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APPARATUS FOR TREATING WELLS

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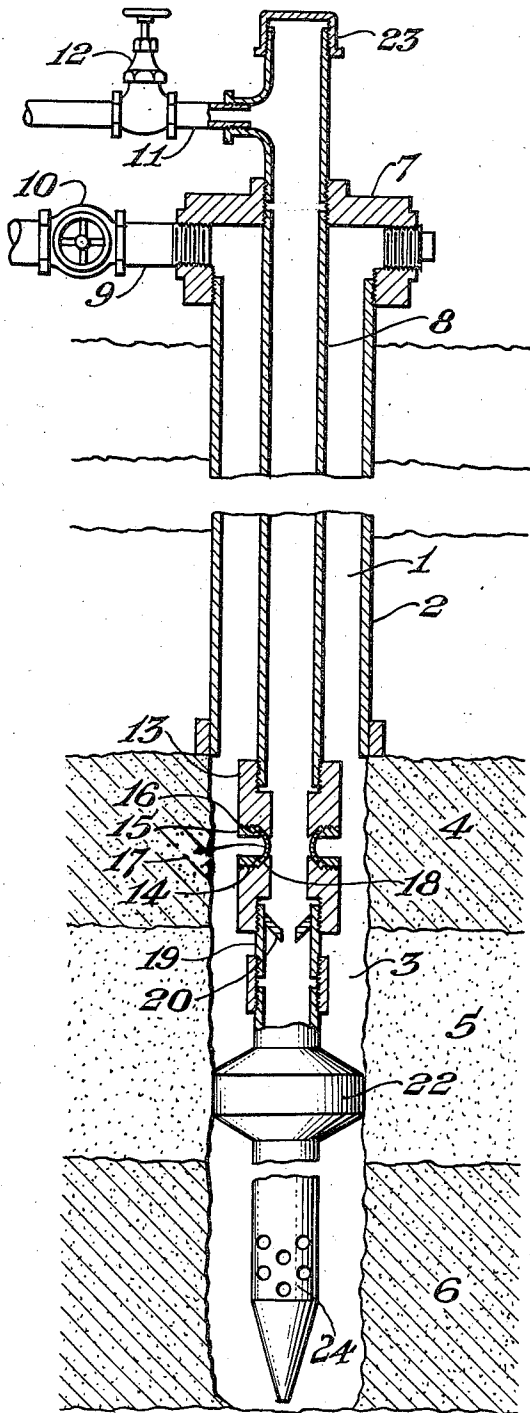


Fig. 1

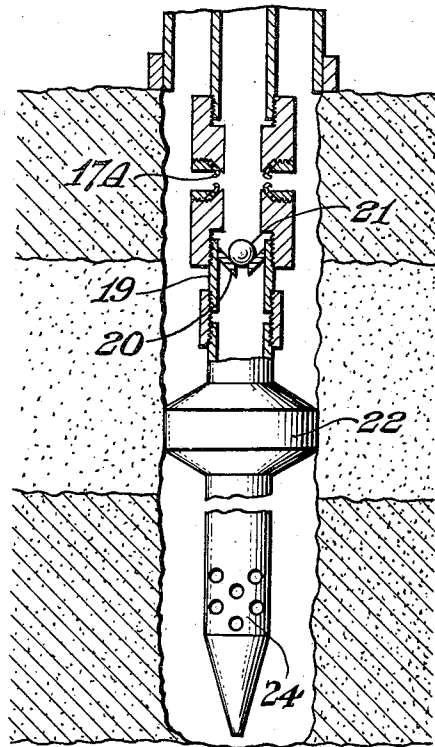


Fig. 2

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APPARATUS FOR TREATING WELLS

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3 Claims. (Cl. 166—1)

This invention relates to apparatus for treating deep wells such as those drilled for the production of oil, gas, brine, or water. It more particularly concerns apparatus which may be suitably used to ensure the introduction of any desired quantity of a fluid agent into each of more than one stratum penetrated by the bore of a well.

Wells such as those drilled for the production of oil sometimes penetrate more than one stratum of a productive nature. In treating such wells with a fluid agent, such as for example, an acid to bring about an increase in the permeability of the producing strata and thereby an increase in production from the well, it is generally desirable to be assured that each stratum receives a proportionate quantity of acid for otherwise a major portion may be forced into or drain away into one stratum since it oftentimes happens that the different strata vary widely in their permeability to fluids. If such be the case, inferior results obtain as regards the greatest increased yield from an acid treatment.

It is, therefore, the principal object of the invention to provide an apparatus which may be employed in the treatment of wells penetrating a plurality of productive strata with a fluid agent whereby any desired quantity of said fluid may be injected independently into each of two or more strata.

Another object of the invention is to provide an apparatus whereby two or more strata may be treated with a fluid agent independently of each other.

Still another object of the invention is to provide an apparatus for treating wells whereby a fluid reagent may be separately and independently introduced into each of two or more productive strata.

Still other objects and advantages of the invention will be apparent during the course of the following description.

The invention then resides in the apparatus hereinafter more fully described, the accompanying drawing, and following description setting forth in detail one mode of practicing the invention, such mode illustrating, however, but one of several ways in which the invention can be carried out.

In the drawing: Fig. 1 is a diagrammatic view in vertical section of a well showing the apparatus suitably arranged for carrying out the introduction of an agent such as acid into the lower of two productive strata.

Fig. 2 is a diagrammatic view in vertical sec-

tion of the lower portion of the well bore penetrating the producing strata showing the apparatus suitably arranged for the introduction of acid into a second productive stratum located at a higher level.

As shown, the upper portion 1 of the well bore is cased with metal pipe 2 while the lower portion 3 of the well bore passes through producing stratum 4, an impervious stratum 5, and ends in a second producing stratum 6. Above the ground level, the well is shown equipped with casing head 7 through which the well tubing string 8 provided with cap 23 extends into the well. Pipe 9 controlled by valve 10 communicates with the well bore through the casing head 7, while pipe 11 controlled by valve 12 communicates with the well bore through the well tubing string 8. Pipes 9 and 11 and their controlling valves serve as a means whereby the introduction of fluids into the well may be brought about in accordance with this invention. In threaded engagement with the well tubing 8 and positioned opposite the upper producing stratum, a cylindrical tubular body member 13 is shown equipped with laterally directed threaded sockets 14 having apertures there-through which are in alignment with the holes carried by hollow plug members 15. Hollow plug members 15 provided with tapered end portions 16 screw-threadedly engage the sockets 14 and bear at their tapered end portions upon sheet metal sealing covers 17 so as to hold the covers against the sloping shoulders 18 of the sockets 14 thus forming a seal over the apertures in the plug. Screw-threadedly attached to the lower end of the body member 13, a short nipple 19 carries a ball valve seat 20 adapted to form a seal when a ball 21 is dropped through the tubing and positioned in the seat 20, as shown in Fig. 2. The well tubing 8 continues to the bottom of the well bore and ends in a perforate section 24. The well tubing 8 carries a conventional tubing packer 22 shown in seated position adjacent the impervious stratum 5. In the view illustrated in Fig. 2, the ball 21 is in a seated position and the sheet metal sealing covers 17 of Fig. 1 covering the hollow plugs 15 are shown ruptured as at 17A permitting passage of a treating agent from the tubing 8 to the upper stratum 4.

The method and apparatus will be best understood from a description of an acid treatment of two strata independently of each other employing the apparatus to introduce the acid. The introduction of acid into the lower produc-

tive stratum is carried out first by pumping the acid into the well through pipe 11 while valve 12 is maintained in an open position. The acid passes down the well tubing 8 through the open valve 20 in which the ball has not yet been seated and out the lower end of the tubing into the lower producing stratum 6. The acid solution is prevented from entering the upper productive stratum since the hollow plug members 15 communicating between the well tubing and the upper productive stratum are sealed off by sheet metal covers 17. After the desired quantity of acid has been introduced into the lower producing stratum, the tubing cap 23 is removed and the ball 21 is dropped into the well through the tubing 8 where it engages the seat of valve 20. Thereafter pressure is applied on the tubing as by pumping to rupture the thin sheet metal covers 17. The acid treatment of the upper producing stratum is then carried out by introducing the desired quantity of acid into the well through pipe 11 with valve 12 maintained in an open position. If desired, a quantity of oil or other fluid may be introduced into the annular space between the casing and the tubing through pipe 9 to prevent the acid solution from rising up into the casing as the introduction of acid into the upper formation is being carried out.

After the desired quantity of acid has been introduced into the well, it may be forced into the surrounding formation by introducing a quantity of liquid, such as oil, into the well through the tubing and applying pressure thereto. During the acidization of the upper productive stratum, acid is positively prevented from reaching the lower stratum and assurance is thus had that all of the acid is being introduced into the upper stratum. After the acid solution has been given sufficient time to react, which usually requires from 1 to 4 hours or more, the spent acid solution may be withdrawn as by swabbing the well through the tubing 8. Thereafter the well may be put into production.

The metal sheets or discs which serve to cover the openings in the hollow plug members thus preventing the acid from entering the upper producing stratum while the lower producing stratum is being treated, may be made of any suitable metal as, for example, copper. They should be of such a thickness as to withstand the pressure which is applied to force the acid into the lower stratum and yet of such thinness that they may be ruptured readily by the application of fluid pressure when the ball is dropped closing valve 20. For example, copper sheets adapted to burst under pressure of from about 100 to 2000 pounds pressure per square inch may be suitably employed. Other materials besides metals may be obviously employed to form the sealing covers for the plug members. For ex-

ample, these covers may be made of frangible materials adapted to burst upon application of pressure such as Bakelite, hard rubber, glass, or the like.

In carrying out an acid treatment such as described above, it is generally preferably to employ an aqueous solution of hydrochloric acid inhibited against corrosive attack upon iron or steel such as is described in U. S. Patent 1,877,504. It is to be understood that while the apparatus has been described with particular reference to its use in connection with carrying out an acid treatment, it may also be suitably employed in carrying out the treatment of a well with any fluid agent wherein it is desired to separately and independently treat more than one stratum. It will also be evident that the apparatus may be readily adapted to independently treat more than two stratum by duplicating the assembly shown and arranging to have the covers for the plug members of each assembly burst or rupture at different pressures as well as by employing ball valves of varying sizes so to allow the ball seating in the lower valve to pass or drop through the upper valve seats.

I claim:

1. In a well treating device, the combination of a tubing string, a tubular member having a laterally directed aperture therethrough carried by the tubing string, a sealing cover for said aperture adapted to rupture under relatively high pressure, valvular means positioned below the aperture for closing the lower end of the tubing string, and sealing means adapted to seal the annular space in the well bore at a point below the aperture in said body member.

2. In a well treating device, the combination of a tubing string, a tubular member having laterally directed apertures therethrough carried by the tubing string, cover members adapted to seal the apertures and to rupture in response to a relatively high pressure applied interiorly of the tubing string, a closable valve positioned below the apertures for closing the passage-way communicating with the lower end of the tubing string, and sealing means adapted to seal the annular space in well bore at a point below the apertures in said tubular member.

3. In a well treating device, the combination of a well tubing string having an opening in the lower end, a tubular body member having apertures therethrough carried by the tubing string, sealing covers for the apertures adapted to rupture in response to relatively high pump pressure, a ball seat valve located below the apertures, a ball adapted to be dropped through the tubing string to seat in the valve in sealing relationship, and a packer adapted to seal the annular space in the well bore at a point below the apertures in the tubular body member.

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