W. D. HUFF.

OPERATING AND RECLAIMING OIL WELLS.

APPLICATION FILED JAN. 11, 1916.

1,200,423. Patented Oct. 3, 1916.

Fig. 1.

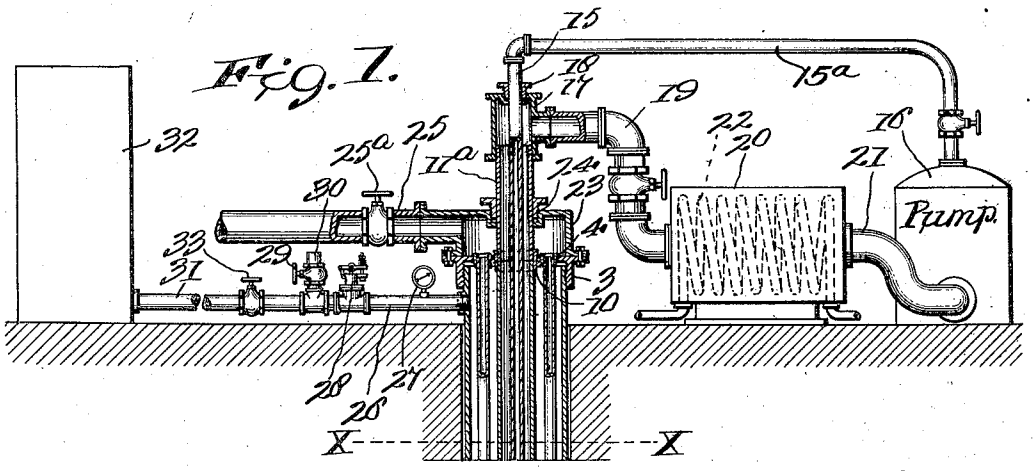


Fig. 2.

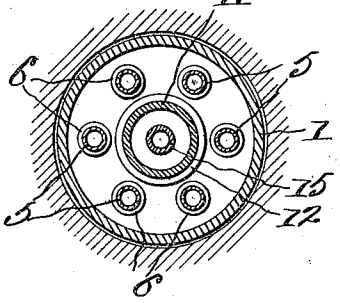


Fig. 3.

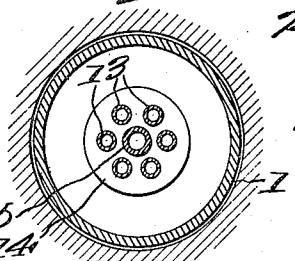


Fig. 4.

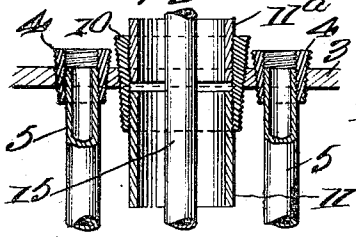


Fig. 5.

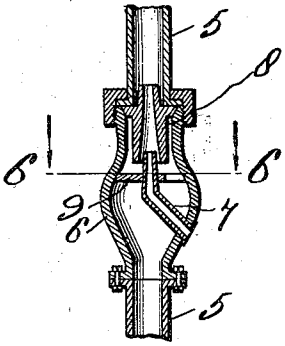
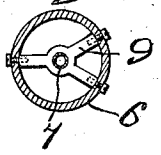


Fig. 6.



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UNITED STATES PATENT OFFICE.

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OPERATING AND RECLAIMING OIL-WELLS.

1,200,423. Specification of Letters Patent. Patented Oct. 3, 1916.

Application filed January 11, 1916. Serial No. 71,596.

To all whom it may concern:

Be it known that I, WILLIAM D. HUFF, a citizen of the United States, residing at La Fayette, in the parish of Lafayette and State of Louisiana, have invented certain new and useful Improvements in Operating and Reclaiming Oil-Wells; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My present invention relates to improvements in operating and reclaiming oil wells.

It is well known that in operating oil wells after a certain period of flow the oil begins to thicken around the opening into the well, due to the presence of paraffin, or other causes, and in course of time the oil stops flowing; and it is the purpose of my present invention to expedite the flow of oil in those wells in which this flow has already begun to diminish, and to reclaim those oil wells in which the flow has already ceased, due to the causes aforesaid.

According to my present invention I heat the interior of the well near the bottom with any hot fluid, such, for instance, as air, which is preferably used in the regenerative way, as will be hereinafter described; and this heat not only serves to thin the oil in the veins, permitting it to flow from the oil-bearing strata into the well, but also generates steam or other gas pressure in the well, which depresses the liquid in the well from the static head down to a point below a series of steam ejectors, carried by pipes mounted in the well, which add the dynamic effect of the ejector to the lifting effect of the pressure in the well, and thus lift the oil or other liquid in the well through the casing and deliver it to a delivery pipe, as will be hereinafter more fully described.

My invention will be more clearly understood by reference to the accompanying drawings, in which similar parts are indicated by similar reference symbols throughout the several views, and in which:—

Figure 1 shows a central vertical section through the well casing, and illustrates the entire apparatus, parts being shown in elevation and parts diagrammatically; Fig. 2 shows a section along the line 2—2 of Fig. 1, and looking in the direction of the arrows; Fig. 3 shows a section along the line 3—3 of Fig. 1, and looking in the direction of the arrows; Fig. 4 is an enlarged view of a portion of the device shown in Fig. 1, and shows part of the closed head of the well casing with its connections; Fig. 5 is an enlarged view of the ejector shown in Fig. 1; and Fig. 6 shows a section along the line 6—6 of Fig. 5, and looking in the direction of the arrows.

The well casing 1 is constructed in the usual way, and is provided with perforations 2 near its lower end, or with a suitable screen such as is well known in the art. This casing 1 is closed at the top with a screw cap 3, provided with a series of tapered screw couplings 4, screwed into said cap, and provided with internal screw threads adapted to engage the screw threads at the upper ends of the lifting pipes 5. Near their lower ends these pipes 5 are provided with an enlarged chamber 6, having an inlet nozzle 7 for directing steam or gas pressure upward through the nozzle 8, and this nozzle 7 is steadied and centered in the chamber 6 in any convenient way, as by means of the three-legged spider 9, such form of spider being used since it can be readily assembled in the chamber 6; but said spider may be cast integral with said chamber if desired.

Mounted in the central portion of the head 3 is a larger tapered screw coupling 10, externally threaded to engage in the head 3, and internally threaded to engage the two members 11 and 11^a of the return pipe for the heating fluid. This return pipe projects down into the center of the well, and is provided with a coupling 12, having a head 12^a into which the upper ends of the heating pipes 13 are secured, the lower ends of said pipes being secured in the head 14^a of the closed chamber 14. The heating fluid supply pipe 15 passes through these heads 14^a and 12^a, and also through the stuffing box 18 at the top of the apparatus, and is connected by the pipe 15^a to the force pump 16. Heating fluid, such as hot air, is forced from said pump through the pipe 15^a and down through the pipe 15 into the chamber 14, whence it rises through the heating pipes 13 and enters the chamber 12, whence it rises through the annular space between the pipes 11 and 15 and enters the union 17, passing through the pipe 19 to any suitable heater 20, and from this heater it is delivered by the pipe 21 to the pump 16. Any

suitable heater may be used, but I have shown a heater provided with a steam coil 22, shown in dotted lines in Fig. 1.

Above the closed head 3 of the well casing I provide a chamber 23, into which the upper ends of the lifting pipes 5 open, and this chamber is connected to the delivery pipe 25, controlled by the valve 25ª, which delivery pipe leads to a suitable reservoir (not shown), or other point of delivery of the liquid pumped from the well.

The upper part of the well casing below the closed cap 3 is provided with a pipe 26, having a pressure gage 27, a safety valve 28, and a valve 29 closing the pipe 30, open to the atmosphere, so that the pressure may be automatically relieved when it becomes excessive on the interior of the well casing, or may be relieved by opening the valve 29, when desired. This pipe 26 may be also connected to any suitable pipe 31, connected to a source of water or crude oil supply 32, which pipe 31 is controlled by the valve 33. Thus if it be desired to charge the well with crude oil or water, this may be accomplished by opening the valve 33, having previously relieved the pressure on the interior of the well casing by means of the valve 29 and pipe 30.

The operation of the device is as follows: The normal static head of liquid in the well, composed either of crude oil, or water, or both, would ordinarily be indicated by the line X—X in Fig. 1. Now start the pump 16, and the heater 20, and the hot air, or other fluid, will be pumped down through the pipe 15, to the chamber 14, located near the bottom of the well, from thence the hot fluid will rise through the heating pipes 13, and, entering the chamber 12, will pass up through the annular space between the pipes 11 and 15, and will be sucked back into the heater 20 by the suction end of the pump, and being heated in returning to the pump will be delivered to the pipe 15, and the flow of the heating fluid will be continued indefinitely.

While I have described air as the preferred form of heating fluid, it will be obvious that water, steam, or other heating fluids, may be used if desired. As the flow of the heating fluid continues, the liquid in the well casing surrounding the pipes 13 will be heated, and this hot liquid flowing through the screen at the bottom of the well will enter the oil-bearing strata, and will thin the same, permitting the oil to flow more freely. As the pressure increases on the interior of the well casing, steam and other gases will be generated, which, rising in the interior of the well casing beneath the closed cap 3, will accumulate under pressure, and will force the level of the liquid in the interior of the well casing from the line X—X downward, until the level of the liquid arrives at a point substantially indicated by the line Y—Y just below the ejector chamber 6. Meantime, of course, the liquid from the well will have risen to a corresponding height in the pipes 5, so as to obtain static equlibrium. As soon as the level of the liquid passes below the nozzle 7, the steam and other gases generated will rush in through those nozzles and will tend to further lift the liquid in the pipes 5, until it reaches the chamber 23 and passes through the delivery pipe 25, being carried to the point of destination, not shown. This process will continue indefinitely, so long as the flow of the heating liquid is maintained, and so long as the well continues to flow. If the well ceases to flow, or flows slowly, it may be desirable to relieve the pressure on the interior of the well casing, which may be done by opening the valve 29 and permitting the pressure to escape through the pipe 30, at which time the liquid in the well will return to the then existing static head. By having the circuit for the heating fluid closed, as shown, a great economy in heat is secured.

In order to prevent excessive pressure in the well casing, which might endanger the apparatus, I provide the pipe 26, provided with a pressure gage 27 and a safety valve 28, and this pipe 26 is also connected to the pipe 30 controlled by the valve 29. It frequently may be desirable in reclaiming old wells to supply the interior of the casing with a sufficient amount of liquid to be used in thinning the oil at the bottom of the well, and also in generating the steam and gas pressure needed to operate the ejectors, and for this purpose the pipe 26 may be connected by a suitable pipe 31 to any source of liquid supply 32. This source of liquid supply may be either crude oil, or water, preferably crude oil, and the pipe 31 may be connected to or cut off from the pipe 26 by means of the valve 33. Thus, when it is desired to charge the well with liquid, the valve 33 is opened and the liquid flows from the reservoir 32 into the well casing, rising to the desired height in the well, after which the heating fluid is turned on and the operation of heating the liquid in the well is inaugurated. The liquid so supplied will be heated, as already described, and will thin the oil in the oil-bearing strata, and will start the oil to flowing, and after the well casing has filled up with liquid to a suitable height the process of delivering the liquid from the well casing to the pipe 25 will be resumed. Thus it will be seen that I provide an apparatus which can be used to expedite the flow of liquid in sluggish wells, and also to reclaim wells, the oil-bearing strata of which have become clogged up.

While I have described the use of heated air as the heating medium, it will be seen

that hot water, or other heated fluid, may be used for conveying the heat to the liquid in the well for the purpose of thinning the oil in the oilbearing strata, and for generating the gas pressure in the well, whereby the ejectors are operated.

In practice I prefer hot air in the system as herein described, because the air being compressed by the pump after leaving the heater is thereby still further heated, and moreover the supply of air may be always replenished from the atmosphere. Moreover, where the well is deep there would be practically no energy wasted in lifting the return supply of air from the bottom of the well to the heater; whereas, if a liquid were used as the heating medium, considerable force would be required to lift the liquid up from the bottom of a deep well to the heater. For these and other reasons I prefer to use air as the heating medium where the wells are of any appreciable depth. By using the tapered screw connections 4 and 10 (see Figs. 1 and 4) the enlargements 6 on the pipes 5, and 12 and 14 on the pipe 13 can pass freely through the cap before the screw connection is put in place.

While I have shown six lifting pipes 6 and six heating pipes 13, the number of these pipes may be varied at will. Moreover, any suitable form of heaters may be used in place of the heaters 15 and 20. Moreover, various modifications might be made in the herein described apparatus and in the construction, combination and arrangement of parts which could be used without departing from the spirit of my invention.

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

1. In an oil well the combination with a casing and a closed cap therefor, of a series of pipes projecting down through said closed cap and each provided with an ejector opening into the interior of said casing and adapted to direct steam and gas under pressure upward through said pipes, a heating fluid return pipe projecting down through said cap and nearly to the bottom of the well, a fluid heater carried by said return pipe, and a supply pipe for the heating fluid passing through said return pipe and delivering heated fluid to said fluid heater, substantially as described.

2. In an oil well the combination with a casing and a closed cap therefor, of a series of pipes projecting down through said closed cap and each provided with an ejector opening into the interior of said casing and adapted to direct steam and gas under pressure upward through said pipes, a heating fluid return pipe projecting down through said cap and nearly to the bottom of the well, a fluid heater carried by said return pipe, a supply pipe for the heating fluid passing through said return pipe and delivering heated fluid to said fluid heater, a pump for delivering heated fluid to said supply pipe, a return main connecting said fluid return pipe and said pump, and a heater located in said return main whereby a regenerative heating system is provided, substantially as described.

3. In an oil well the combination with a casing and a closed cap therefor, with means for supplying liquid to the interior of said casing, of a series of pipes projecting down through said closed cap and each provided with an ejector opening into the interior of said casing and adapted to direct steam and gas under pressure upward through said pipes, a heating fluid return pipe projecting down through said cap and nearly to the bottom of the well, a fluid heater carried by said return pipe, a supply pipe for the heating fluid passing through said return pipe and delivering heated fluid to said fluid heater, a pump for delivering heated fluid to said supply pipe, a return main connecting said fluid return pipe and said pump, and a heater located in said return main whereby a regenerative heating system is provided, substantially as described.

4. In an oil well the combination with a casing and a closed cap therefor, of a series of pipes projecting down through said closed cap and each provided with an ejector opening into the interior of said casing and adapted to direct steam and gas under pressure upward through said pipes, and means for generating heat in said casing, said means comprising a heater for heating air, a pump drawing hot air from said heater, an air-delivery pipe leading from said pump nearly to the bottom of the well, an air heater receiving the hot air from said pipe, and a return pipe inclosing said hot air-delivery pipe for returning the air after leaving the heater in the well to said first-mentioned heater, substantially as described.

5. In an oil well the combination with a casing and a closed cap therefor, of a series of pipes projecting down through said closed cap and each provided with an ejector opening into the interior of said casing and adapted to direct steam and gas under pressure upward through said pipes, and means for generating heat in said casing, said means comprising a heater for heating air, a pump for drawing hot air from said heater, a hot air delivery pipe leading from said pump down in the well below the oil-bearing strata, a return pipe inclosing said hot air delivery pipe, and connected to said heater, and an air heater for heating the liquid in the well interposed between the lower end of said hot air delivery pipe and said return pipe, substantially as described.

6. In an oil well the combination with a casing and a closed cap therefor, of a series of pipes projecting down through said closed cap and each provided with an ejector opening into the interior of said casing and adapted to direct steam and gas under pressure upward through said pipes, and means for generating heat in said casing, said means comprising a heater for heating air, a pump for drawing hot air from said heater, a hot air delivery pipe leading from said pump down in the well below the oil-bearing strata, a return pipe inclosing said hot air delivery pipe, and connected to said heater, and a series of heating pipes for heating the liquid in the well interposed between the lower end of said hot air delivery pipe and said return pipe, substantially as described.

7. In an oil well the combination with a casing and a closed cap therefor, of a series of pipes projecting down through said closed cap and each provided with an ejector opening into the interior of said casing and adapted to direct steam and gas under pressure upward through said pipes, and means for generating heat in said casing, said means comprising a heater for heating air, a pump for drawing hot air from said heater, a hot air delivery pipe leading from said pump down in the well below the oil-bearing strata, a return pipe inclosing said hot air delivery pipe, and connected to said heater, a hot air chamber receiving the heated air from the lower end of said hot air delivery pipe, and a series of pipes connecting said chamber with the lower end of said return pipe, substantially as described.

8. In an oil well the combination with a casing and a closed cap therefor, and means for delivering liquid to the interior of said casing, of a series of pipes projecting down through said closed cap and each provided with an ejector opening into the interior of said casing and adapted to direct steam and gas under pressure upward through said pipes, and means for generating heat in said casing, said means comprising a heater for heating air, a pump drawing hot air from from said heater, an air-delivery pipe leading from said pump nearly to the bottom of the well, an air heater receiving the hot air from said pipe, and a return pipe inclosing said hot air delivery pipe for returning the air after leaving the heater in the well to said first-mentioned heater, substantially as described.

9. In an oil well the combination with a casing and a closed cap therefor, and means for delivering liquid to the interior of said casing, of a series of pipes projecting down through said closed cap and each provided with an ejector opening into the interior of said casing and adapted to direct steam and gas under pressure upward through said pipes, and means for generating heat in said casing, said means comprising a heater for heating air, a pump for drawing hot air from said heater, a hot air delivery pipe leading from said pump down in the well below the oil-bearing strata, a return pipe inclosing said hot air delivery pipe, and connected to said heater, and an air heater for heating the liquid in the well interposed between the lower end of said hot air delivery pipe and said return pipe.

10. In an oil well the combination with a casing and a closed cap therefor, and means for delivering liquid to the interior of said casing, of a series of pipes projecting down through said closed cap and each provided with an ejector opening into the interior of said casing and adapted to direct steam and gas under pressure upward through said pipes, and means for generating heat in said casing, said means comprising a heater for heating air, a pump for drawing hot air from said heater, a hot air delivery pipe leading from said pump down in the well below the oil-bearing strata, a return pipe inclosing said hot air delivery pipe, and connected to said heater, and a series of heating pipes for heating the liquid in the well interposed between the lower end of said hot air delivery pipe and said return pipe, substantially as described.

11. In an oil well the combination with a casing and a closed cap therefor, and means for delivering liquid to the interior of said casing, of a series of pipes projecting down through said closed cap and each provided with an ejector opening into the interior of said casing and adapted to direct steam and gas under pressure upward through said pipes, and means for generating heat in said casing, said means comprising a heater for heating air, a pump for drawing hot air from said heater, a hot air delivery pipe leading from said pump down in the well below the oil-bearing strata, a return pipe inclosing said hot air delivery pipe, and connected to said heater, a hot air chamber receiving the heated air from the lower end of said hot air delivery pipe, and a series of pipes connecting said chamber with the lower end of said return pipe, substantially as described.

In testimony whereof, I affix my signature.

WILLIAM DANIEL HUFF.