

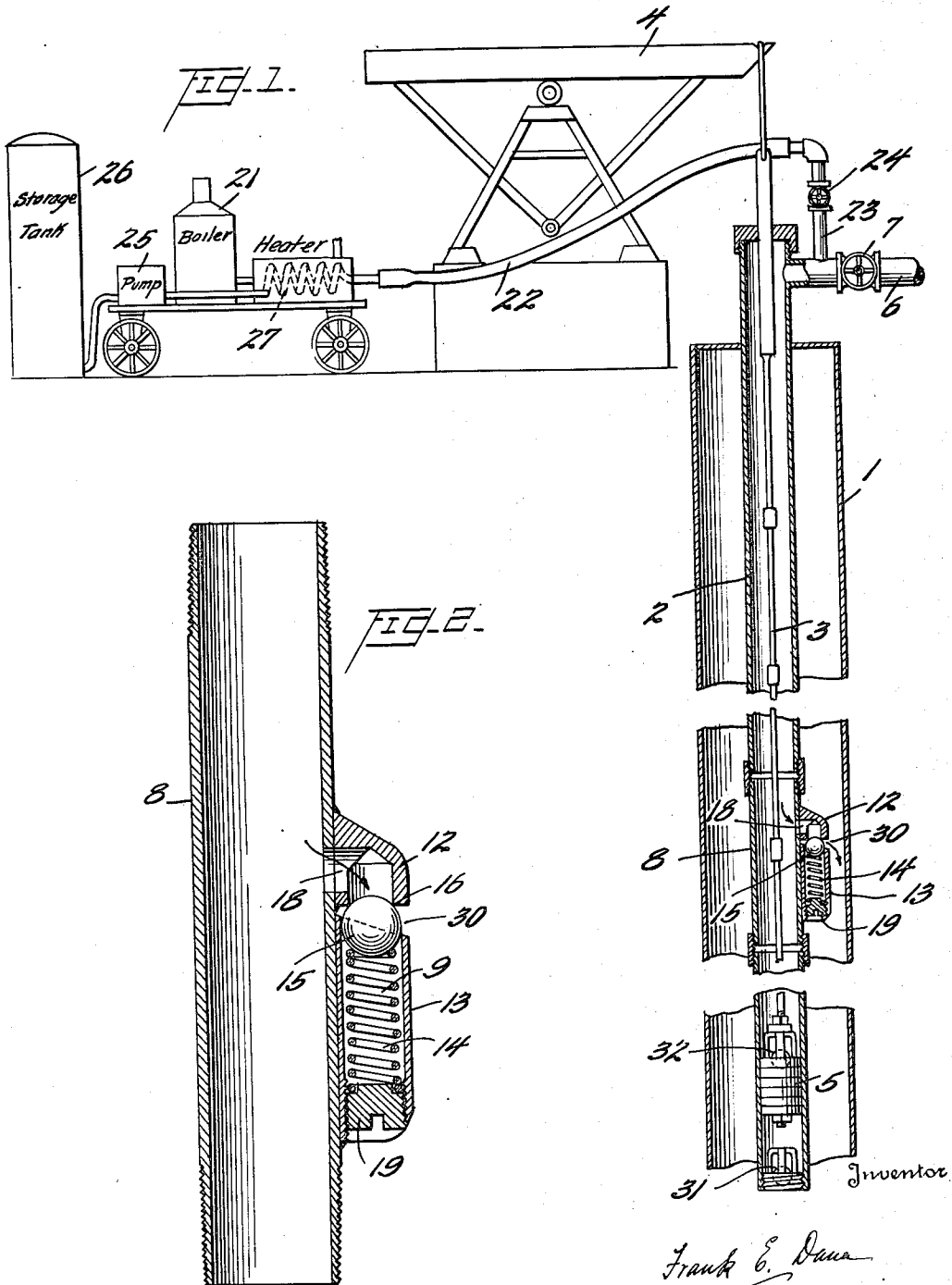
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METHOD FOR CLEANING OIL WELLS

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METHOD FOR CLEANING OIL WELLS

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This invention relates to a method for cleaning oil wells, and more particularly, for removing paraffin deposited on the inside of the tubing or oil discharge pipe and outside of sucker rods. As is well known to those skilled in the art, considerable difficulty is encountered in the operation of oil wells by reason of the accumulation on the inside of the tubing and on the outside of the sucker rods of deposits of paraffin. In the course of the normal pumping operation, a point is reached, sooner or later, when the obstruction caused by these deposits is such, that the well has to be shut down and the paraffin deposits cleared away. Obviously, this occasions loss of production time, which is particularly serious in the case of some of the paraffin removing systems previously employed. That is, the procedure in the case of some of the cleaning operations required the removal of the sucker rods from the tubing, which is necessarily a slow operation. Also, other cleaning systems hitherto proposed involved the use of additional equipment, some of which had to be installed or introduced into the well proper, thus again involving considerable expense and loss of time. A further disadvantage of paraffin removing system using a solvent medium, resided in the fact that, the solution of paraffin in the solvent medium, resulting from the cleaning operation, was permitted to escape into the well proper, thus eventually leading to the obstruction of the producing sands and to a reduced output.

The paraffin removing system forming the object of the present invention has been devised with a view of eliminating the drawbacks of the prior methods. By means of the present invention, wells can be cleared of their paraffin deposits in a rapid and inexpensive manner, with a minimum loss of production time, utilizing the tubing already installed in the well and the associated pumping equipment. As will appear below, the structure of the well tubing and related equipment is rendered instantly available for the deparaffining operation by including in the original well tubing a simple and inexpensive release valve, which thereafter forms a permanent part of the installation.

In order that my invention may be clearly understood, it should be pointed out that paraffin usually deposits in well tubing all the way from the top of the well to a depth of 1000 to 2000 feet, depending upon the characteristics of the oil field. In the practice of my invention, a spring controlled release valve is installed in the tubing of the well at a point which is approxi-

mately 1000 feet beneath the lowermost paraffin deposit. The procedure in cleaning a well is briefly as follows: The well pump is shut off and hot oil or equivalent paraffin melting or solvent medium is forced down through the top of the tubing in quantity sufficient to displace all of the cold oil in the tubing which is present therein above the release valve. The oil is forced down at such a pressure, that the release valve is opened and the cold oil is discharged into the annular space between the tubing and casing and down into the bottom of the well. Inasmuch as substantially cold oil only is discharged into the casing, there is no danger of any appreciable quantity of paraffin reaching the lower end thereof and, hence, the oil strata. When all of the cold oil above the release valve has been discharged into the casing, as stated above, the introduction of hot oil, or other deparaffining fluid, into the tubing is discontinued, the release valve closes automatically and the hot oil is permitted to stand in the tubing for a length of time sufficient to melt the accumulated paraffin off the tubing and the sucker rods. At the end of this period, the usual well pump is set in operation, and the solution or mixture of molten paraffin in oil is pumped out of the tubing through the top thereof and is discharged into any suitable receiver.

It will be seen, therefore, that my method does not involve pulling of the tubing, the use of additional equipment or the continuous circulation of cleaning media, all of which are attended by loss of time and expense. My procedure simply involves a method wherein a deparaffining fluid is introduced through the top of the tubing in quantity sufficient to form in the tubing a column of deparaffining fluid considerably more extensive than the region in the tubing in which the paraffin accumulations occur; the oil displaced by the deparaffining fluid column is discharged from the tubing at a point considerably below the lowermost region of paraffin deposits. When all such oil has been discharged from the tubing the introduction of the deparaffining fluid is discontinued, and the fluid remains in the tubing until the accumulated paraffin has become displaced from the tubing wall and dispersed in the column of deparaffining fluid, whereupon the fluid with its paraffin content is discharged through the top of the tubing.

The invention will be described in greater detail by reference to the annexed drawing in which,

Figure 1 is a diagrammatic representation of

a well provided with the necessary equipment to carry out the present invention, the casing of the well being shown on an enlarged scale, in order that certain details may be more readily apparent.

Figure 2 is a cross-section through the coupling member, or portion of tubing carrying a preferred form of a release valve.

In the following description of the method of this invention, it is to be understood, that various deparaffining media or fluids may be utilized and, therefore, I shall describe the invention in connection with the use of hot oil, which is an inexpensive and convenient deparaffining material. In lieu of hot oil, fluids having a solvent action or effecting removal of paraffin from the tubing wall by chemical action may be employed.

Referring to the drawing, 1 designates portions of a well casing inside of which is arranged in the usual manner the tubing or discharge pipe 2. Inside the tubing, the sucker rods 3 are reciprocated in the usual manner by the pumping jack 4, thus operating the pump 5, and lifting to the surface the oil which is discharged to storage through the line 6 controlled by the valve 7.

The coupling member 8, carrying the release valve, generally designated as 9, is installed in the tubing at a point which is approximately about 1000 feet lower than the lowest known or estimated deposit of paraffin in the tubing. Referring more particularly to Figure 2: The coupling member is connected to the tubing in any suitable manner, as by threaded joints. On one side thereof it is provided with the housing 13 for the ball valve 15 and the spring 14, which normally retains the valve against its seat 16. The valve housing is connected to the coupling members by means of passage 18, which is suitably dimensioned to permit the desired volume of flow past the ball valve 15. At its lower end, this housing is suitably closed off by the threaded plug 19 which likewise serves to adjust the compression of the spring 14. The overall width of the coupling member is such, as to permit its ready insertion inside of the casing and, in order to prevent the housing from hanging on obstructions while going in or coming out of the casing, the top and bottom ends thereof are suitably rounded off as at 12. The coupling member and its associated parts are made of materials which are suitable to withstand the particular conditions existing in the well where the device is installed. Further, while Figure 2 shows the valve housing as a separate unit and attached to the coupling member, as by welding, it is obvious that the housing assembly can be made integral with the coupling member.

The equipment necessary for the paraffin removing operation is completed by the provision of a portable heating unit, comprising a boiler 21 and a heat exchanger 27, connected by a hose 22, to a bleeder pipe 23 which joins onto the main oil discharge line 7 to the storage tank through a control valve 24. A high pressure pump 25 is provided to take the fluid to be used in the cleaning operation—generally oil—from a storage tank 28 and force it through the heater 27.

In practicing the invention, when it becomes necessary to clean well tubing of paraffin, the well pump is stopped and the valve 7 connecting the tubing to the storage tank is closed off. The portable heating unit and high pressure pump are now brought up to the well and the heater is connected to the bleeder pipe 23; the valve 24 in

this pipe is opened and the high pressure pump is started to force fluid—oil—from the storage tank through the heater 27 and then down into the tubing through the top thereof. As the hot oil is forced in through the top, the pressure applied by the pump to the oil together with weight of the column of oil in the tubing above the release valve will overcome the force of the spring 14, normally retaining the valve 15 against its seat, the compression of the spring having been originally adjusted with due regard to the height of the column and the pump pressure. When the release valve opens, cold oil will be discharged through the outlet 30 to the annular space between the tubing and casing, eventually reaching the bottom of the well. As mentioned before, the release valve is installed a considerable distance beneath the lowermost paraffin deposit area, and only sufficient hot oil is injected into the tubing to substantially replace the cold oil above the release valve, but no more. This is an important point and, inasmuch as the volume of the cold oil in the tubing above the release valve can readily be calculated, it is therefore feasible to avoid the injection of a quantity of hot oil greater than that necessary to replace such volume. The displacement of the cold oil above the release valve leads to two important results: First, the oil discharged into the casing through the release valve, consists of cold oil only, is free of any increase in paraffin content, so that the return of such oil underground will not occasion any further difficulty by reason of clogging of the production sands. Second, the large volume of hot oil introduced into the tubing, extending as it does over a region appreciably greater than the paraffin deposit area and enhanced by the increased capacity of the clean tubing in the last thousand feet thereof, will facilitate the rapid melting and removal of the paraffin deposits, by reason of the large quantity of heat contained in the injected hot oil.

Since the amount of paraffin that is deposited in the tubing varies in different oil fields, it is not possible to state precisely the amount of hot oil that is to be used in all cases. The amount of oil which is to be displaced by the injected hot oil and which is to be estimated, will depend on length of tubing, tubing size, sucker rod size and volume in cubic inches or gallons of paraffin to be melted. The paraffin volume is estimated from past cleaning operations. A factor which is also to be taken into consideration in the selection of the particular equipment to be used in carrying out my invention, is the resistance offered to the injection of hot oil by reason of the obstruction to flow created by the paraffin deposits. The particular equipment which is used in my operations is capable of injecting 2 to 20 barrels of oil per hour, at any temperature deemed necessary from 150° F. to 500° F.

As the piston of hot oil is forced down by the high pressure pump, forcing the cold oil ahead of it and out through the release valve, the paraffin deposits start to melt and become intimately mixed with the oil through the entire length of the heated oil column. When the desired quantity of hot oil has been introduced into the tubing, valve 7 is opened and a sufficient volume of hot oil is injected in flow line or pipe 6, to clean this line to storage. The injection of the hot oil by the high pressure pump is then discontinued and valve 24 is closed. Usually, the accumulated paraffin has during the

injection period become dislodged, molten, and distributed in the injected hot oil; the well pump 5 is therefore immediately put back in operation to discharge the hot oil with its molten paraffin in solution through the top of the tubing and line 6 to any suitable point. The cleaning operation described herein, not only removes the paraffin from the inside of the tubing and off the sucker rods, but also cleans the tank line 6 of paraffin deposits.

In this connection, it should be pointed out that the paraffin to be removed is a constituent of paraffin base crude oils; the percentage of paraffin content varies in different districts, but is known to vary in content from 2% to 20%. The paraffin accumulates on the walls of the tubing and sucker rods during producing periods—varying from weeks to years—and deposits in those areas, where the oil reaches lower temperatures due to the presence of cold water around the casing at points above the oil formations. Tests have proven that even when the total volume of paraffin melted by the hot oil is as high as 25% of the total volume, the paraffin dispersed in the oil will remain therein and will not reset on the sucker rods or tubing and can be brought to the surface of the well, even though the temperature of some of the injected hot oil, when it reaches the surface, has fallen to 68° F.—70° F., which is approximately the producing temperature; note that ordinarily, paraffin melts in hot oil at about 145° F. The important result that flows from this fact is, that the pumping out of the injected hot oil and its paraffin content need not be speeded up unduly, which avoids overloading of the pumping equipment.

The simplicity and ease of operation of my novel system of paraffin removal will be apparent from a reading of the foregoing description. The only additional piece of equipment necessary in the well proper is the release valve with its associated coupling member, and this is readily installed with the tubing. The well pump itself is used for discharging the molten or dissolved paraffin, through the top of the tubing and the method of operation is such, that return of the molten or dissolved paraffin to the bottom of the well is completely precluded. My method of operation avoids the necessity of withdrawing the sucker rods, the well pump, or even of the tubing sections, with the attendant loss of production time, as was frequently the case heretofore in the cleaning of wells. Further, the release valve serves an addition and useful purpose: It occasionally happens that by reason of circumstances, the cleaning of the well is neglected for some time; the tubing then becomes so choked up with paraffin deposits, that a high resistance or back pressure is created to the lift of the column of the oil raised by pump in the tubing. The back pressure thus created is frequently sufficient to damage the well pump and to cause the tubing to crack. Where the tubing of a well is provided with a release valve, as described herein, damage to the tubing will be avoided, since the valve will open and release the pressure as soon as the latter reaches a dangerous, predetermined value.

As will appear from the above, my invention is not based upon a circulation of a hot medium through the tubing as practiced heretofore. In my procedure, a column of cold oil is displaced by a corresponding column of hot oil. In comparison with the circulation method of cleaning oil tubing, my method has the advantage of

requiring less time and less heat. In the circulation method considerable heat is wasted by reason of the heating up of the entire length of tubing and of the oil therein, while in practicing the method of my invention, the heating is restricted to a certain region of the tubing, as set out above.

While the preferred method of well cleaning, according to this invention, contemplates the use of a release valve as described above, the method is advantageously employed under certain conditions, without the use of such a valve. Thus, in cleaning a seized well, the tubing of which is not provided with a release valve 9 and the well pump of which is provided with conventional means for unseating the valves of the pump, as is well known in the art, the procedure is as follows: The well pumping operation is discontinued, and by suitably manipulating the sucker rods at the surface of the well, in a manner well known to those skilled in the art, the standing and travelling valves 31 and 32, respectively, of the well pump 5 are lifted off their seats, so as to enable the desired amount of cold oil to run out of the tubing direct to the oil formation, while hot oil is being introduced at the top to take its place as a fluid column. The pump valves are then resealed with their customarily provided reseating mechanism, and the well pump is set in operation to withdraw to the surface the column of the mixture of hot oil and molten paraffin in solution. It will therefore be apparent that in this method and construction, the valve means for forming the deparaffining fluid column is located within the tubing and that the cleaning operation may also be carried out successfully, in this instance, without the provision of a special release valve, so that the installation of the latter in the tubing may therefore be postponed until such time as the tubing has to be withdrawn for some other purposes.

The invention may likewise be applied to the servicing of flowing wells, without resorting to the use of a release valve. In this case, the high pressure pump at the surface must be sufficiently powerful to force the hot oil down into the tubing against the existing bottom hole pressures. The injection of hot oil is stopped when an adequate amount has been introduced into the tubing and the oil is permitted to stand therein for a length of time sufficient to melt the paraffin. Flowing of the well is then resumed, so as to bring to the surface the hot oil and molten paraffin. Similarly, I also contemplate the application of this invention to the cleaning of wells operating by gas lift; here, following the release of the casing pressure and closing of the gas lift valves, the same procedure is followed as in the case of the cleaning of flowing wells. After a suitable amount of hot oil has been injected into the casing, the gas lift is again put into operation bringing to the surface the oil with its molten paraffin.

I claim:

1. In an oil well, the method of treating the tubing thereof to remove deposits of paraffin therefrom which comprises, introducing a deparaffining fluid through the top of the tubing to form a progressively increasing, downwardly moving fluid piston upon the oil in the tubing, until there is formed in the tubing a column of deparaffining fluid in contact with the tubing surface and of a length at least substantially equal to the depth of normal paraffin deposits in said tubing, simultaneously discharging oil

from the tubing at a point substantially lower than the lower limit of said paraffin deposits but substantially above the bottom of the tubing, discontinuing the introduction of the deparaffining fluid and maintaining the fluid in the tubing until the accumulated paraffin has become displaced from the tubing wall into the fluid column, and thereupon discharging the fluid column through the top of the tubing.

2. In a method according to claim 1, in which the deparaffining fluid is constituted by a heated hydrocarbon oil.

3. In a method according to claim 1, in which the deparaffining fluid is constituted by a paraffin solvent.

4. In a method according to claim 1, in which the oil displaced by the column of deparaffining fluid is discharged from the tubing at a substantially constant rate, whereby a liquid column is continually maintained throughout the tubing during the deparaffining operation.

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