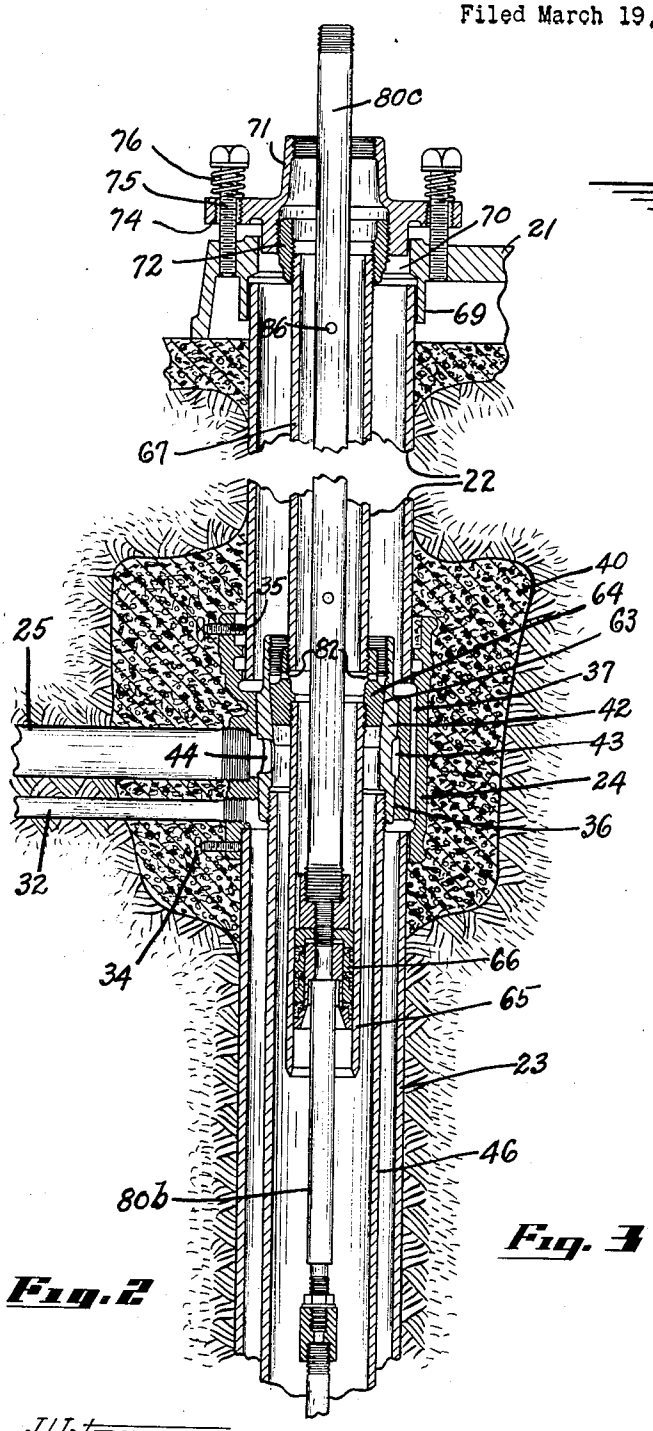


Fig. 2

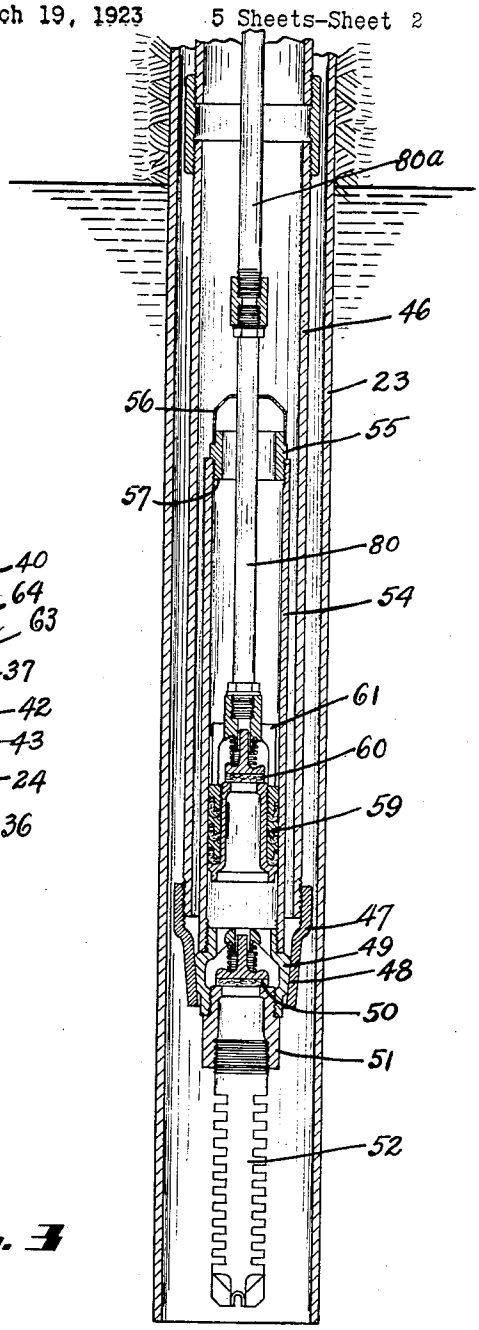


Fig. 3

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PUMPING APPARATUS

Filed March 19, 1923 5 Sheets-Sheet 3

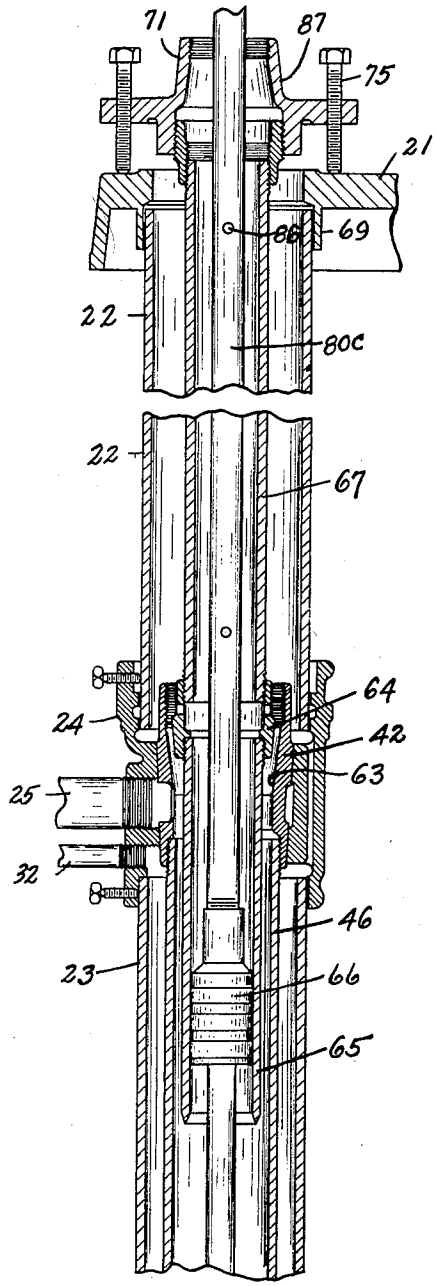


Fig. 4

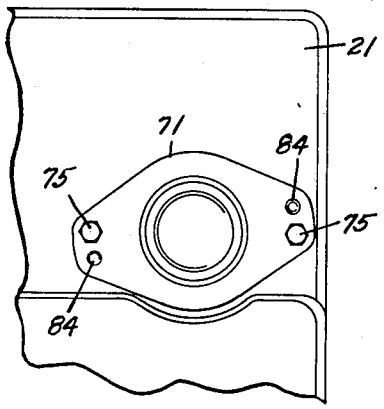


Fig. 5

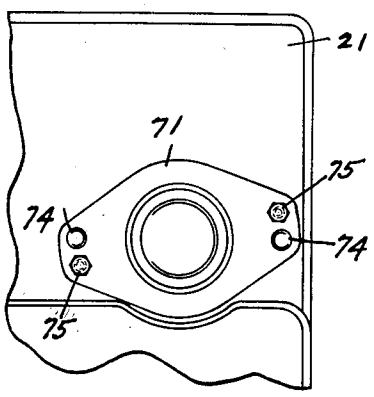


Fig. 6

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June 9, 1925. 1,541,111

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PUMPING APPARATUS

Filed March 19, 1923 5 Sheets-Sheet 4

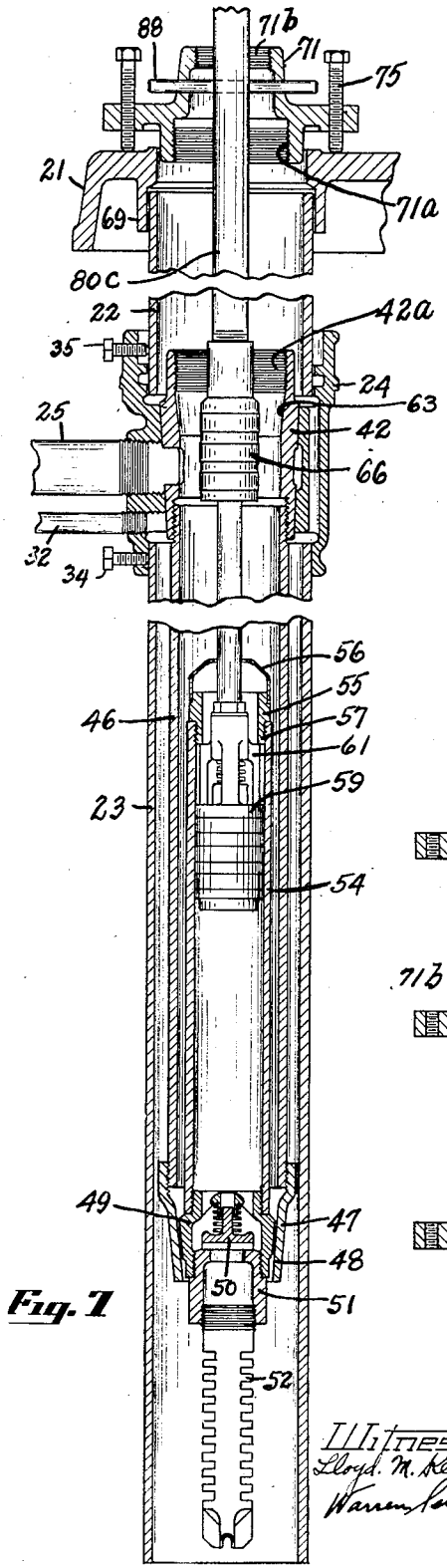


Fig. 1

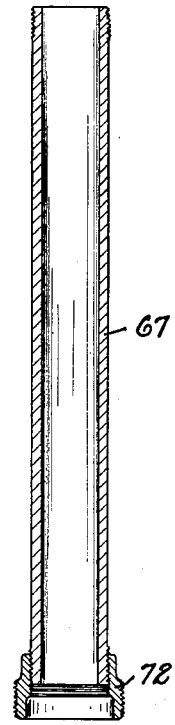


Fig. 8

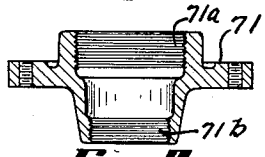


Fig. 9

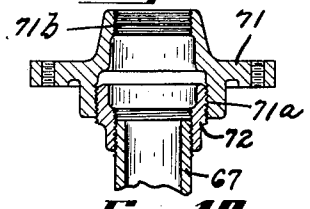


Fig. 10

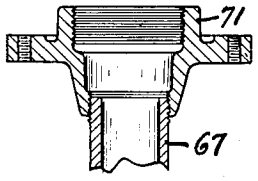


Fig. 11

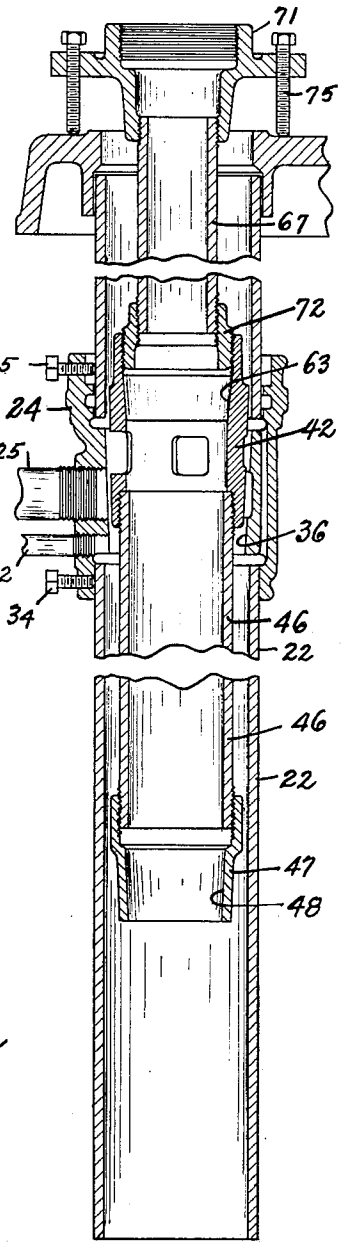


Fig. 12

Witnesses
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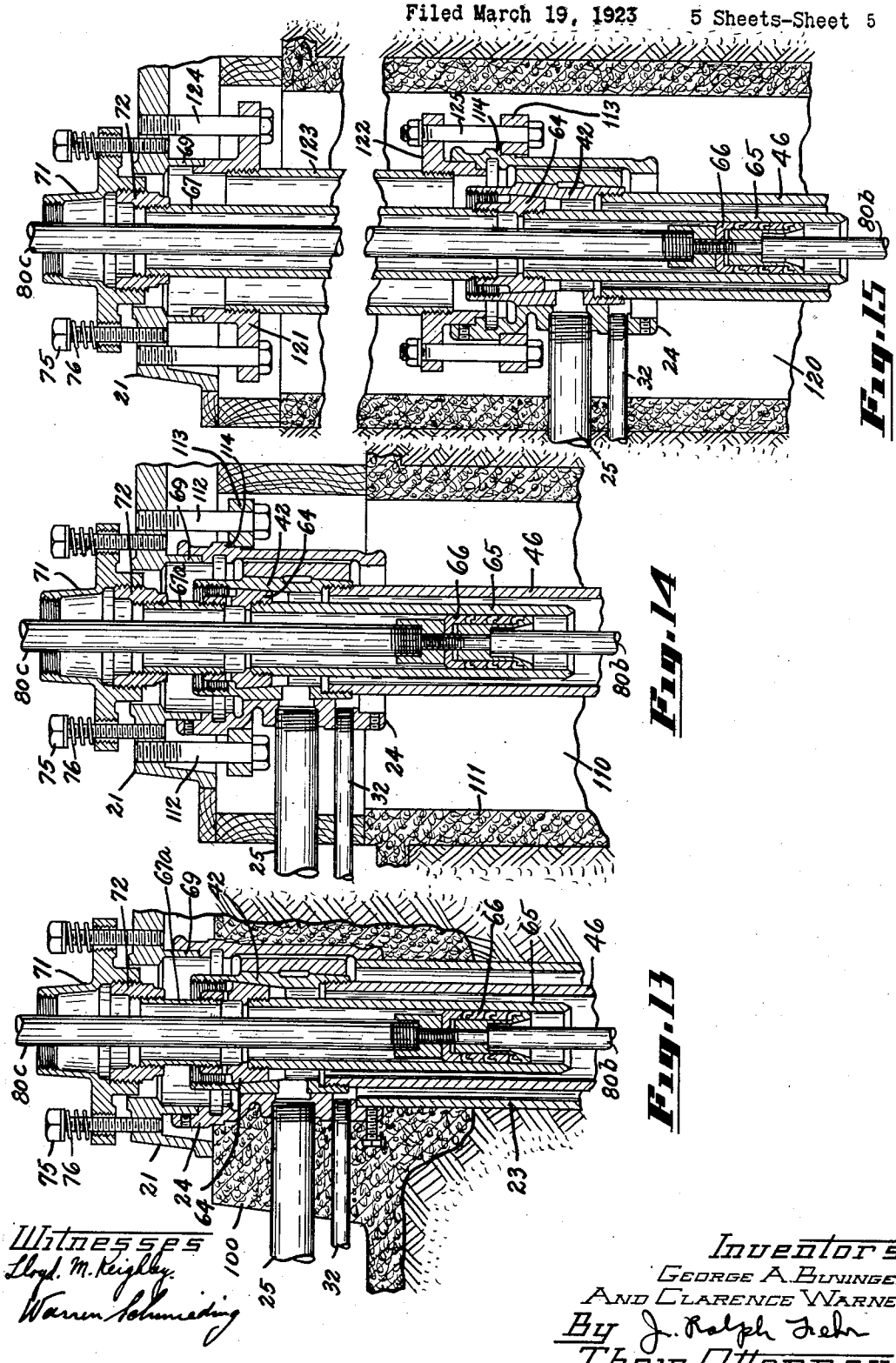
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June 9, 1925. 1,541,111

G. A. BUVINGER ET AL

PUMPING APPARATUS

Filed March 19, 1923 5 Sheets-Sheet 5



Witnesses
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Patented June 9, 1925. 1,541,111

UNITED STATES PATENT OFFICE.

GEORGE A. BUVINGER AND CLARENCE WARNER, OF DAYTON, OHIO, ASSIGNORS TO DELCO-LIGHT COMPANY, OF DAYTON, OHIO, A CORPORATION OF DELAWARE.

PUMPING APPARATUS.

Application filed March 19, 1923. Serial No. 626,173.

To all whom it may concern:

Be it known that we, GEORGE A. BUVINGER and CLARENCE WARNER, citizens of the United States of America, residing at Dayton, county of Montgomery, and State of Ohio, have invented certain new and useful Improvements in Pumping Apparatus, of which the following is a full, clear, and exact description.

The present invention relates to pumping apparatus of the deep well type wherein the pump is located within a well and the operating mechanism above the well.

It is among the objects of the invention to provide certain improvements in the underground structure which aim to prevent freezing of water in the apparatus, to prevent contamination of the well by excluding dirt and surface seepage, and to provide for the removal of pump parts by devices which are easily accessible from above the well.

One manner of carrying out these aims of the invention is to locate within the well and below frost line a support having a discharge port connected with an outlet pipe located so as to be out of danger of freezing. This part of the apparatus can be permanently installed. A container enclosing the underground pump is removably mounted upon the support and has an outlet to the discharge port of its support. Liquid is not allowed to rise in the apparatus above the container outlet. Pump parts are removed from the container, and the container from its support by the use of the devices accessible from above the well.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings, wherein preferred embodiments of forms of the present invention are clearly shown.

In the drawings:

Fig. 1 is an underground sectional view showing in elevation a drilled well having a well casing connected with pump driving mechanism exposed above ground and with a storage tank;

Figs. 2 and 3 comprise a sectional view of the well casing and pump mechanism shown in Fig. 1 in operative position;

Fig. 4 is the sectional view of the upper part of the mechanism showing how some of the mechanism may be removed;

Fig. 5 is the plan view of the mechanism as in Fig. 2;

Fig. 6 is the plan view of the mechanism as in Fig. 4;

Fig. 7 is the sectional view showing how some of the lower mechanism can be removed;

Fig. 8 is the sectional view of the extension pipe;

Fig. 9 is the sectional view of the pulling flange which may be connected to the pipe shown in Fig. 8 in various ways;

Fig. 10 is the sectional view which shows one manner in which the pipe in Fig. 8 may be connected to the pulling flange;

Fig. 11 is a sectional view showing another manner in which the pipe is connected with the pulling flange;

Fig. 12 is the sectional view showing how other parts of the mechanism may be removed;

Fig. 13 is a fragmentary sectional view showing how the apparatus can be adapted for a drilled well with the pump drive located in a frost proof pit;

Fig. 14 is a view similar to Fig. 13 showing how the apparatus can be adapted for an open well with the pump drive located in a pit; and

Fig. 15 is a view similar to Fig. 14 showing how the apparatus can be adapted for an open well with the pump drive exposed above ground.

The disclosed embodiment of the present invention includes a device called the "discharge head" which is adapted to be located below the frost line and to be connected with a discharge pipe leading underground to the storage tank protected from freezing. The discharge head supports the pump cylinder or cylinders by means of devices, which cooperate with the discharge head also to prevent water from rising above the frost line. These devices and cylinders are removable from the well without disturbing the discharge head, and with the use of apparatus forming a part of the pumping apparatus.

In the drawings, 20 is the pump driving mechanism. This driving mechanism is

clearly shown and described in the copending application of Charles F. Kettering and George A. Buvinger, Serial No. 624,323, filed March 12, 1923. Driving mechanism 20 has all of its parts enclosed and is mounted upon a base 21 which is placed directly over a casing having an upper portion 22 and a lower portion 23 which are coupled by means of a discharge head 24. Discharge head 24 is connected to discharge pipe 25. Casing 22 is made of such length that the discharge head 24 and the discharge pipe 25 are buried in the ground below the frost line.

Discharge pipe 25 is connected with an air-charger 26 which in turn is connected with a storage tank 27. This air-charger is clearly shown and described in the copending application of George A. Buvinger, Clarence Warner and Jasper A. Smith, Serial No. 628,799, filed March 30, 1923, and briefly stating its functions herein it may be said that water from the discharge pipe 25 ordinarily flows through a check valve 28, valve body 29, and into the storage tank 27. However, should it be necessary to charge the storage tank 27 with air a lever 30 is shifted so that some of the water passing through the valve body 29 will be diverted into tank 31 and force air therein into the storage tank 27. The valve 30 is shifted into another position so that the tank 31 will be cut off from the water, in the system, and the water contained within the tank 31 can flow out of the drain pipe 32 connected with head 24 while air is being admitted to tank 31 through a pipe 33.

After the well casing 23 has been driven into the drilled well in the usual manner, a small pit is dug around the casing to a depth below the frost line. The casing 23 is cut off below the frost line and the discharge head 24 is placed on top of casing 23 and secured by screw 34. The upper casing 22 is placed in vertical position with its lower end received by the head 24 and is secured by screw 35. After pipes 25 and 22 are attached the pit is filled with cement 40 so as to provide a seal for the well casing which extends above ground and is protected in a manner to be described.

Discharge head 24 is provided with a seat 36 which is tapered about five degrees and is less in diameter than the internal diameter of casing 22. The seat 36 is bypassed by a passage 37 which is provided for a purpose to be described. The seat 36 provides a support for devices which support the pump cylinders and seat 36 cooperates with these devices to provide a seal preventing water from issuing from the pump above the frost line.

One of these sealing and supporting devices 42 is called the drop pipe hanger provided with a conical outer surface adapting the hanger to rest upon the seat 36. The hanger 42 is provided with a groove 43 and opening 44 to provide a water passage into the discharge head 24. Hanger 42 supports drop pipe 46 which extends substantially to the bottom of the well and carries at its lower end a seat member 47 having a substantially five-degree taper seat 48 for receiving a foot valve body or hanger 49. A spring pressed valve 50 rests upon a seat 51 screwed into body 49, and seat 51 carries strainer 52. Valve body or hanger 49 also supports a cylinder 54 which is provided at its upper end with a ring 55 carrying a screen 56. Ring 55 extends within the cylinder 54 and provides a shoulder 57. A piston 59 reciprocates within cylinder 54 and is provided at its upper end with a spring pressed valve 60. Piston 59 is provided with an upper extending portion 61 which is adapted to engage with the shoulder 57 on the ring 55 for a purpose to be described hereinafter.

Another device which cooperates to seal the discharge head and to support a pump cylinder is the differential cylinder hanger 64 which is externally tapered to be received by the internally tapered seat 63 of the hanger 42. Hanger 64 supports a differential cylinder 65 in which piston 66 reciprocates, and hanger 64 is connected with an extension pipe 67.

The pump base is provided with a downwardly extending flange 69 into which the casing 22 extends. By permitting the casing 22 to slide within the flange 69, expansion or contraction of the casing 22 longitudinally can take place without raising or lowering the base 21. Base 21 is provided with an opening 70 into which a pulling flange 71 may extend. Pulling flange 71 is connected by means of pulling plug 72 to pipe 67. Pulling flange 71 can move vertically in the opening 70 whereby expansion or contraction of the pipe 67 may take place without affecting the pump base 21. Tapped holes 74 are provided in the flange 71 through which bolts 75, having a diameter less than the diameter of the tapped hole 74, are adapted to extend and to screw into the pump base 21. Springs 76 are interposed between the heads of these bolts 75 and the flange 71 which yieldingly bear downwardly upon the flange and tend to maintain the hanger 64 upon its seat 63. In this manner the hanger 64 and the hanger 42 are held in nested relation with respect to the discharge head 24 by means which can yield in response to differences in expansion or contraction of parts of the apparatus. Thus the discharge head will be maintained sealed for all temperatures and without danger of breakage of parts.

Pistons 59 and 66 are actuated by a pump rod comprising sections 80, 80^a, 80^b, and 80^c which are reciprocated by means of the

pump driving mechanism 20 to cause water to be lifted and forced into the tank 27 in the usual mode of operation of differential lift pumps.

The hanger 64 and the piston 66 cooperate to form a wall whereby the water is normally prevented from moving into the casing 22 or the extension pipe 67 or any of the mechanisms located above the discharge head. Also, should any of the water work its way above the piston 66 it will flow through openings 82 in the nanger 64 and enter into the drop pipe hanger 42 and after the drop pipe hanger becomes full this water will flow over the upper edge thereof and pass through the opening 37 in the discharge head 24 and through well casing 23 to the well.

The degree of the taper of the seat 48 of member 47 is such that the frictional engagement between the coupling 47 and valve body is sufficient to maintain the lower cylinder in position.

One of the features of the present invention is the providing of a construction in which the working parts of the pump are readily removable from the well while discharge head 24, discharge pipe 25, and the drain pipe 32 are left undisturbed. The pumping apparatus itself includes devices for assisting in removing the pump parts. The tapped holes 74 in the pulling flange are of larger diameter than the bolts 75. The pulling flange 71 is also provided with tapped holes 84 to be engaged by bolts 75. To remove the differential cylinder 65 the driving mechanism 20 is uncoupled from the pump rod section 80^c and shifted to one side of base 21, and the bolts 75 are withdrawn from the base (as shown in Fig. 5) 21 and are screwed into the holes 84 of the pulling flange 71. When these bolts 75 are shifted so as to be screwed into the holes 84 they are thrown out of alignment with the holes in the base 21 (as shown in Fig. 6) and then by screwing the bolts downwardly they will bear against the pump base as is shown in Fig. 4. Further movements of these bolts will cause the pulling flange 71 to move upwardly thereby unwedging hanger 64 from the seat 63 and permitting the extension pipe 67 and the differential cylinder 65 to be removed. Fig. 5 shows the location of the bolts 75 when the mechanism is in normal operation while Fig. 6 shows the bolts in the position in which they are used for lifting the pulling flange. The tapped holes 74 are provided for receiving screw eyes (not shown) by means of which the flange 71 can be attached to a hoist.

The pulling flange 71 and the bolts 75 may be herein termed a jack while the pipe 67 is used as an extension for said jack. Also it will be noted that the well casing 22 forms a storage chamber for a portion of said jack whereby said members are always intact.

After the extension pipe 67 and the differential cylinder 65 are removed, the lower cylinder 54, foot valve 49, the strainer 52, the screen 56, piston 59 at the lower end, and the piston 66 at the upper end, can be removed as a unit. This is done in the following manner: The plug 72 is disconnected from the pulling flange 71 whereby the extension pipe 67 can be removed. The pulling flange is then placed in the same position as is shown in Fig. 4. The bolts 75 are then partly withdrawn from the pulling flange 71. The sucker rod is then pulled upwardly until the hole 86 in the sucker rod section 80^c is brought in direct alignment with holes 87 in the pulling flange 71. Bar 88 is then inserted in the holes 87 and hole 86. At this time the extension 61 upon the lower cylinder will be in engagement with the shoulder 57 on the ring 55. Now when the bolts 75 are screwed downwardly the pulling flange 71 will move upwardly carrying with them the bar 88 and likewise the sucker rod 80 which in turn will move the cylinder upwardly unwedging the seal between the foot valve body or hanger 49 and its seat 48. Fig. 7 shows the foot valve body or hanger 49 raised from the seat 48. By hoisting the flange 71, the pump rod, pistons, lower cylinder and foot valve and screen will be removed.

The pulling flange 71 and the drop pipe hanger 42 are provided with like internally threaded portions 71^a and 42^a respectively, each for receiving the pulling plug 72. Pulling flange 71 is provided with a threaded portion 71^b for receiving a threaded end of pipe 67. If pulling flange 71 and the unit including the pipe 67 and plug 72 are inverted that end of the pipe 67 which was screw threaded into the hanger 64 can be connected to the screw threaded portion 71^b of the coupling 71 as is clearly shown in Fig. 11.

Should it happen that for any reason it is desirable to remove the drop pipe 46, as for instance if the sucker rod 80 should break, the pipe 67 and the pulling flange 71 are connected as shown in Fig. 11 and this assembly is screwed into drop pipe hanger 42 as shown in Fig. 12. The extension pipe 67, the pulling flange 71, and the bolts 75 are then used as a jack whereby the drop pipe hanger 42 may be unwedged from its seat 36. Then the drop pipe 46 is removed by hoisting the flange 71. If the pump rod should break, then the lower cylinder and piston can be removed when the drop pipe is hoisted.

It is obvious that the installation of the pumping apparatus is carried out in the re-

verse order with respect to the order of disassembling.

The sealing of the well casing at the discharge head has been described in detail. This has been provided by the nesting of hangers 64 and 42 in the discharge head 24 and by the closing of cylinder 65 by the piston 66. The upper end of casing 22 is received by the flange 69 of base 21 and is covered by the pulling flange 71. The extension pipe 67 is closed by the power head 20 when mounted over the well as shown in Fig. 1. Thus the pump is protected against the entrance of dirt, surface seepage and the like. The copending application referred to Serial No. 624,323 discloses means for preventing lubricating oil from the power head 20 entering the well.

If the drilled well terminates in a frost proof pit in which the power head 20 can be located, then the installation is modified as shown in Fig. 13. The discharge head 24 is embedded in the concrete foundation 100, the flange 69 of base 21 is received by the head 24, and a short extension pipe 67^a connects the differential pump hanger 64 with pulling plug 72.

Fig. 14 shows an installation similar to that of Fig. 13, but the base 21 is located in a frost proof pit over an open well 110 having concrete lining 111. The head 24 is supported from the base 21 by means of bolts 112 and a collar 113 engaging a shoulder 114 on the head 24.

Fig. 15 shows an installation when the power head base 21 is located in an exposed place on the ground over an open well 120. The discharge head 24 is suspended from the base 21 at a distance such as to be out of danger from frost by means of like flanges 121 and 122 attached to an extension pipe 123, bolts 124 attaching the flange 121 to base 21, and by means of bolts 125 attaching head 24 to flange 122. In this installation the longer extension pipe 67 is used to connect the pulling plug 72 with hanger 64.

In all these installations the discharge head is adapted for location below the frost line. In a drilled well it is supported preferably in a body of concrete within or upon the ground. The manner of supporting the pump mechanism by the discharge head and of sealing the discharge against exit of water except through the discharge pipe is the same for all installations. The method of assembling and disassembling is the same for all installations disclosed. Therefore the present invention provides apparatus which is relatively universal in its application.

Since there is practically no necessity for removal of the discharge head 24 from the well, the connection between the discharge head and pipes 25 and 32 can be made permanent, thereby permitting the discharge head and pipes to be buried under ground below the frost line where the power head is exposed above ground instead of being in a frost proof enclosure. Since the discharge head is sealed against discharge of water except through the pipe 25, no water in the apparatus is exposed to freezing temperature and damage by freezing is avoided.

From the foregoing it is apparent that in one of its aspects the present invention provided a support, namely, the discharge head 24, which can be located within a well at any desired distance below the top of the well so as to be below the frost zone. The drop pipe 46 and the hanger 42 constitute a container which is supported by the discharge head. All of the water in the underground structure which is elevated by the lower pump is confined within this container except as the water flows out into the discharge head. Therefore the water in the structure is prevented from freezing. To mount the container upon its support and the cover or upper cylinder upon the container it is only necessary to lower these parts into the well on the end of the extension pipe. The pump rod is used to lower the lower pump cylinder. After the pump parts are in position, this extension pipe is used as part of the means for holding the container and its cover in position.

These features of the invention are of very great advantage because they provide for confining the water below frost line, and at the same time allow the pump to be withdrawn from the well by means accessible from above the well, and without disturbing the discharge pipe.

Where the installation is made as shown in Fig. 2, the freezing of the earth above the discharge head will cause the base 21 to be moved upwardly away from the casing 22 and the extension pipe 67. This movement is possible since the casing 22 is free from positive connection with the base 21. As the base 21 moves up carrying the screws 75, the tension in springs 76 will decrease. These springs are adjusted initially so that enough tension will remain in the springs to maintain a downward pressure upon the extension pipe 67 to maintain the hanger 64 upon its seat.

While the form of mechanism herein shown and described constitutes preferred embodiments of one form of invention, it is to be understood that other forms might be adopted and various changes and alterations made in the shape, size, and proportion of the elements therein without departing from the spirit and scope of the invention.

Claims:

1. In a pumping apparatus, the combination with a well casing and a pump; of a container for the pump removably carried by the inside wall of the casing, and having

a discharge through the well casing below the top of the well casing.

2. In a pumping apparatus, the combination with a well casing and a pump; of a container carried by the inside wall of the casing for receiving liquid elevated by the pump; of means for preventing water rising in the apparatus above a certain level; and a discharge duct for the container located adjacent and immediately below said level.

3. In a pumping apparatus, the combination with a pump adapted to be located in a well casing and a power head located above the well for driving the pump; of a container adapted to be carried by the inside wall of the well casing at any desired distance below the power head for receiving liquid raised by the pump; and a discharge duct from the container leading through a side of the well casing.

4. In a pumping apparatus, the combination with a well casing and a pump; of a separate container for the pump carried by the inside wall of the casing; and a discharge duct for the container extending through a side wall of the casing.

5. In a pumping apparatus, the combination with a well casing located within the ground and having a support substantially below the top thereof; of a container mounted on said support; of a base located above the well; and means for holding the container on its support including a member connected with the base and engaging the container, and including provisions for exerting downward pressure on the member while allowing for differences in expansion between the ground and said member.

6. In a pumping apparatus, the combination of a well casing and a pump; of a container of liquid elevated by the pump removably mounted within the casing; of a cover for the container removable from the casing without removing the container; of a member located above the container; and means connected with the member and bearing upon said cover for maintaining the cover on the container.

7. In a pumping apparatus, the combination with a well casing and a pump; of a container of liquid elevated by the pump removably mounted within the casing; of a cover for the container removable from the casing without removing the container; of a member located above the container; and resilient means connected with the member and bearing upon said cover for yieldingly maintaining the cover on the container.

8. In a pumping apparatus, the combination with a well casing and a pump; of a container of liquid elevated by the pump removably mounted within the casing; of a cover for the container; of a container support; of a member located above the container; and means connected with the member and bearing upon said container for maintaining the container on the support.

9. In a pumping apparatus, the combination with a well casing and a pump; of a container of liquid elevated by the pump removably mounted within the casing; of a cover for the container; of a container support; of a member located above the container; and resilient means connected with the member and bearing upon said container for yieldingly maintaining the container on the support.

10. In a pump apparatus, the combination with a well casing having a support substantially below the top thereof; of a container having a removable cover and mounted on said support; and means for holding the cover on the container and the container on its support, including a member extending from the top of the casing down to the container and provisions for exerting downward pressure on the member while allowing for differences in expansion between parts of the apparatus.

11. In a pumping apparatus, the combination with a well casing having a discharge pipe extending from a side wall thereof; of a pump; and a container for the pump removably carried by the inside wall of the casing and having an outlet connected with the discharge pipe.

12. In a pump apparatus, the combination with a discharge head; of means for supporting the head within a well; of a pump; and a water column container carrying the pump and suspended from the discharge head, said container being removable from the well without removing the discharge head, and having an outlet into the discharge head.

13. In a pump apparatus, the combination with a discharge head; of means for supporting the head within a well; a pump; a pump container removable from the well without removing the discharge head, and having an outlet into the discharge head.

14. In a pump apparatus, the combination with a discharge head; of means for supporting the head within a well; a pump; a pump container suspended from the discharge head, removable from the well without removing the discharge head, and having an outlet into the discharge head.

15. In a pump apparatus, the combination with a discharge head; of means for supporting the head within a well; and a water column container having a valve controlled inlet, said container being supported solely by the discharge head and removable therethrough and having an outlet leading into the discharge head.

16. In a pumping apparatus, the combination with a discharge head having a seat; of a water column container having a supporting portion adapted to be received by

said seat, said container and discharge head having ports in the supporting portion and in said seat, said ports registering by the engagement of the seat and the container supporting portion.

17. In a pumping apparatus, the combination with a discharge head having a tapered seat; of a water column container having a companion tapered supporting portion adapted to be received by said seat, said container and discharge head having ports in the side walls of each, said ports registering by the engagement of the tapered seat and tapered supporting portion.

18. In a pumping apparatus, the combination with a discharge head having a seat; of a water column container having a supporting portion adapted to be received by said seat, said container and discharge head having ports connected by the engagement of the seat and the container supporting portion; and means accessible from above the well for holding the container upon its seat and for maintaining the connection between said ports.

19. In a pumping apparatus, the combination with a discharge head having a seat; of a water column container having a supporting portion adapted to be received by said seat, said container and discharge head having ports connected by the engagement of the seat and the container supporting portion; and means accessible from above the well for holding the container upon its seat with yielding pressure.

20. In a pumping apparatus, the combination with a discharge head; of a pump including a cylinder having a valve controlled inlet, and a piston having a valve; and a drop pipe for supporting said pump and for receiving liquid elevated by said pump, said drop pipe being supported by and removable through the discharge head and having an outlet thereinto.

21. In a pumping apparatus, the combination with a well casing having a discharge passage leading therefrom; of a pump including a cylinder having a valve controlled inlet, and a piston having a valve; and a drop pipe for supporting said pump and for receiving liquid elevated by said pump, said drop pipe being supported by the casing and extending below the passage and removable upwardly above the passage and having an outlet into said passage.

22. In a pump apparatus, the combination with a discharge head and means for supporting the head within a well; of a drop pipe suspended from and removable through the head and having an outlet into the head, and extending below water level in the well.

23. In a pump apparatus, the combination with a discharge head and means for supporting the head within a well; of a drop pipe suspended from and removable through the head and having an outlet into the head, and extending below water level in the well and a pump cylinder removably supported by the drop pipe.

24. In a pumping apparatus, the combination with a discharge head having a seat; of a drop pipe removably supported upon said head seat, and provided with a seat; and a pump cylinder removably supported upon said drop pipe seat.

25. In a pumping apparatus, the combination with a discharge head; of a plurality of cylinders; and a container for the cylinders for supporting the cylinders upon the head said container being suspended from and removable through the head and providing a passage from the cylinders to the head.

26. In a pumping apparatus, the combination with a discharge head; of a plurality of cylinders; and a container for the cylinders supporting the cylinders upon the head and providing a passage thereto, said cylinders being removable without removing the container.

27. In a pumping apparatus, the combination with a discharge head supported in a well; of a container removably supported by the discharge head; a plurality of cylinders located at different levels in the container; means providing a passage adjacent the upper end of the uppermost cylinder from the container to the discharge head; and means for preventing rise of liquid in the apparatus above the level of the uppermost cylinder.

28. In a pumping apparatus, the combination with a well casing having a discharge passage through a side wall thereof; of a container supported in the well and having an outlet at its upper end connected with the discharge passage; and a plurality of cylinders located in said container.

29. In a pumping apparatus, the combination with a well casing having a discharge passage through a side wall thereof; of a container supported in the well and having an outlet at its upper end connected with the discharge passage; and a plurality of cylinders located in said container and separately removable therefrom.

30. In a pumping apparatus, the combination with a well casing having a discharge passage through a side wall thereof; of a container supported in the well and having an outlet at its upper end connected with the discharge passage; and pump cylinders one located at each end of the container.

31. In a pumping apparatus, the combination with a well casing having a discharge passage through a side wall thereof; of a container supported in the well and having an outlet at its upper end connected with the discharge passage; a plurality of cyl-

inders located at different levels in the container; and means for preventing rise of liquid in the apparatus above the level of the uppermost cylinder.

32. In a pumping apparatus, the combination with a discharge head; of a drop pipe supported by the head and having an outlet connected therewith; an upper pump cylinder and piston located within the drop pipe and sealing the upper end thereof; and a lower cylinder supported by the drop pipe adjacent the lower end thereof.

33. In a pumping apparatus, the combination with a discharge head having a seat; of a drop pipe hanger supported by said head seat and having a seat and having a passage leading to the head; a drop pipe attached to the drop pipe hanger; a cylinder hanger supported by the drop pipe hanger seat; and a cylinder attached to said cylinder hanger.

34. In a pumping apparatus, the combination with a discharge head having a conical seat; of a drop pipe hanger nested against the head seat and having a conical seat and a passage leading to the discharge head through said head seat; a cylinder hanger nested against the drop pipe hanger seat above the passage in the drop pipe hanger; a drop pipe suspended from the drop pipe hanger; and a cylinder suspended from the cylinder hanger.

35. In a pumping apparatus, the combination with a discharge head having a conical seat, and means for supporting the head within a well; of a drop pipe hanger nested against the head seat and having a conical seat and a passage leading to the discharge head through said head seat; a cylinder hanger nested against the drop pipe hanger seat above the passage in the drop pipe hanger; a drop pipe suspended from the drop pipe hanger; a cylinder suspended from the cylinder hanger; and means extending above the well for holding the cylinder hanger and the drop pipe hanger upon their respective seats.

36. In a pumping apparatus, the combination with a discharge head having a conical seat, and means for supporting the head within a well; of a drop pipe hanger nested against the head seat and having a conical seat and a passage leading to the discharge head through said head seat; a cylinder hanger nested against the drop pipe hanger seat above the passage in the drop pipe hanger; a drop pipe suspended from the drop pipe hanger; a cylinder suspended from the cylinder hanger; and means attached to the cylinder hanger and extending above the well for holding the cylinder hanger and the drop pipe hanger upon their respective seats.

37. In a pumping apparatus, the combination with a discharge head having a conical seat, and means for supporting the head within a well; of a drop pipe hanger nested against the head seat and having a conical seat and a passage leading to the discharge head through said head seat; a cylinder hanger nested against the drop pipe hanger seat above the passage in the drop pipe hanger; a drop pipe suspended from the drop pipe hanger; a cylinder suspended from the cylinder hanger; and means exerting pressure directly upon the cylinder hanger for holding the cylinder and drop pipe in position.

38. In a pumping apparatus, the combination with a discharge head heaving a discharge port and a seat and a passage for conducting fluid from above the seat to below it; of a container including means for sealing said seat and having a passage leading through the seat to said discharge port.

39. In a pumping apparatus, the combination with a well casing having a discharge pipe leading through a side wall thereof; of means tending to prevent the passage of liquid into the casing above the discharge pipe; and means providing a drain through the casing past the sealing means.

40. In a pumping apparatus, the combination with a support located within a well below the top thereof; of a pump; of a container mounted upon the support and removable independent of the support for receiving liquid elevated by said pump; and means including a member for holding the container on the support while said pump is delivering liquid to said container or for removing the container from the support.

41. In a pumping apparatus, the combination with a support located within a well below the top thereof; of a pump mounted on the support and removable therefrom; and means including a member for holding the pump on its support while said pump is operative and for withdrawing the pump from its support.

42. In a pumping apparatus, the combination with a container supported within a well below the top thereof; of a removable cover for the container; of a pump for delivering liquid to the container; of a pump rod connected with the pump and extending through the cover and means including a member bearing on said cover and extending to the top of the well for holding the cover in position on the container, said means providing a tool for withdrawing the cover from the well.

43. In a pumping apparatus, the combination with a container supported within a well below the top thereof; of a pump cylinder removably mounted in the container; and means including a member connected with the cylinder and extending to the top of the well for holding the cylinder in the container, said means providing a tool for removing the cylinder from the container.

44. In a pumping apparatus, the combination with a container supported within a well below the top thereof; of a pump cylinder removably mounted in the container; and means including a member connected with the cylinder and bearing on said container and extending to the top of the well for holding said cylinder in the container and the container on the support, said means providing a tool for removing the cylinder and container separately from the well.

45. In a pumping apparatus, the combination with a support located within a well below the top thereof; of a pump mounted upon said support; and means for yieldingly holding the pump on its support, said means including a member for withdrawing the pump from the well.

46. In a pumping apparatus, the combination with a support located within a well below the top thereof; of a container mounted on said support; a pump located within the container; means including a part located in the well for removing the pump from the container; and means including a part located in the well for removing the container or the container and pump.

47. In a pumping apparatus, the combination with a support located within a well below the top thereof; of a pump mounted on said support and including a portion below the top of the well; and means for removing the pump including a member located adjacent the pump rod and connected to said portion and extending adjacent the top of the well and adapted to be attached to the pump rod and to hoisting apparatus.

48. In a pumping apparatus, the combination with a support located within a well below the top thereof; of a pump mounted on said support; a rod for operating and for removing the pump said rod having a transverse aperture; a tubular member surrounding the rod and adapted to be attached to a hoisting device and having a transverse aperture, said apertures being adapted, when aligned, to receive a bar for connecting the tubular member and the pump rod.

49. In a pumping apparatus, the combination with a support located within a well below the top thereof; of a pump mounted on said support; a rod for operating and for removing the pump, said rod having a transverse aperture; a tubular member surrounding the rod and having a flange provided with a threaded aperture; a hoisting screw cooperating with a stationary part and the threaded aperture for elevating the flange member, said member having a transverse aperture, said apertures being adapted, when aligned to receive a bar for connecting the flanged member with the pump rod.

50. In a pumping apparatus, the combination with a support located within a well below the top thereof; of a container mounted on said support; a cover for the container; a tubular member located above the support and normally attached to a stationary part; and an extension member normally attached to the tubular member and to the cover to hold the cover in position or to provide for removal of the cover from above the well, said extension member adapted to be attached also to the tubular member and to the container for removal of the container by lifting the tubular member when detached from the stationary part.

51. In a pumping apparatus, the combination with a support located within a well, and a stationary part located above the well; of a pump part mounted on said support; an extension member projecting from above the well down to the pump part; and means cooperating with the stationary part and adapted to be arranged to exert a push or a pull on the extension member to hold the pump part in place or to remove it from the well.

52. In a pumping apparatus, the combination with a support located within a well, and a stationary part located above the well; of a pump part mounted on said support; an extension pipe projecting from above the well and attached to the pump part; a tubular flanged member attached to the pipe above the well; and screws extending through the flanged member and threaded into the staticnary part to force the pipe and pump part down, said flanged member having threaded apertures whereby said screws may cooperate with the stationary part and flanged member to lift the extension pipe and pump part.

53. In a pumping apparatus, the combination with a well casing and a pump mounted therein; of a stationary part located on the ground adjacent the well casing; and means for maintaining the pump in position including an extension member located in the casing, and devices cooperating with said stationary part and the extension member for exerting downward pressure upon said member while permitting movement of the ground relative to the extension member.

In testimony whereof we hereto affix our signatures.

GEORGE A. BUVINGER.
CLARENCE WARNER.

Witnesses:
MILDRED PEARE,
LLOYD M. KEIGHLEY.