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SELECTIVE PLUGGING OF OIL WELLS

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Fig. 1

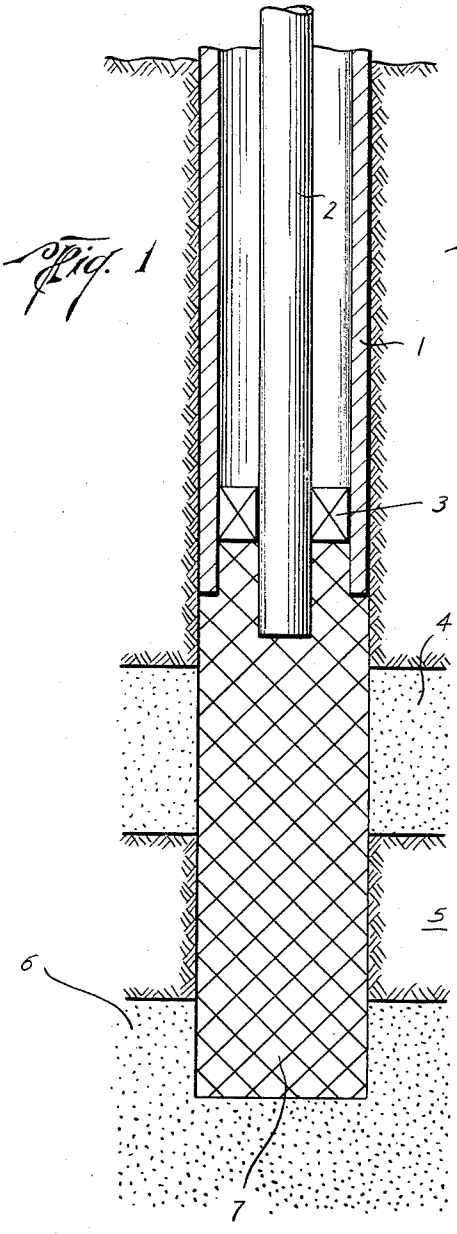
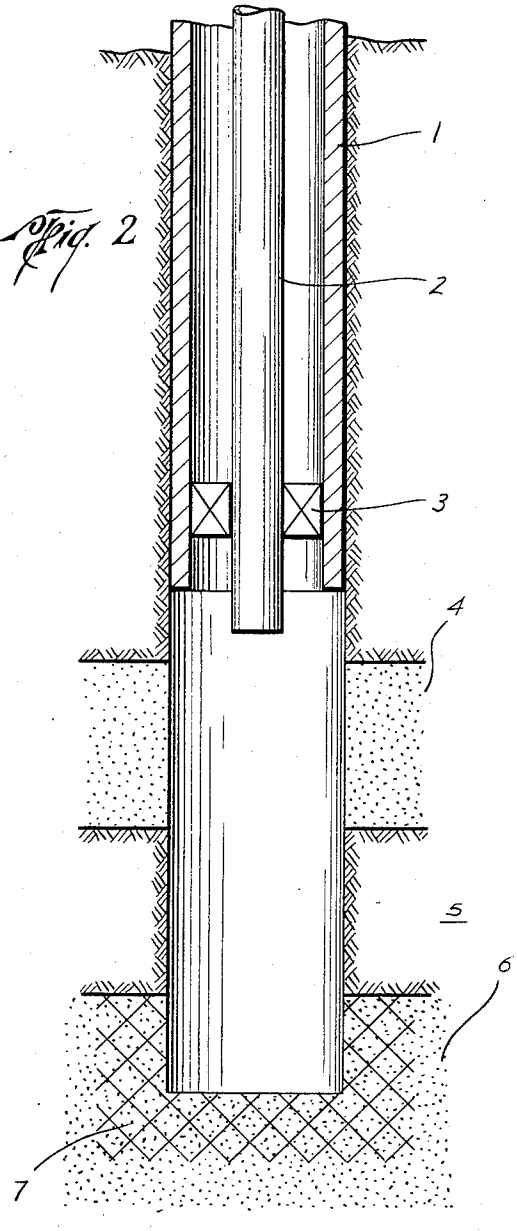


Fig. 2



Frederick W. Wiegand
INVENTOR.

BY G C Helmig

ATTORNEY

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SELECTIVE PLUGGING OF OIL WELLS

Frederick W. Wiegand, San Antonio, Tex.

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This invention relates to the reworking of oil and gas wells, and more particularly to an improvement in the sealing off of water formations.

Pay production from a well is sometimes interfered with by production of water in sands at the petroleum fluid formations. Wells have been abandoned when corrective measures have failed economically to remedy the difficulty. Attempts are made to reduce or block water flow by cementing off a water producing formation, but cementing and other known expedients are complex and costly and run into unforeseen troubles and unpredictable undersurface conditions.

An object of the present invention is to provide a simple, inexpensive, and effective seal for the water flow problem by an operation requiring a minimum of time and no special equipment or skill. Neither is there any need for a reboring operation, as often is required with present day cementing methods. The proposal is to plug off water flow by injecting into the producing formation a petroleum asphalt, which is soluble in the petroleum fluid but is insoluble in water, and to easily accomplish that purpose by utilizing a petroleum asphalt which is pure in the sense that it is normally an extremely hard solid at ordinary temperatures and free of foreign matter except that during its injection and for convenience of handling it contains a certain amount of water and is in an emulsified liquid state for flow into the well from the surface and downward to the formation level to be plugged, whereupon, under the application of pressure, the liquid asphalt emulsion is injected into the pores of the wall of the well bore, with the emulsion water being removed in the process and the solid asphalt then filling the porous formation and affording an insoluble barrier to further water flow but going into solution with petroleum fluids so that water sands remain sealed while oil and gas sands are free for production.

Other objects and advantages will become apparent during the course of the following specification having reference to the accompanying drawing, wherein Figures 1 and 2 are vertical, sectional views illustrating what may be considered a typical lower fragment of a well bore and respectively showing a load of emulsified, viscous asphalt ready for pressure action thereon, and a treated bottom hole in condition for production.

The drawing is intended as illustrative of a bottom, open hole of a well into which extends from the surface the customary outer casing **1** and the production tubing string **2**, with a packer assembly **3** near the lower ends of the casing and the tubing to seal off the annular space between them. Different strata, as at **4**, **5**, and **6**, are indicated as intersected by the bottom hole. For this discussion, the strata **4** and **6** may be considered respectively as an oil sand and the water sand separated from one another by an intervening nonproducing layer **5**. There will not always be a distinct line of demarcation at the bottom hole between separate producing formations, and often the water producing sand will be above the petroleum producing formation. The actual relationship of the bottom hole formation is of no consequence to the practice of this invention, since there is contemplated the filling of the bottom hole with an ample volume of water-emulsified petroleum asphalt to reach into the entire formation which surrounds the open hole, as is illustrated in Fig. 1, wherein the fluid or emulsified asphalt body is indicated at **7**.

When water flow into a well renders further operation unprofitable, the production is discontinued and the hole is pumped as dry as possible. Immediately thereafter, petroleum asphalt emulsified with approximately thirty percent water to form a thick viscous liquid is supplied, as by pouring into the upper or surface end of the tubing string **2** in an estimated amount to drop by gravity and completely fill the open hole and preferably, also, a short length of the lower end of the tubing string. The amount of emulsified asphalt required for any given well will vary, and may be as little as ten barrels and as much as thirty barrels.

Pump pressure controlled at the surface end of the tubing is applied on the body of emulsified asphalt in the bottom hole through a standing fluid column. Compressed air or petroleum gas or a liquid such as oil or water may be employed for the pressure transmitting column. Such pressure on the emulsified asphalt will push it outwardly from the bottom well hole and into the surrounding formation sands. The extrusion of the asphalt into the porous formation will continue until the hole is clear or practically clear, which is to say, the pressuring operation may be ended so as to leave a thin asphalt lining on the wall. The applied pressure of the thick viscous asphalt body will tend to squeeze out the emulsifying water, and the separation of water is further effected by the flow through the finely divided formation pores of the asphalt in thin particle streams, which frees the water. With the separation of the emulsion agent, the solid asphalt particles fill and plug the formation. Water flow pores will remain blocked; but since petroleum asphalt is soluble in petrolum fluids, it will go into the petroleum fluid, and the oil and gas producing formations will clear up after a short interval. The result will be somewhat as illustrated in Fig. 2, wherein the oil sand **4** is open, as it was initially, and the water sand **6** is blanked off by the diffusion therein of the asphalt **7**. Thus, after only a minimum lapse of time, the well may be put back into paying operation.

What is claimed is:

1. In the production of an oil well having a packed-off bottom hole and a production tubing between the surface and the bottom hole of the well, the method of sealing off a portion of the producing formation at the bottom hole including flowing down the tubing from the surface and substantially filling the packed-off bottom hole with pure petroleum asphalt emulsified with approximately thirty percent water and without temperature elevation, forcing the same from the bottom hole into the porous formation wall by transmission of pressure against the hole contained body of water emulsified asphalt and through a tubing confined fluid column, which column pressure application injects through and fills the formation pores at said bottom hole with solid asphalt which is impervious to water and blocks production at a formation water zone but is soluble in oil and dissolves to reopen oil production from a formation oil zone.

2. A method of reworking an existing oil well having a production tubing string communicating with and being peripherally packed off immediately above the hole cavity at the producing formation, said method comprising discontinuing the normal withdrawal of oil through the production tubing string from the packed-off formation hole

cavity, then substantially filling the hole cavity by passing downwardly through the production tubing string a predetermined amount of water emulsified asphalt in thick viscous form at room air temperature, thereafter applying fluid pressure internally of the tubing string and on the previously deposited emulsified asphalt contained in the hole cavity and thereby squeezing said asphalt emulsion outwardly from the hole cavity and into the producing formation, whose porous structure causes the solid asphalt to divide into thin asphalt particle streams which fill the porous formation and tend to free the water portion of the emulsion, continuing such fluid pressure application until substantially all the asphalt is pushed out of the hole cavity and into the porous formation, then removing such fluid pressure application and after a time interval sufficient to permit the asphalt fill in the oil zone of the formation to be dissolved into and flow with the oil into the formation hole cavity and thereafter resuming the withdrawal of oil through the production tubing string from the formation hole cavity.

3. The method of reworking a petroleum fluid well also producing gas in order to reduce the gas-oil ratio and without pulling the packed-off production pipe from the well, comprising pumping water emulsified asphalt at ordinary air temperature through the production pipe downwardly into the packed-off well cavity and out into the cavity wall formations producing oil and gas to an extent that the emulsion on being ejected from the well cavity is divided by its entrance into the small pores of the formations into thin streams from which the water separates as the solid asphalt penetrates the pores and plugs off the formations, allowing a time interval during which the solid asphalt plugging the pores of the oil formation dissolves into the oil and then producing through the production string and from the well cavity while that formation containing dry gas remains blocked off.

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