

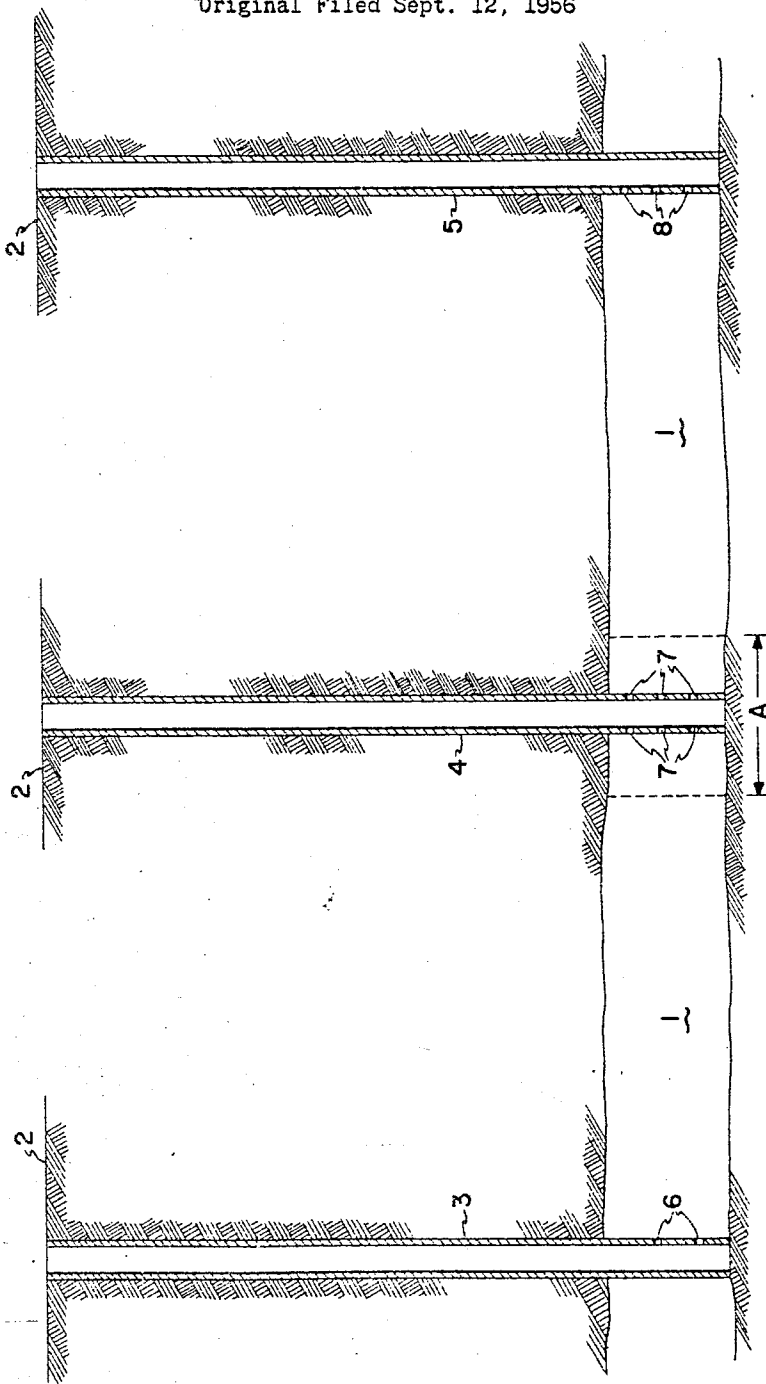
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METHOD FOR CLEANING A FORMATION IN THE VICINITY OF A WELL BORE

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METHOD FOR CLEANING A FORMATION IN THE VICINITY OF A WELL BORE

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20 Claims. (Cl. 166-9)

This application is a continuation of copending application Serial No. 609,497, filed on the 12th day of September, 1956, now abandoned.

The present invention is broadly concerned with an improved method for cleaning up an injection well bore hole. The invention is directed toward a method for increasing the susceptibility of the area about the well to accept the introduction of injected fluids.

One specific adaptation of the present invention is concerned with an improved method for the recovery of crude petroleum oil from subterranean formations wherein an improved technique for carrying out a secondary recovery operation is utilized. In accordance with the specific adaptation of the process, the area adjacent and about an injection bore hole is specially treated with carbon dioxide in a manner to render more effective a second stage step wherein an oil scavenging fluid such as water is injected into the injection hole and caused to flow toward one or more production wells.

It is known in the art that after a reservoir has been subjected to secondary recovery operations such as waterflooding the area about the injection well bore holes tends to become relatively non-susceptible to the further introduction of fluids. This is due to the fact that the pores of the formation tend to be clogged with mud, scale such as iron oxide, and the like. Furthermore, the residual oil in the area immediately adjacent the well bore hole tends to make the introduction of additional fluid relatively difficult. It is also well known in the art to use various methods and techniques for removing oil in secondary recovery operations. For example it has been suggested that gas be injected and that the reservoir be repressured. Furthermore it is known in the art to inject water at an injection well and to cause this water to flow toward a producing well driving oil ahead of it to the producing well. Another procedure suggested has been to introduce a bank of low-boiling hydrocarbon such as propane and to drive this bank by means of either water or natural gas toward the producing well. These methods have been successful to some degree. However, in many instances, the beneficial results have not been significant.

As pointed out heretofore in oil production processes, the area about a bore hole becomes less porous due to scale and mud clogging. Thus, if a conventional technique such as water flooding or propane washing be employed, it is often difficult to inject these fluids effectively and efficiently into a formation. A considerable and high-pressure drop is encountered in the area about the bore hole.

In accordance with the present invention, carbon dioxide under a very high pressure is injected into the bore hole and the bore hole then sealed off. A time period is allowed to elapse at the end of which the pressure is released. During the time that pressure is maintained on the bore hole, the carbon dioxide seeps into and dissolves in the residual fluids for several feet about the circumference of the bore hole. When the pressure is released on the carbon carbon dioxide, the carbon dioxide expands and exerts a gas pressure on the residual oil and other fluids causing them to backflow into the

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bore hole. This washes the mud particles and scale from the pores thereby producing a highly porous formation about the bore hole. In addition, the removal of the residual oil secured by this process increases the susceptibility of the area about the bore hole for further liquid injection. During the backflowing operation, the liquid or fluid is pumped from the injection well. Water or any other suitable oil-displacing fluid is then pumped into the formation through the injection well and caused to flow toward the production wells.

The process of the present invention may be fully understood by reference to the drawing illustrating one embodiment of the same. Referring specifically to the drawing, an oil-containing formation 1 is shown positioned below the earth's surface 2. Bore holes 3, 4, and 5 extend from the earth's surface into the oil-containing formation. Suitable ports or conduits 6, 7, and 8 permit fluid to flow between the formation 1 and well bore holes 3, 4, and 5 respectively.

In accordance with the present invention, carbon dioxide is introduced under pressure and by suitable means through bore hole 4 and the bore hole then sealed off. A period of time is then permitted to lapse during which the carbon dioxide seeps into and dissolves in the residual oil and other fluids about the bore hole in area A. Thereafter pressure is released on the bore hole 4 and residual oil backflows into bore hole 4 and is removed by suitable pumps. This backflowing causes scale, mud particles, and the like to be removed from the pores of the formation about the bore hole.

Upon completion of this phase of the operation, a flooding medium such as water, a bank of propane, gas, or the like, is introduced by suitable means through bore hole 4. This flooding medium is caused to flow through the formation in the direction of bore holes 3 and 5 and is removed along with the recovered oil by means of these bore holes to the surface.

The present invention is concerned with an effective method for cleaning up a well bore hole immediately about the bore hole. A specific adaptation of the invention in essence comprises a particular arrangement of processing secondary recovery steps. The process consists initially in the step of injecting a limited quantity of carbon dioxide into an injection bore hole. The quantity should be at least enough to penetrate at least 3 to 4 feet from the bore hole. The hole is then sealed off at an elevated pressure which is in the range from about 1,000 to 12,000 pounds per square inch but less than the pressure required to lift the overburden. A preferred pressure is in the range from about 1,000 to 2,000 pounds per square inch. The hole is sealed off for a period of time which is in the range from about one to twelve hours. The pressure and time used will depend upon the type of oil formation being treated. Upon release of the pressure from the injection well, pumping is continued as long as the backflow of fluids continues. After this stage water or other driving medium is introduced in a conventional manner. The operation is very desirable in that the injected fluid such as water can fan out on a much greater periphery, namely the circumference of the purged area rather than the circumference of bore hole 4.

What is claimed is:

1. Improved method for the recovery of oil from a subterranean formation in a secondary recovery operation which comprises the steps of injecting a treating agent consisting essentially of carbon dioxide into an injection well; sealing off the injection well for a period of time at a pressure in excess of the formation pressure such that the carbon dioxide will be forced several feet into the formation; releasing the pressure in said injection well at the end of said period of time; whereby fluid from

the formation backflows into said injection well; removing said fluid from said injection well and thereafter introducing a flooded fluid into said formation about said injection well and causing said flooding fluid to flow to a producing well.

2. Process as defined in claim 1 wherein said time period is in the range from about one to twelve hours.

3. Process as defined in claim 1 in which the treating agent is injected in a quantity sufficient to penetrate into the formation a distance of at least about 3 to 4 feet from the injection well.

4. An improved method for the recovery of oil from a subterranean formation in a secondary recovery operation comprising injecting a treating agent consisting essentially of carbon dioxide into an injection well; maintaining the pressure of said carbon dioxide within the bore hole until the desired quantity of carbon dioxide has been forced into the formation; thereafter releasing the pressure in said injection well whereby fluid within said formation backflows into said injection well thus reducing the oil saturation of the formation adjacent the injection well; removing said fluid from said injection well and thereafter introducing a flooding fluid into said formation about said injection well and causing said flooding fluid to flow to a producing well.

5. A process as defined by claim 4 wherein the pressure maintained on said well bore is in the range from about 1,000 to 12,000 lbs. per square inch.

6. A process as defined by claim 4 wherein the pressure maintained on said well bore is within the range of 20 1,000 to 2,000 lbs. per square inch.

7. An improved method for increasing the injectivity of an injection well drilled into a subterranean formation which comprises the steps of: injecting a treating agent consisting essentially of carbon dioxide into an injection well at a pressure in excess of the formation pressure in a quantity sufficient to penetrate several feet into the formation; sealing off the injection well for a period of time; releasing the pressure in said injection well at the end of said period of time; and removing said fluid from said injection well.

8. An improved method for increasing the injectivity of an injection well drilled into a subterranean formation which comprises the steps of: injecting a treating agent consisting essentially of carbon dioxide into said injection well under pressure in excess of the formation pressure until carbon dioxide has been forced several feet into the formation; thereafter releasing the pressure in said injection well whereby carbon dioxide injected into the formation expands thus driving fluid from within the formation back into said injection well thus reducing oil saturation of the formation adjacent the injection well; and removing said fluid from said injection well.

9. A method for increasing the injectivity of an injection well drilled into a subterranean formation containing petroleum which comprises the steps of: injecting carbon dioxide into said injection well at a pressure sufficient to permit said carbon dioxide to penetrate several feet into the formation; sealing off the injection well for a period of time; releasing the pressure in said injection well at the end of said period of time; and removing fluid from said injection well.

10. Process as defined in claim 9 wherein said period of time is in the range from about one to twelve hours.

11. A method for increasing the injectivity of an injection well drilled into a subterranean oil containing formation which comprises the steps of: injecting carbon dioxide into said injection well under pressure in excess

of the formation pressure until carbon dioxide has been forced at least several feet into the formation; and thereafter releasing the pressure in said injection well whereby carbon dioxide injected into the formation expands thus driving fluid from the formation back into said injection well thus reducing oil saturation of the formation adjacent the injection well and removing plugging material from the face of the well bore adjacent the formation.

12. A method of increasing the transfer of an oil recovery fluid from an injection well which contains water into the surrounding oil bearing formation in which the well has been formed and wherein a relatively fluid impervious skin has been deposited on the surface of said oil bearing formation, which comprises introducing under pressure carbon dioxide adjacent to said fluid impervious skin said carbon dioxide used being at least 20 pounds per foot of vertical thickness of said oil bearing formation, continuing the injection of carbon dioxide to maintain the pressure until said skin has been destroyed and thereafter injecting an oil recovery fluid into the well.

13. In the method of claim 12 said carbon dioxide being injected at a pressure in excess of 100 p.s.i.

14. In the method of claim 12, the additional step of back flowing the well by suddenly reducing the pressure on the carbon dioxide.

15. In the method of claim 12, the additional step of back flowing the well by suddenly reducing the pressure on the carbon dioxide and withdrawing the carbon dioxide and water from the well.

16. A method of increasing the transfer of an oil recovery fluid from an injection well into the surrounding oil bearing formation in which the well has been formed and wherein a relatively fluid impervious skin has been deposited on the surface of said oil bearing formation, which comprises introducing under pressure water and carbon dioxide adjacent to said fluid impervious skin said carbon dioxide used being at least 20 pounds per foot of vertical thickness of said oil bearing formation, continuing the injection of water and carbon dioxide to maintain the pressure until said skin has been destroyed and thereafter injecting an oil recovery fluid into the well.

17. In the method of claim 16 said carbon dioxide and water being injected at a pressure in excess of 100 p.s.i.

18. In the method of claim 16, the additional step of back flowing the well by suddenly reducing the pressure on the water and carbon dioxide.

19. In the method of claim 16, the additional step of back flowing the well by suddenly reducing the pressure on the water and carbon dioxide and withdrawing the water and carbon dioxide from the well.

20. A method of increasing the injectivity of an injection well drilled into a subterranean formation which comprises: injecting carbon dioxide under pressure into the well; maintaining sufficient pressure on the well to permit the carbon dioxide to seep into the formation immediately adjacent the well; thereafter releasing the pressure in said well; removing fluid from said injection well; and then injecting an oil recovery fluid into the well.

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