No. 850,037. PATENTED APR. 9, 1907.

F. J. MOSER.

METHOD OF RAISING LIQUIDS FROM WELLS.

APPLICATION FILED JULY 11, 1906.

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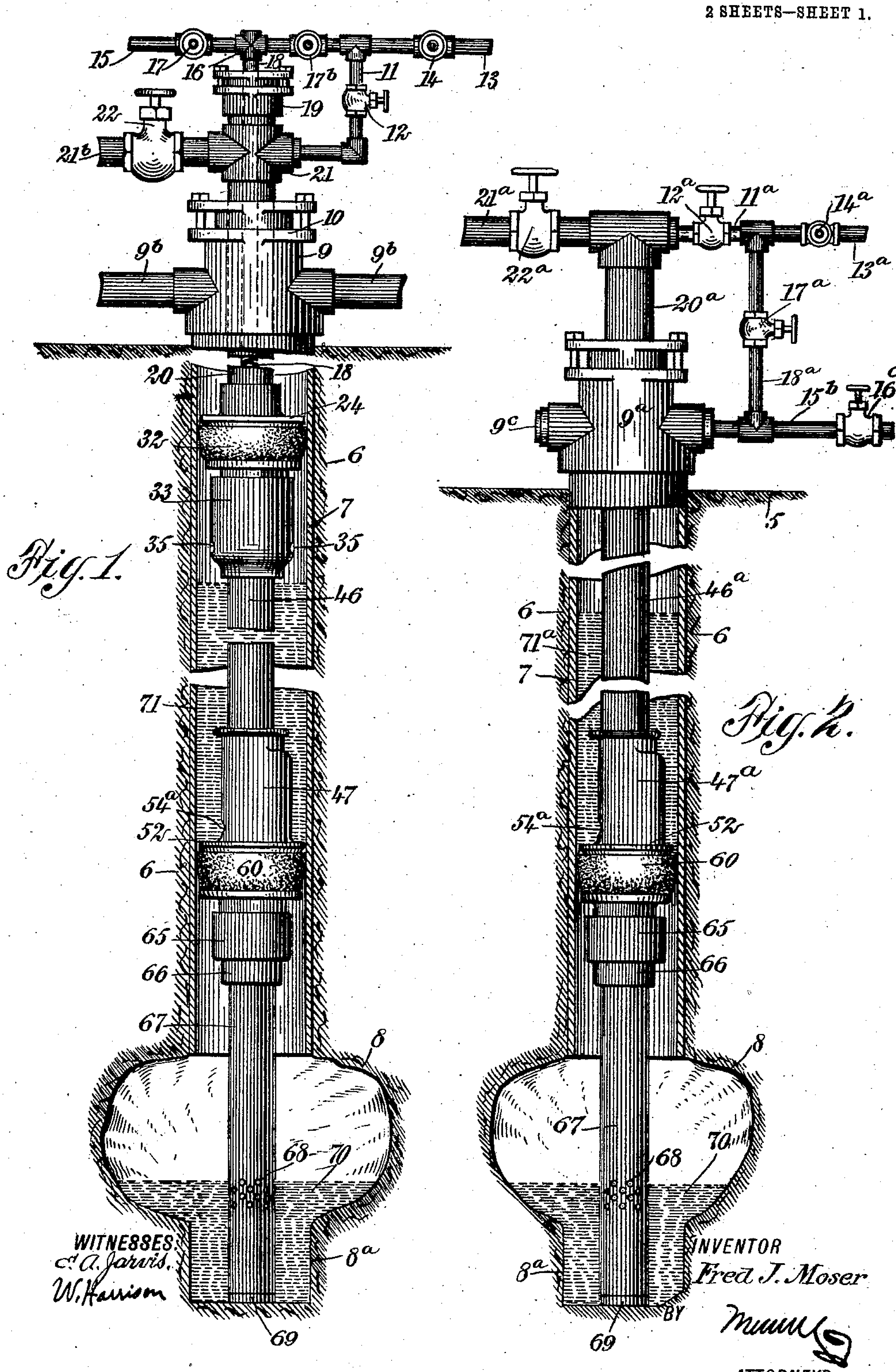

WITNESSES:
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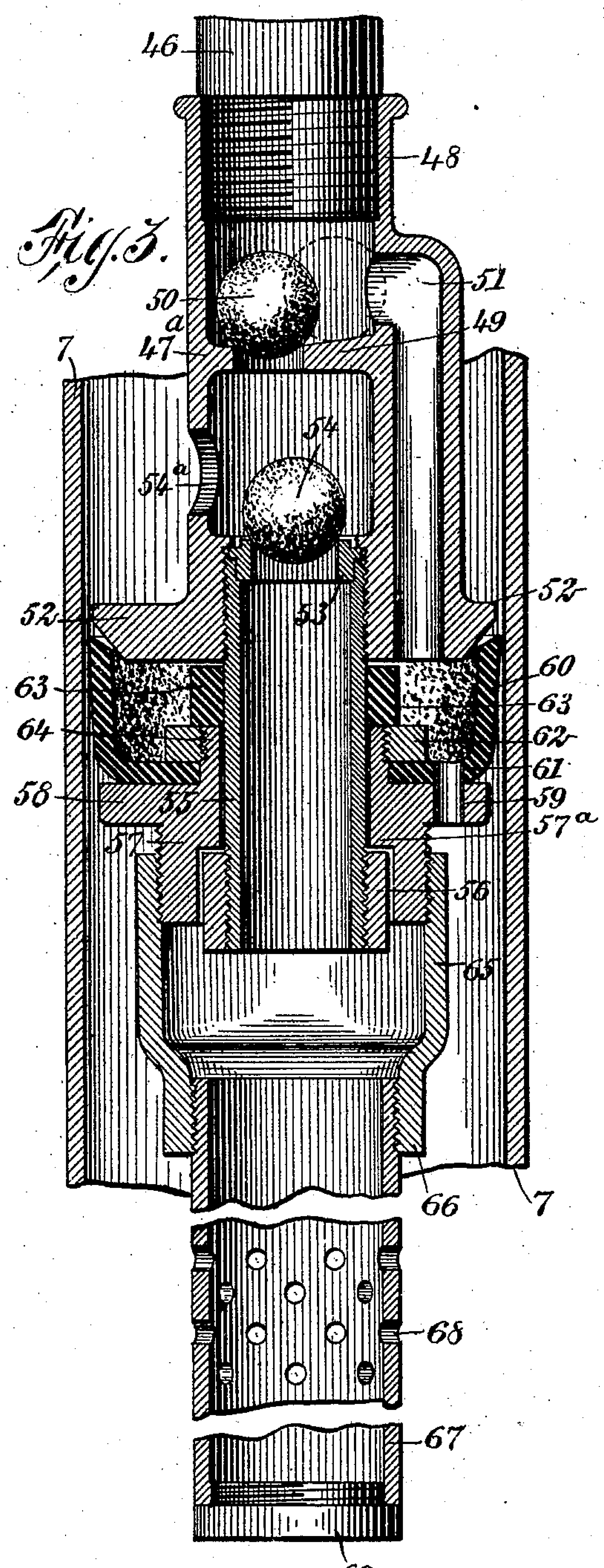

Fig. 3.

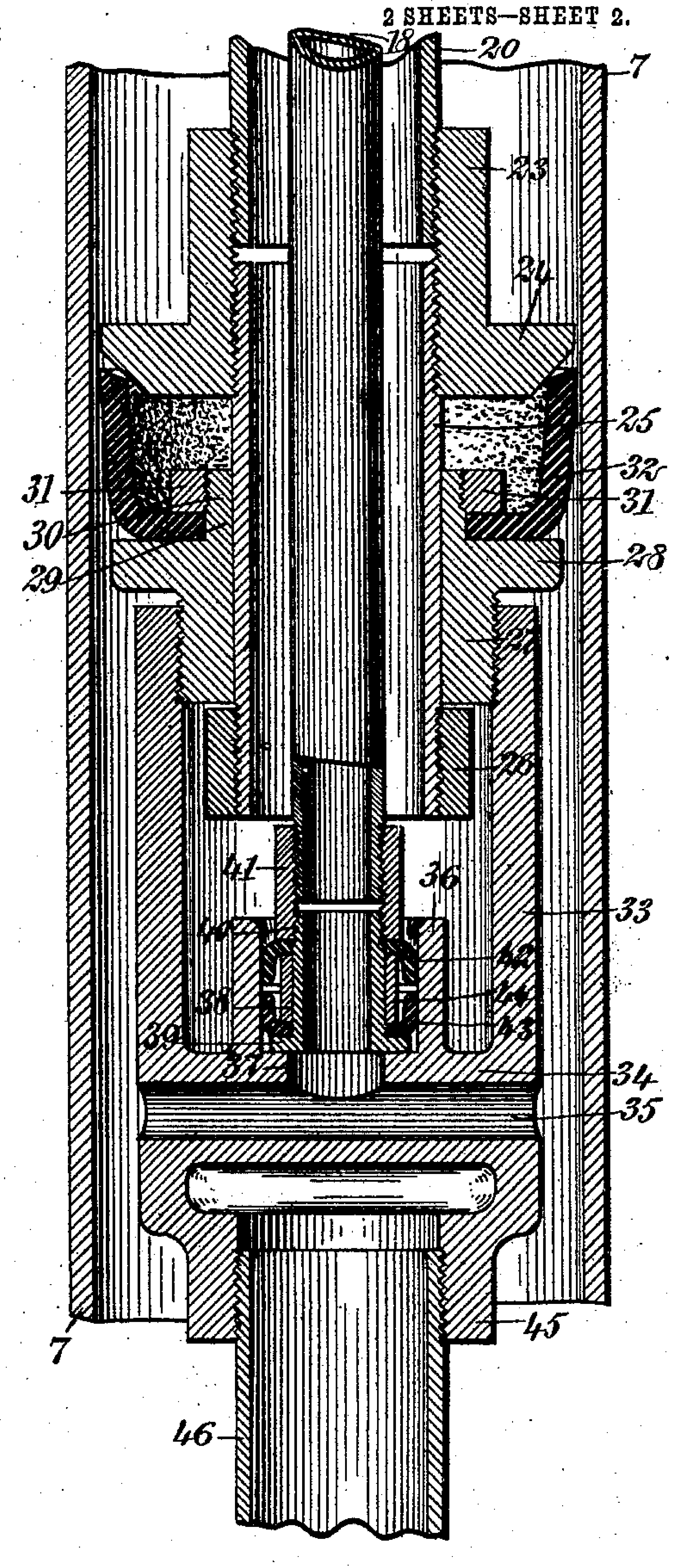

Fig. 4.

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UNITED STATES PATENT OFFICE.

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METHOD OF RAISING LIQUIDS FROM WELLS.

No. 850,037. Specification of Letters Patent. Patented April 9, 1907.

Application filed July 11, 1905. Serial No. 269,171.

To all whom it may concern:

Be it known that I, Fred Joseph Moser, a citizen of the United States, and a resident of Kane, in the county of McKean and State of Pennsylvania, have invented a new and Improved Method of Raising Liquids from Wells, of which the following is a full, clear, and exact description.

My invention relates to a method of raising liquids from wells, and admits of general use, but is of peculiar service in connection with the raising of liquids from oil-wells.

My invention may be considered in connection with Patent No. 721,594, dated February 24, 1903, and Patent No. 751,323, dated February 2, 1904, both issued to Thomas F. Moran and myself.

The present invention undertakes to improve upon the methods disclosed in the patents above mentioned.

Reference is to be had to the accompanying drawings, forming a part of this specification, in which similar characters of reference indicate corresponding parts in all the figures.

Figure 1 is a fragmentary vertical section through a well equipped with one form of my invention and suitable particularly for deep wells. Fig. 2 is a somewhat similar section through a well equipped with my invention, the well in this instance being comparatively shallow and the mechanism being varied accordingly. Fig. 3 is a vertical enlarged section through the packing disposed in the vicinity of the shot-hole and showing the relation of the parts connected with the packing; and Fig. 4 is an enlarged vertical section of the auxiliary packing 32 and parts connected therewith, this packing being used only in deep wells, as indicated in Fig. 1.

The surface of the earth is shown at 5, the drill-hole at 6, and a metallic cylinder fitting into the drill-hole at 7, which is used to shut out fresh water from the well and in some instances extends to the oil strata, as shown. The shot-hole is shown at 8 and the pocket at 8ª. This pocket may be considered as a short section or continuation of the drill-hole, but located below the shot-hole. Mounted upon the upper end of the cylinder or casing 7 is the casing-head 9 9ª and stuffing-box 10. In deep wells, as shown in Fig. 1, the casing-head is provided with pipes 9ᵇ, which may be used for removing natural gas formed within the well. If the well is comparatively shallow, as indicated in Fig. 2, it is desirable to provide the casing-head 9ª with a plug 9ᶜ. It prevents the escape of any aeriform body contained therein. The pipe 11 is provided with a valve 12 and communicates with the so-called "air-pipe" 13. While I use the term "air-pipe" because of its technical meaning, I contemplate the employment of this pipe for conducting into the well any aeriform body—such, for instance, as natural gas—which may be used for raising the liquid. The air-pipe is provided with a hand-valve 14 and is connected with a blow-off pipe by means of a **T** 16, the blow-off pipe being provided with a hand-valve 17. Between the **T** 16 and the pipe 11 the air-pipe 13 is further provided with a hand-valve 17ᵇ. The air-pipe 18 is continued downwardly through a tubing-head 19 and through a tube 20. The pipe 11 connects with a **T** 21 upon the tube 20.

In Fig. 2 the air-pipe is shown at 13ª and is provided with a hand-valve 14ª. A short pipe 11ª, forming virtually a continuation of the air-pipe, communicates with a tubing 20ª and is provided with a hand-valve 12ª. The air-discharge pipe is shown at 15ᵇ and is provided with a hand-valve 16ᶜ. This pipe is connected with the casing-head 9ª. From the air-discharge pipe the pipe 18ª leads upward to the air-pipe 13ª and is provided with a hand-valve 17ª. The oil-discharge pipe is shown at 21ª 21ᵇ and is normally closed by a hand-valve 22ª 22. The tube 20 is threaded at its lower end and provided with a collar 23, having a conoidal disk 24 integral with it. This collar 23 is connected rigidly with a tube 25, and upon the lower end of this tube is a collar 26. A sleeve 27 fits slidably upon the tube 25 and is provided with a flange 28 and also with an annular portion 29, being threaded at 30, as indicated in Fig. 4. Threaded upon this annular portion 29 is a collar 31. This collar engages a cup-shaped packing 32, of leather, which encircles the annular portion 29. A comparatively large sleeve 33 is threaded internally at its upper end and fitted upon the sleeve 27. The sleeve 33 is provided with a core 34, having a passage 35, this passage communicating with the air-pipe 18 by means of an opening 37, as indicated in Fig. 4. An annular bead 36 extends upward through the core 34 and is integral with the sleeve 33. A sleeve 38 is provided with an annular flange 39 and with a threaded portion 40. Engaging this threaded portion is another sleeve 41, threaded internally and also engaging the air-pipe 18. Cup-shaped packings 42 43, preferably of leather, encircle the sleeve 38 and are spaced apart and otherwise held in position by an annular member 44, as will be understood from Fig. 4. The sleeve 33 is provided with a reduced portion 45, the latter being engaged by a tube 46 46^a^. The tubes 20 and 46 may be considered as the "tubing" when used as in Fig. 1, as these two tubes virtually form continuations of each other. A housing 47 is connected with the tube 46 at a point disposed a little above the shot-hole. This housing is provided with a neck 48, threaded internally, as shown, and fitting the lower end of the tube 46. Disposed within the housing 47 and integral therewith is a valve-seat 49, normally supporting the ball-valve 50. A passage 51 extends downwardly through the housing 47. This housing terminates at its lower extremity in a conoidal member 52. An inserted valve-seat 53 is mounted within the housing 47 and normally supports a ball-valve 54. An outlet-passage 54^a^ is provided for permitting liquid to escape from the housing after raising the ball-valve 54. The inserted valve-seat 53 is held in place by a sleeve 55, which is threaded at its upper end and screwed into the housing. The lower end of the sleeve 55 is threaded externally and fitted with a collar 56. Slidably encircling the sleeve 55 is another sleeve 57, provided with a shoulder 57^a^, this shoulder being adapted to move into engagement with the collar 56, which forms a limiting-stop therefor. This sleeve 57 is provided with disk-like portion 58, having a vertical passage 59 through it. A cup-shaped packing 60, preferably of leather, is provided with a passage 61, registering with the passage 59. A collar 62 is threaded internally and fitted upon a threaded portion 64 of the sleeve 57, this portion being integral with the body of the sleeve. A packing 63, preferably of annular form and made of rubber, encircles the sleeve 55. A sleeve 65, of substantially funnel shape, is threaded internally and fitted upon the sleeve 57. This sleeve 65 is provided with a reduced portion 66, threaded internally, and fitted within it is an anchor-pipe 67, provided with perforations 68 and closed at its lower end by means of a plug 69. The liquid to be raised is shown at 70, and the main body of liquid in the well is shown at 71 71^a^, this main body having been partially raised, as hereinafter described.

The housing 47^a^ is in all respects similar to the housing 47, the internal parts being identical, the only difference being that the two housings are connected with parts of somewhat different character in the upper portion of the well.

Referring to Fig. 4, it will be seen that as the sleeve 27 fits slidably upon the sleeve 25 the tube 20, the sleeve 23, the conoidal member 24, the sleeve 25, and the collar 26 are rigid in relation to each other and that the sleeve 27, the packing 32, the sleeve 33, and the tube 46 are likewise rigid in relation to each other, yet the parts last mentioned considered as a unit are slidable in relation to the parts first mentioned—that is to say, the connection between the sleeve 25 and the sleeve 27 is a slip-joint. The weight of the tube 20 and parts resting thereupon forces the conoidal member 24 down upon the packing 32, so as to distend the same and make it fluid-tight within the drill-hole, the collar 27 being free to move slightly away from the lower end of the sleeve 25 to allow for this movement. The air-pipe 18 is fitted independently of the slip-joint mentioned. The lower end of the air-pipe being provided with the cup-shaped valves 42 43, of leather, is lowered into position and is encircled by the bead 36, so as to make a water-tight connection having a high degree of play, sufficient, for instance, to allow for slight imperfections in fitting. The housing 47 and the parts below it are also provided with slip-joint and water-tight packing somewhat similar to that just described. The weight of the tube 46 and housing 47 causes the conoidal member 52 to expand the packing 60 and render it fluid-tight within the drill-hole. The collar 56 recedes from the shoulder 57^a^ for this purpose. The rubber packing 63 is easily compressed by the weight of the housing and parts connected thereto and the efficiency of the slip-joint formed by the sleeves 55 and 57. By the means above described the tubing from the top of the well downward may be handled from above in such manner that when the parts are properly rested in place complete fluid-tight connections are made.

The operation of the device embodying my method is as follows: I will first explain the action of the mechanism shown in Fig. 2. The valves 17^a^ and 22^a^ being closed and the valves 14^a^ and 12^a^ being open, the aeriform body is thus admitted through the air-pipe 13^a^ to the tubing 20^a^ and passes downward to the housing 47^a^, which, as above described, is identical with the housing 47. Referring now to Fig. 3, it will be seen that the aeriform body forces the ball-valve 50 upon its seat 49, passing downwardly through the passages 51, 61, and 59 into the lower portion of the drill-hole and also into the shot-hole 8, where it exercises a downward pressure upon the upper level of the liquid 70. This forces the liquid through the passages 68, up through the anchor-pipe 67. The liquid continues its upward force, passing through the sleeve 55 and raising the ball-valve 54, so as to pass it through the aperture 54^a directly into the drill-hole. The ball-valve 54 then closes upon its seat, thereby preventing retrogression of the liquid. If desired, the operator can now allow more liquid to accumulate within the shot-hole and pocket 8^a and then repeat the operation, so as to add to the store of liquid within the drill-hole above the packing 60. The liquid may thus be increased according to the size of the well until a considerable volume is thus stored. This is what I call making the "initial lifts" of the liquid. After each application of the aeriform body the valve 22^a is opened and the valve 12^a closed, so as to allow the aeriform body to blow off, and thus relieve the aeriform pressure from the shot-hole. Unless this pressure were relieved it would retard the formation of the liquid within the bottom of the well. The operator now being ready to make what I call the "final lift" closes the valve 12^a, opens the valves 14^a 17^a, and also opens the valve 22^a. The aeriform body thereupon passes downwardly through the short pipe 18^a, out into the casing-head 9^a, and directly into the drill-hole. Here it exercises a downward pressure upon the upper surface of the liquid 71^a and causes the same to pass into the housing 47^a through the aperture 54^a, dislodging the ball 50 from its seat. The ball thus dislodged closes the upper end of the passage 51 and prevents the liquid from passing down into the well again through said passage. The pressure of the aeriform body upon the upper surface of the liquid 71^a thus causes the liquid to ascend through the tubing 46^a to the surface of the earth, and it is there discharged through the oil-discharge pipe 21^a.

Where the wells are deep, and consequently the apparatus shown in Fig. 1 is employed, the initial lifts are made in a manner somewhat analogous to that above described. To make the initial lifts when using the apparatus shown in this figure, the operator closes the hand-valve 17^b and opens the hand-valves 12 and 14. The aeriform body under pressure thereupon passes downwardly through the tubes 20 46, sleeves 25 and 33, passing around the outside of the core 34, and down through the tube 45 to the housing 47. The ball-valve 50 being in its normal position upon its seat 49, the aeriform body passes downwardly through the passages 51 61 59 into the drill-hole, where it exercises a downward pressure upon the upper level of the liquid 70. It thus raises a considerable volume of this liquid, which passes through the aperture 68 of the anchor-pipe 67 and flows upwardly through the sleeve 55, raising the ball-valve 54, and passing out into the drill-hole through the aperture 54^a. After each discharge the ball-valve 54 drops back into its normal position, preventing retrogression of the liquid. The aeriform body is allowed to escape from the well after each of these initial lifts. This escape is made through the discharge-pipe 21^b, the valve 22 being opened for the purpose, the valves 17^b and 12 being meanwhile closed. After one or more charges of liquid have been thus raised into the drill-hole above the packing 60 the operator proceeds to make the final lift, so as to raise the liquid thus accumulated to the surface of the earth. To accomplish this purpose, he closes the valve 12, opens the valves 14 and 17^b, and closes the valve 17. The aeriform body under pressure thereupon descends through the air-pipe 18 and passes out through the passage 35, as will be understood from Figs. 1 and 4. The aeriform body then presses downwardly upon the upper surface of the liquid 71, and thus causes the liquid to flow through the passage 54^a and upwardly through the tube 46 to a point above the level of the earth, and it is thence discharged to the oil-discharge pipe 21^b, the valve 22 being opened for the purpose. As above described, the ball-valve 50 automatically closes the passage 51. When, however, the liquid 71 has been discharged to the surface of the earth, the ball-valve 50 drops back into its normal position. (Indicated in Fig. 3.)

Where the apparatus shown in Fig. 2 is employed and in making the initial lifts incidental to the use of the apparatus shown in Fig. 1, a comparatively low pressure may be employed. The reason for this is that the initial lift raises the liquid but a few feet. If, therefore, the well is shallow, no great pressure is needed in the aeriform body, and even if the well be of considerable depth no large pressure is needed for making the initial lift. Considerable pressure, however, is of course necessary to make the final lift from a deep well.

To persons unfamiliar with this art it might seem that there would be no necessity for making the initial lift if, as in Fig. 1, the well is to employ a high pressure of an aeriform body. The reason for employing first a low pressure and then a high pressure in cases where the liquid is to be raised a considerable distance, as in Fig. 1, is based mainly upon a fact which otherwise arises. The oil-rock is very porous and readily absorbs an aeriform body if the latter be applied thereto at a pressure higher than the natural pressure of the liquid or gas stored in the rock itself—that is to say, the aeriform body by finding its way into the pores of the oil-rock necessitates the use of a volume of liquid, or in practice necessitates a high aeriform pressure, in order to make it effective in raising the liquid to the surface of the earth. The porous rock may be considered as a sort of yielding substance which wastes the energy possessed by the aeriform body under pressure. I therefore seek by the initial lifts to merely get the liquid out of the porous rock and elevate it a few feet, so as to place it within a better receptacle, as it were, in order that the pressure of the aeriform body may be applied to the surface of the liquid without the aeriform body going out into the rock, and thereby having its pressure dissipated.

In practical experiments which I have tried along the above line I have found that it required in some instances a pressure apparently two or three times as great as would logically be required to raise the liquid. In some cases where I employed a pressure of three hundred and fifty pounds of air I could only develop in the well a pressure of a little more than one hundred pounds per square inch. The reason is obvious. The aeriform body simply passed off into the porous rock almost as fast as I could supply it.

In many wells comparatively small charges—say consisting of less than two barrels each—can be made within a drill-hole of six inches in diameter without any great difficulty being experienced. These charges may be raised as above described, so as to accumulate the volume of liquid to be lifted, and then the entire volume thus accumulated may be raised to the surface of the earth.

Oil-wells produce more or less natural gas, and when the volume of pressure of such gas is sufficient it may be used for the purpose of making the initial lift of the liquid instead of applying air-pressure from the surface of the earth for that purpose. The action would be as follows: In the construction shown in Fig. 1 the valves 17, 17^b, and 22 and either 12 or 14 should be closed. In Fig. 2 the valves 22^a, 12^a, and either the valve 14^a or the valve 17^a should be closed. This causes the natural gas to collect in the well, and as the pressure becomes strong enough it forces the liquid in the well upward above the packing, after which the valves may be opened and the gas allowed to escape from the well.

It will be noted that the mechanism above described is to a great extent automatic and that as between the two forms shown the parts may be adapted to wells of almost any depth.

It will also be noted that the system shown in Fig. 2 practically accomplishes with one pipe what is accomplished by the use of two or more pipes. I therefore designate the apparatus shown in this figure as a "one-pipe system."

Having thus described my invention, I claim as new and desire to secure by Letters Patent—

1. The method herein described of raising liquids from wells, which consists in applying pressure intermittently to the upper surface of a liquid resting freely within the well and otherwise unconfined, thereby elevating the said liquid piecemeal in the form of distinct charges to a slightly higher level, and finally raising to the surface of the earth the liquid thus elevated.

2. The method herein described of raising liquids from wells, which consists in intermittently applying pressure of an aeriform body to the upper surface of a liquid resting freely within the well and otherwise unconfined, so as to elevate the same piecemeal to a slightly higher level, and then applying a single charge of an aeriform body under comparatively high pressure so as to elevate to the surface of the earth the aggregate volume of liquid thus raised piecemeal.

3. The method herein described of raising liquid from wells which consists in applying an aeriform body under pressure to a body of liquid in the well for the purpose of forcing a portion of said liquid to a position between two packings one disposed above the other in the drill-hole of the well, preventing retrogression of the same and finally applying an aeriform body under pressure between the two said packing for the purpose of forcing the liquid contained therein to the surface of the earth.

4. The method herein described of raising liquids from wells, which consists in subjecting a liquid resting freely within the well and otherwise unconfined to the action of an aeriform body so as to raise said liquid to a level slightly higher than the normal level of the liquid in the well, causing the supply of said aeriform body to be cut off when the upper surface of said liquid thus raised reaches a predertermined level, preventing retrogression of said liquid thus raised, and finally elevating the latter to the surface of the earth.

5. The method herein described of raising liquids from wells, which consists in causing an aeriform body under pressure to escape into the drill-hole of the well, and accumulating sufficient pressure upon the upper surface of a body of free liquid contained within the well to raise a portion of said free liquid to a point above a packing within said well, allowing the liquid thus raised to escape from the piping into the drill-hole of the well above said packing, preventing retrogression of the liquid thus raised above said packing, and finally making a separate application of an aeriform body to the portion of liquid thus treated so as to raise the same to the surface of the earth.

6. The method herein described of raising liquids from wells, which consists in applying an aeriform body under pressure to a body of free liquid contained within the well for the purpose of collecting it in the drill-hole in a slightly-elevated position above the packing, relieving the pressure thus employed so as to allow another supply of free liquid to accumulate within the well, then raising a portion

of said supply thus accumulated in the same way, merging it with the portion first raised and finally applying an aeriform body under pressure within the drill-hole in the well upon the upper surface of the liquid thus raised for the purpose of forcing the same to the surface of the earth.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

FRED JOSEPH MOSER.

Witnesses:
E. C. ANDERSEN,
GEO. W. CROSSMIE.