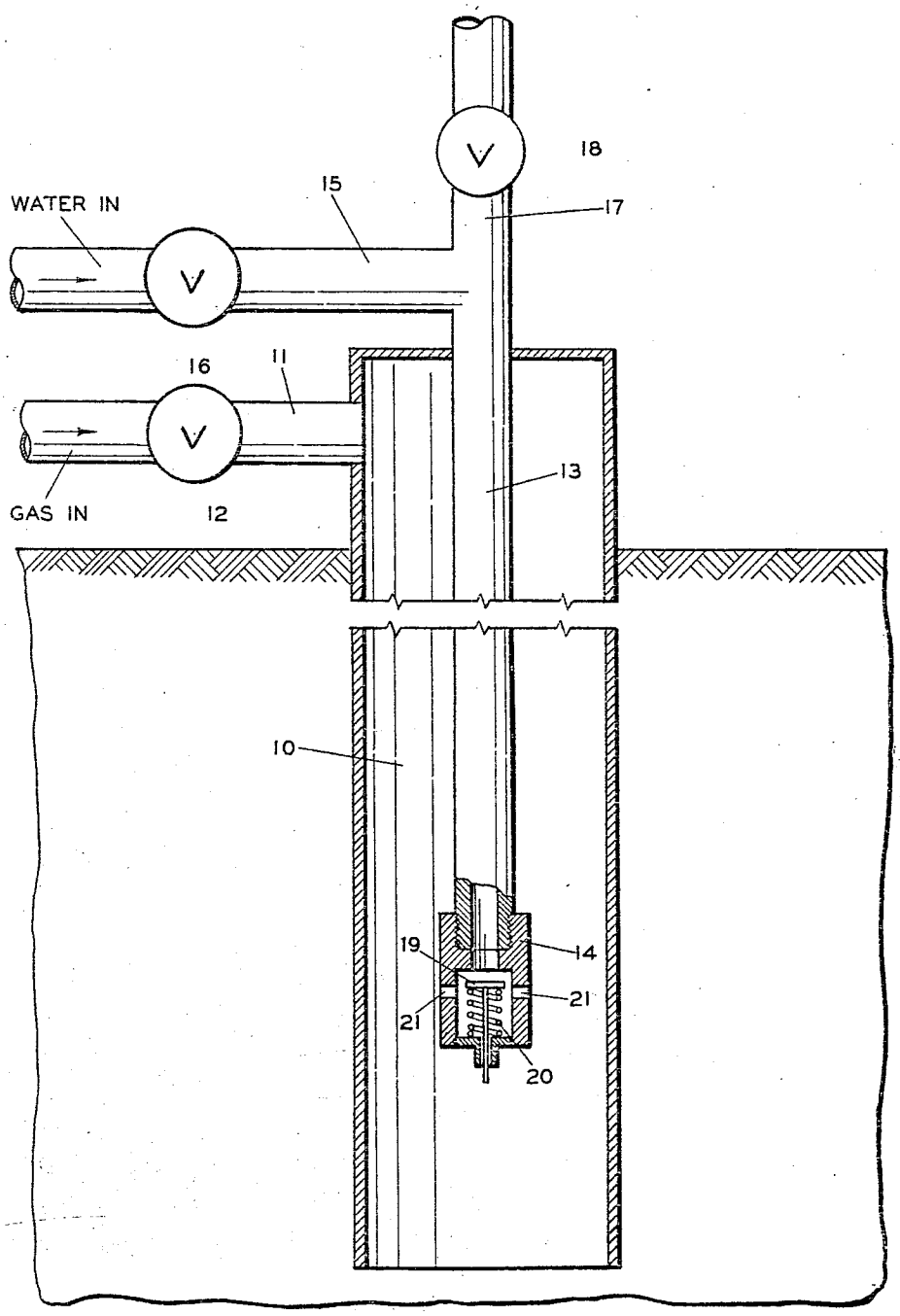
July 4, 1950 W. J. ROBERTS 2,514,259

METHOD AND APPARATUS FOR INJECTING WATER OR OTHER LIQUIDS INTO GAS INPUT WELLS

Filed Nov. 23, 1943



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Patented July 4, 1950 2,514,259

UNITED STATES PATENT OFFICE

2,514,259

METHOD AND APPARATUS FOR INJECTING WATER OR OTHER LIQUIDS INTO GAS INPUT WELLS

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Application November 23, 1943, Serial No. 511,494

4 Claims. (Cl. 166—1)

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The invention relates to a method and apparatus for injecting water or other liquids into gas input wells.

In the oil producing art, it is now common practice to return to the producing strata, part or all of the gas produced in a given field, in order that the original pressure of the field may be conserved as much as possible and the yield of crude oil is thereby greatly prolonged. It is also common practice to introduce gas from a nearby or even a remote field into a so-called input well located in the field to be treated.

It has under certain circumstances been found advantageous to also introduce water into certain old fields which are being produced under gas drive, and this ingestion of water has customarily been accomplished by the use of pumps driven by any convenient prime mover. The water, in the case of a gas drive installation, is introduced for the purpose of preventing or minimizing the tendency of the input gas to channel the formation and disturb nearby offset wells which may or may not belong to the company operating the input well.

Due to the uncertainty as to the amount of water input that will be necessary to safeguard the formation, the selection of a proper size of pump is largely a matter of guesswork and the operator often finds that the original pump must be replaced by a larger one, or else the original pump chosen is unnecessarily large and must be choked down or else replaced by a smaller, less expensive pump. In any event, the investment represented by any pump regardless of size or type is appreciable, and a great saving may be realized by the use of the present invention which eliminates the use of any pump.

The invention has for an object, the injection of water to an oil bearing formation, for any purpose known to the art at a minimum of cost for installation and operation of the input well.

Another object of the invention is to provide for control of the rate of water input over a large range of flow without alteration of the original installation.

Other objects and advantages will be recognized by considerations of the following specification and the drawing forming a part thereof.

In the drawing, which is a condensed sectional view of a well bore fitted in accordance with the invention, the numeral 10 indicates a casing which is fitted with an inlet 11 for introduction of gas under pressure, the inlet usually being provided with a control valve 12. It is pointed out here that in the past, it has been customary

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to inject water into the conduit 11 or correspondingly into the top of the casing 10 by means of a pump. In accordance with the invention, however, there is placed within the casing a string of tubing 13 fitted with a back-flow check valve 14 at the lower end thereof. It must be understood that the tubing 13 need not run all the way to the bottom of the well, need only be run to a depth such that, when filled with water to a point at or near the surface of the ground, the pressure at valve 14 due to the head of water will exceed the gas pressure in casing 10 by an amount at least equal to the closing force of the valve spring. The level of valve 14 in the casing 10 hence may be near the bottom of the well bore or not, depending upon the relationship between the depth of the well and the pressure existing in the field at the time pressure flooding is to be adopted.

The water supply line 15 is fitted with a valve 16 for adjusting the rate of water input. The tubing 13 may be continued upwardly as at 17 and fitted with a gate valve 18, if desired, for purposes to be discussed later.

The check valve 14 may be of any approved type, the principal considerations being that the valve disc 19 should open by pressure applied from above and should close when a superior pressure exists below. It preferably should have a spring 20 urging the valve disc upwardly, or toward the closing position. A ball valve could as well replace the type generally illustrated. In either case, outlets 21 are provided in sufficient size and number to provide the required flowway.

In operation, gas at the desired pressure is supplied from line 11 to the interior of casing 10. Water from a reservoir, lake, treating plant or any available source is introduced to tubing 13 from line 15 and under control of valve 16. At first valve 14 will be closed due to the combined forces of spring 20 and of gas pressure in the casing upon the lower side of the disc or ball) 19. Since a column of water 2.31 feet in height exerts a pressure of one pound per square inch, as tubing 13 becomes filled, the head of water will become great enough to overcome the gas pressure plus the spring pressure and valve member 19 will open, allowing the water to enter the well. The valve member 19 will assume a position or degree of opening proportional to the degree of opening of valve 16, within the range of loading of spring 20. Beyond the range of the spring, that is, when it is fully compressed and valve 14 is fully open, the flow will be in proportion to

opening of valve 16 due to the increase or decrease of head of the water column in tubing 13. Thus the rate of water input is adjusted from the surface of the ground by manipulation of valve 16. When it is desired to cease injection of water, the same may be accomplished by closing valve 16, after which valve 14 will automatically close as soon as the head of water in tubing 13 becomes less than the gas pressure in casing 10.

The level of water in casing 10 will ordinarily be below the valve 14 and flow is continuous through the tubing 13 as the water is forced into the formation by gas under pressure admitted through passage 11. During operation, pressure in casing 10 is maintained above the formation pressure.

In the event it becomes necessary to pull tubing 13 to repair valve 14 or for any other reason, a small portable compressor may be connected to valve 18. By opening this valve and operating the compressor, the column of water standing in tubing 13 may be expelled through valve 14 to the casing 10 against the casing or well pressure. The tubing 13 may then be pulled while empty much more easily than if it were filled with water.

What is claimed is:

1. An apparatus for injecting water into a subterranean oil formation against high gas pressure existing therein, comprising a well casing sealed in the well bore and having a closure at its upper end, means for supplying gas to said casing at a substantially constant rate, a pipe extending through said closure so as to lie within said casing, means for supplying water to said pipe at a controlled rate, and a spring pressed downwardly opening check valve at the lower end of said pipe for supporting a column of water in the pipe; whereby due to spring pressure said valve will not open unless the pressure in said casing falls below the pressure in said pipe by an amount at least equal to the closing force of said spring, whereby water is injected into said formation, said pipe extending towards but terminating short of the formation.

2. An apparatus for intermittently injecting water into a high pressure oil well comprising in combination a pair of concentric tubes the outer of which provides a well casing sealed in said formation and having a closure at the upper end,

said inner tube extending through said closure in sealed relation thereto, means for supplying gas to said casing at a substantially constant rate, means for maintaining a substantially constant head of water in the inner of said tubes, and a spring closed, downwardly opening check valve at the lower end of said inner tube, whereby water is discharged from said inner tube into said well whenever the pressure in said well falls substantially below the hydrostatic pressure of the column of water held in said inner tube by said valve.

3. The method of injecting water into a gas-tight well containing gas pressure during a gas drive in a gas driven oil field to reduce gas by-passing for at least a time, which comprises in combination the steps of injecting gas under pressure into said well, injecting water into said well against said gas pressure by gravity, and restraining the entrance of water unless its gravity head exceeds said gas pressure by a substantial amount, whereby blowing of gas into said gravity head of water is substantially eliminated.

4. A method of reducing gas by-passing while gas driving a subterranean oil formation, comprising the steps of supplying gas at a substantially constant rate to a subterranean oil formation under pressure and injecting water into said formation from a water column when the pressure in said formation falls a predetermined amount below the gravity head of said water column.

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