No. 746,980. PATENTED DEC. 15, 1903.

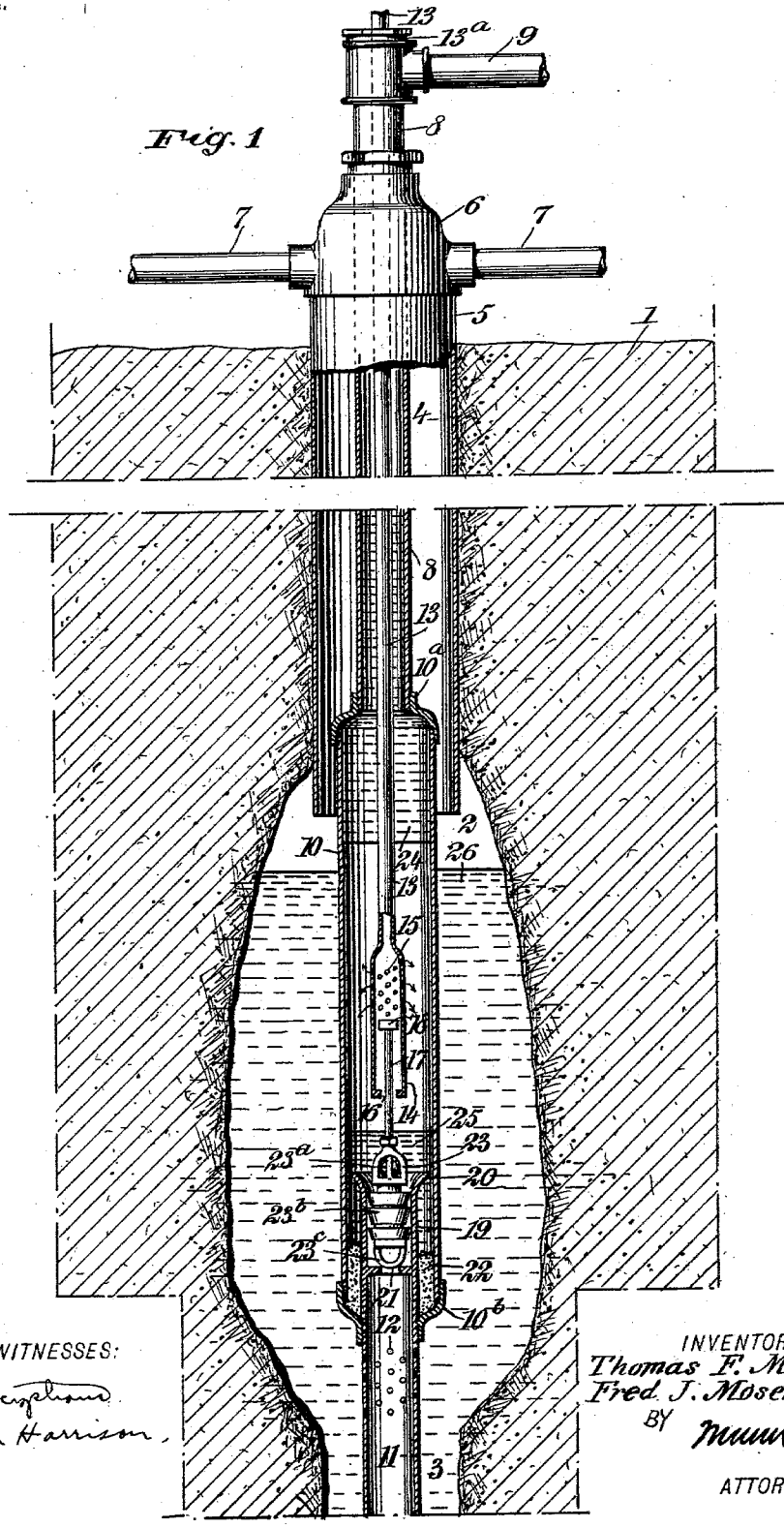
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METHOD OF FLOWING LIQUIDS FROM WELLS.

APPLICATION FILED MAR. 4, 1903.

NO MODEL. 2 SHEETS—SHEET 1.

Fig. 1




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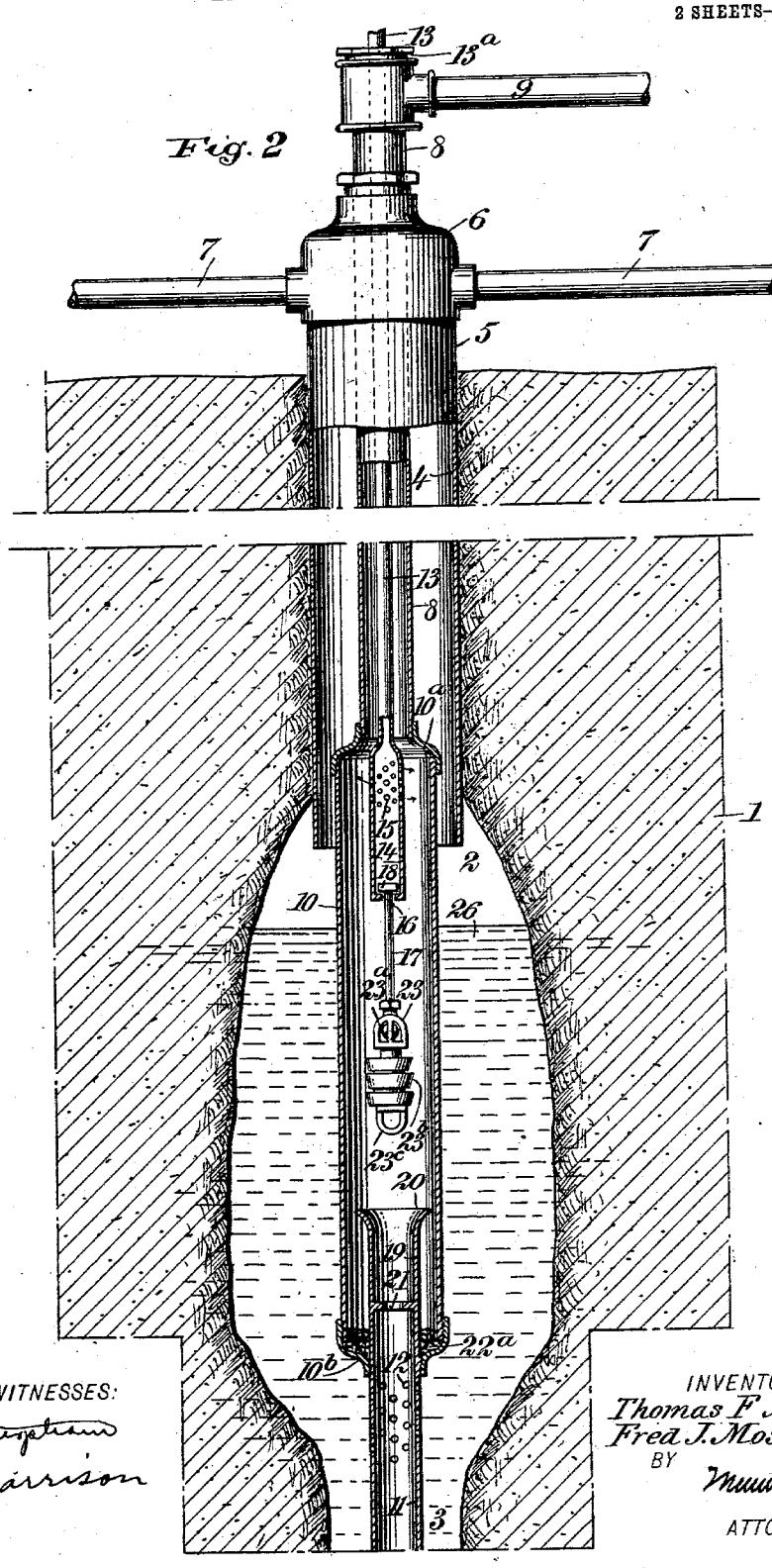
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METHOD OF FLOWING LIQUIDS FROM WELLS.

APPLICATION FILED MAR. 4, 1903.

NO MODEL. 2 SHEETS—SHEET 2.

Fig. 2




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No. 746,980. Patented December 15, 1903.

# UNITED STATES PATENT OFFICE.

THOMAS FRANCES MORAN, OF DE YOUNG, AND FRED JOSEPH MOSER, OF KANE, PENNSYLVANIA.

## METHOD OF FLOWING LIQUIDS FROM WELLS.

SPECIFICATION forming part of Letters Patent No. 746,980, dated December 15, 1903.

Application filed March 4, 1903. Serial No. 146,086. (No model.)

*To all whom it may concern:*

Be it known that we, THOMAS FRANCES MORAN, a resident of DeYoung, in the county of Elk, and FRED JOSEPH MOSER, a resident of Kane, in the county of McKean, State of Pennsylvania, both citizens of the United States, have invented a new and Improved Method of Flowing Liquids from Wells, of which the following is a full, clear, and exact description.

Our invention relates to a method for raising liquids from wells, and more particularly to raising oil and water from exceedingly deep wells in which the liquid naturally elevates but slightly, if any, higher than the level at which it enters the well, thus affording but little submergence to the mechanism used in carrying out our method.

Our invention further relates to the occasional removal of the lost sand that interferes with the working of the apparatus used incidental to the removal of the liquids.

Our invention further relates to a method for raising liquids without the use of a packer and in the manner hereinafter described.

We are not limited to the use of any particular apparatus in carrying out our method, but preferably employ mechanism substantially like that shown in the accompanying drawings.

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 both figures.

Figure 1 is a vertical central section through a well as equipped with apparatus for carrying out our method, certain parts being shown in elevation. Fig. 2 is a somewhat similar view, but showing the valve as lifted from its seat.

The earth is shown at 1, the shot hole at 2, the basin at 3, and the casing of the drill-hole at 4. A portion 5 of this casing extends above the earth and is surrounded by a casing-head 6 and provided with pipes 7 for conducting away the gas constantly arising within the well. The tubing is shown at 8 and is provided at its upper end with a pipe 9, serving as a fluid-discharge.

Disposed within the shot hole 2 is the casing 10, which has a much larger diameter than the tube 8, into which its contents pass on their way to the surface, and provided with heads $10^a$ $10^b$, the head $10^b$ communicating with a pipe 11, which is provided with perforations 12. The air-pipe is shown at 13 and is provided with a stuffing box $13^a$ or analogous packing arrangement whereby the pipe 13 may be moved vertically without materially interfering with the action of other parts.

The lower end of the air-pipe 13 is provided with a hollow head 14, having perforations 15 and a central opening 16. The valve-stem 17 is provided with a head 18, disposed within the hollow head 14, so that the stem 17 is free to move relatively to the opening 16. The pipe 11 is provided with a portion 19, having a substantially funnel-shaped end 20, which projects upwardly from the head $10^b$, for the purpose of forming a sand-trap, as hereinafter described. At 21 is shown a seat for the main valve. The sand caught by the trap is shown at 22 in Fig. 1, and the small portion of sand remaining in the trap after the same is cleaned out is shown at $22^a$ in Fig. 2. The main valve is shown at 23 and has the usual construction, comprising, among other things, a loose ball $23^a$, a series of annular packings $23^b$ of leather or other suitable material, and a spider $23^c$ for engaging the aperture 21 of the valve-seat. The main valve normally occupies the position indicated in Fig. 1, but may be raised into the position indicated in Fig. 2 when desired.

When the air-pressure is applied through the air-pipe 13, the air escapes from the perforations 15, as indicated in Fig. 2, thereby breaking the body of water or oil contained within the casing 10 into two portions 24 25 and forcing the portion 24 to the surface in the form of a continuous column comparatively free from bubbles.

The general operation of our invention is as follows: Before or after the well has been emptied of its oil or other liquid the natural gas escapes into the shot hole 2 and finds its way to the surface, whence it is conveyed by means of the pipe 7 and utilized for any desired purpose. This action is very simple, owing to the absence of any packer in the drill-hole. The oil or other liquid finds its

way into the usual manner into the shot hole 2 and under the action of gravity of course fills the casing 10, so as to preserve a normally constant level with the liquid 26 outside of said casing and within the shot hole. The liquid of course may rise to various heights, dependent upon the force of the well, the frequency with which the same is emptied, and other conditions well known in the art, also by the pressure of the gas in the drill-hole when shut off at the casing-head 6 exerting its force to raise the fluid 24 in the tube 8 to a height commensurate with the pressure of the gas. In case of an oil-well having little or no gas pressure or of a water-well of low submergence connection can be made from the air-pipe to the top of the well and air turned in on the top of the fluid for the purpose of forcing the liquid up in the enlarged tube. Suppose now it is desired to empty the well. The several parts being in the position indicated in Fig. 1, a charge of air under enormous pressure is suddenly forced through the pipe 13, so as to make its escape violently through the perforations 15 into the casing 10. The liquid within the casing is suddenly broken into two portions 24 25, the portion 25 suddenly closing the main valve 23, thereby preventing much of the liquid from being driven downward and through the perforations 12 into the shot hole, the portion 24 being forced upward in the form of a continuous column to the surface. In other words, the portion 24 of liquid within the casing and tubing acts as a piston and is driven upward in the manner thereof as distinguished from being caused to bubble upward by virtue of the gradual escape of streams of free air. The result is that the liquid issuing from the pipe 9 has the form of a solid stream and does not sputter and splash, as is the case with liquid raised in the usual manner by the application of free air. The air-pressure being now released, gravity and gas-pressure force another portion of the liquid 26 upward through the perforations 12 and into the casing 10, so that the operation may be repeated two, three, or four times in succession until the well is practically emptied.

It is found that by this method a comparatively shallow body of liquid can be raised through the tubing, the principle being that the casing 10, into which the air is discharged to divide the column of liquid contained therein, having a greater diameter than the tube above it, into which its contents pass, affords a means for obtaining the proper height of liquid or the necessary submergence to lift the fluid that naturally does not exist, for the reason that it requires a certain height of liquid above the air-discharge to seal it, so the discharge of air will lift the fluid from the well, while if the tubing contained a column of less height above the air-discharge the air will raise it but a short distance before it blows through it. Now if the height of the column were less than the necessary amount to seal it in a device that had no enlarged tube, corresponding to the tube 10 that we employ, a discharge of air would blow through the liquid instead of expelling it, as above described; but with the use of the larger tube 10 in this method the initial lift of the fluid from the discharge of the air within the tube 10 forces the liquids contained in the tube 10 above the air-discharge into the smaller tube 8, thereby increasing the height of the column of liquid as many times its original height as the capacity of the tube 10 exceeds the capacity of the tube 8, thereby giving the necessary height to the liquid to raise it in a solid column.

Comparatively little air is required for the purpose of raising the liquid by this method, though the initial pressure should be great.

In case the fluid-level of the well is so low that it will not fill the casing 10 to the desired height to furnish enough liquid above the air-discharge, so that a discharge of air would force enough up in the tube 8 to seal it, as explained above, the valves at the top of the well are closed that control the escape of the gas, thereby creating a gas-pressure within the well, which pressing down on the fluid in the shot hole forces it up in the tube 10, affording the necessary amount of fluid to repeat the action above described and affords a means of practically emptying the well of its fluid contents.

Wells of the kind above described contain more or less loose sand, and this sand finds its way into the casing 10. By means of the trap shown at the lower end of the casing 10 the loose sand is banked up, as indicated at 22 in Fig. 1, instead of settling upon the valve 23, as it would necessarily have to do except for this trap. It also accumulates in the shot hole, filling it up in time far enough to prevent the free flow of fluid into the tubing through the perforations 12. The sand filling up in the shot hole under the perforations 12 on being lodged at 22 does comparatively little harm until the perforations 12 become choked or the trap is filled, when of course the sand should be removed. This removal is effected as follows: The air-pipe 13 is raised, as indicated in Fig. 2, thereby raising the valve 23 from its seat. The tubing now being closed by means of the pipe 9 at the top of the well, air is forced through the air-pipe 13 into the casing 10, thus causing the expulsion into the shot hole 2 of any of the liquid contained within the casing 10. The violent expulsion of the liquid through the perforations 12 produces the currents which stir up the sand 22, together with any that may be clogging the perforations 12, and carry the same into the shot hole. The air-pressure being suddenly relaxed, the liquid 26 within the shot hole 2, acting under the influence of gravity and outside pressure of gas and air, is partially forced through the perforations 12 and into the casing 10, carrying with it great quantities of sand held in suspension,

The result is that the casing 10 is filled with liquid in violent agitation and carrying suspended sand. Before the sand has time to settle the air-pipe 13 is lowered, so that the valve 23 occupies the normal position, (indicated in Fig. 1,) and the air-pressure is again suddenly applied, with the result that the portion 24, this time containing large quantities of sand in suspension, is quickly forced upward to the surface, where it makes its escape through the pipe 9, thus removing a portion of the sand from the well. This operation may be repeated as many times as desired or until the bulk of the loose sand in the well has been removed. The valve 23 may be removed for the purpose of repairs by withdrawing the pipe 13. Of course any aeriform medium other than air may be forced through the air-pipe 13 for the purposes above described.

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

1. The method herein described of removing sand from wells containing liquids, which consists in subjecting said liquids to the action of an aeriform body under pressure for the purpose of stirring up the sand, and subjecting a portion of the liquid containing sand in suspension to the action of an aeriform body under pressure for the purpose of raising said liquid and sand to the surface.

2. The method herein described of removing sand from wells containing liquids, which consists in violently agitating the liquids by the aid of air-pressure, for the purpose of stirring up the sand, and violently expelling, also by the aid of air-pressure, a portion of the liquid holding particles of loose sand in suspension.

3. The method herein described of removing sand from wells, which consists in separating, by the aid of natural-gas pressure and of gravity, a body of liquid from the main body contained within the well, subjecting the body of liquid thus separated to the action of air-pressure, for the purpose of expelling said body of liquid into said main body thereof, suddenly releasing said air-pressure, for the purpose of allowing gravity to again separate said body of liquid from said main body thereof, said body of liquid thus separated now holding sand in suspension, and suddenly removing the portion of said body of liquid thus separated, thereby removing the sand it contains.

4. The method herein described of removing sand from wells, which consists in separating, by the aid of a natural-gas pressure and of gravity, a body of liquid from the main body contained within the well, subjecting the body of liquid thus separated to the action of air-pressure for the purpose of expelling said body of liquid into said main body thereof, suddenly relaxing said air-pressure, allowing gravity to again separate said body of liquid from said main body thereof, said body of liquid thus separated now holding sand in suspension, preventing retrogression of the body of liquid thus separated, and applying air-pressure beneath the surface of said body of liquid thus separated, thereby raising to the surface a portion of said liquid holding sand in suspension.

5. The method herein described of raising liquids from wells, which consists in causing said liquids to form into a column having a comparatively large diameter adjacent to its bottom, and also having a comparatively small outlet, and suddenly releasing at a comparatively low point within said column of large diameter a volume of air under high pressure, thus lengthening the portion of said column as the same passes through said outlet, and thereby forming an effective seal.

6. The method herein described of raising liquids from wells, which consists in causing said liquids to form into a column having a comparatively small outlet, and suddenly releasing a volume of compressed air at high pressure within said column at a comparatively low point relatively thereto, thereby breaking the column and causing a portion thereof to become elongated so as to make an effective seal, whereby the air-pressure raises to the surface the portion thus treated.

7. The method herein described of raising liquids from wells, which consists in causing said liquids to form into a column having a comparatively small outlet, and subjecting said column to the sudden expansion of an aeriform substance, applied at high pressure and at a point considerably below the top of said column, thereby breaking the column into two portions, one of which is forced through said small outlet becoming thereby elongated, so as to form an effective seal and thus raise to the surface of the earth.

8. The method herein described of raising liquids from wells, which consists in suddenly liberating below the level of said liquids a comparatively large volume of an aeriform substance at high pressure, thus breaking the body of liquid into two portions and forcing one of said portions through a comparatively small outlet for the purpose of forming an effective seal.

9. The method herein described of raising liquids from wells, which consists in causing said liquids to form, by the action of gravity only, into a column of comparatively large diameter, and applying air at high pressure to said column at a point below the upper level thereof, so as to force a portion of said column through a comparatively small outlet so as to become elongated and lifted to the surface of the earth.

10. The method herein described of raising liquids from wells, which consists in causing said liquids to form, into a column of comparatively large diameter, and applying air at comparatively high pressure and at a point considerably below the upper level of said column for the purpose of breaking said col-

umn and causing a part thereof to become elongated so as to form an effective seal.

11. The method herein described of raising liquids from wells, which consists in causing said liquids to form into a column of comparatively large diameter, then applying air at high pressure to a portion of said liquids for the purpose of breaking said column and causing a portion thereof to be forced through a comparatively small outlet, thus becoming elongated and raised to the surface of the earth.

12. The method herein described of raising liquids from wells, which consists in causing said liquids to accumulate into the form of a column of comparatively large diameter, and intermittently applying the air at high pressure below the upper level of said column for the purpose of breaking said column and forcing a portion through a contracted outlet, thereby causing the same to become elongated and thus form an effective seal so as to be raised to the surface of the earth.

13. The method herein described of raising liquids from wells, which consists in causing said liquids to accumulate in the form of a column of comparatively large diameter, and intermittently subjecting said column to the action of air at high pressure, thereby causing a portion of said column to be elongated so as to form an effective seal and raised to the surface of the earth.

14. The method herein described of raising liquids from wells, which consists in subjecting said liquids to the automatic pressure of a natural gas, for the purpose of elevating said liquids a portion of the distance through which the same are to be raised, and suddenly subjecting a portion of liquids thus raised to the action of an aeriform body of a high pressure for the purpose of elongating said portion of said liquid, and thereby causing the same to seal effectively whereby it may be raised to the surface by such air-pressure.

15. The method herein described of raising liquids from wells, which consists in subjecting said liquids to the automatic pressure of a natural gas for the purpose of elevating said liquids a portion of the distance through which they are to be raised, subjecting said liquids to the action of a volume of compressed air at high pressure suddenly released a considerable distance below the upper level of said liquids, thereby elevating said liquids and causing said liquids thus affected to assume an elongated form for the purpose of causing the same to seal effectively and to be elevated to the surface.

16. The method herein described of raising liquids from wells, which consists in causing said liquids to accumulate in the form of a column of comparatively large diameter and provided with a small outlet, and suddenly applying a high pressure of an aeriform body at a point located within said column and a considerable distance from the surface of said liquids for the purpose of forcing a portion thereof through said outlet, thereby elongating said portion and raising the same to the surface.

17. The method herein described of raising liquids from wells, which consists in releasing below the surface of said liquids an aeriform body at high pressure for the purpose of detaching a portion of said liquid and starting the same upward, and causing said portion of liquid as it rises to the surface of the earth to become elongated whereby its sealing is rendered more effective.

In testimony whereof we have signed our names to this specification in the presence of two subscribing witnesses.

THOMAS FRANCES MORAN.
FRED JOSEPH MOSER.

Witnesses:
E. C. ANDERSEN,
HUGH W. MILLIN.