METHOD OF UNDERGROUND STORAGE IN A RESERVOIR

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ABSTRACT OF THE DISCLOSURE

A method for storing a liquid product in an underground storage reservoir comprising two cavities interconnected below their highest parts by a conduit. The conduit is filled with a displacing fluid heavier than and immiscible with the liquid product. The cavities are partially filled with the displacing fluid and the remaining volume of one cavity is charged with pressurized gas while the remaining volume of the other cavity is filled with liquid product. In this manner, fluid may be flowed and displaced selectively from one cavity to another solely under the combined pressure of the pressurized gas.

This invention relates to the method and apparatus for storing a liquid product, in particular, hydrocarbons, such as, for example, crude petroleum.

In the production of petroleum it is often necessary to store the produced oil temporarily in the vicinity of the oil wells. This storing of the produced oil presents a problem, particularly when the oil wells are situated in the sea.

Although underground storage of petroleum products has been used in the industry, many difficulties in the subsequent extraction of such stored products heretofore remain. Specifically, the underground cavities required for such storage are frequently quite deep and the pumping costs are consequently quite high. If the pump is in the bottom of the cavity, maintenance is difficult if not impossible. Furthermore, if the underground storage cavity is beneath the sea or other large body of water it is equally difficult, if not impossible, to provide power to the pump for operation since the construction of permanent platforms for a requisite prime mover under such conditions is impractical if not prohibitively expensive.

An object of this invention, therefore, is to solve these problems in a simple and relatively inexpensive manner.

To this end, the liquid product of an oil well, according to the invention, is forced into an underground storage reservoir filled with a displacing liquid which is heavier than and immiscible with the liquid product. The said displacing liquid is thereby displaced at least partially from the storage reservoir via a conduit into a second underground reservoir situated at a level equal to or higher than the level of the storage reservoir. A gas under pressure is present in the second reservoir above said displacing liquid.

A suitable displacing liquid is, for example, a salt solution, although other displacing liquids may be used. The essential criteria, however, are that the displacing liquid must be heavier than and immiscible with the liquid product.

The liquid product is, for example, crude petroleum, but it will be obvious that, if desired, other liquid such as gas oil, liquefied butane or propane can also be stored by means of this method.

The gas under pressure employed can be, for example, methane, propane, butane, mixtures thereof or any other suitable gas.
salt solution has flowed away via line 12 and until a sufficiently large cushion of gas has formed above the salt solution 9 in reservoir 7. The valves 16 and 17 are then closed. The situation is then as shown in the figures.

The separating surface between the salt solution 9 and the petroleum 8 has at this point, for example, reached the level designated by 21 and 22 in FIGURES 1 and 2, respectively. The salt solution has reached the level 23 and 24 (in FIGURES 1 and 2, respectively). If it is desired to withdraw oil from the storage installation, valve 14 is opened. Due to the hydrostatic pressure of the salt solution and the gas pressure (FIGURE 1) or due to the gas pressure alone (FIGURE 2), salt solution 9 is now forced from reservoir 7 via connecting line 20 into the storage reservoir 6. As a result, petroleum flows out through line 11 and valve 14. When a sufficient amount of petroleum 8 has been withdrawn, valve 14 is closed again.

Whenever petroleum has to be stored again, it is pumped via line 10 into reservoir 6, valve 14 being closed and valve 15 open. As a result, an amount of salt solution 9 is displaced into reservoir 7 from reservoir 6. Consequently, the pressure of the gas above the level 23 or 24 of the salt solution 9 in reservoir 7 increases gradually. The accumulated pressure can be used again in a later withdrawal of a quantity of petroleum from the storage installation.

I claim as my invention:
1. A method for storing a liquid product in an underground storage reservoir comprising two cavities inter-connected below the highest parts thereof by a conduit including the steps of:
   filling said interconnecting conduit with a displacing fluid that is heavier than and immiscible with said liquid product;
   partially filling said cavities with said displacing fluid;
   charging the remaining volume of one cavity with pressurized gas;
   filling the remaining volume of the other cavity with said liquid product; and
   flowing and displacing fluid selectively from one of said cavities to the other solely under the combined pressure of said pressurized gas.

References Cited

UNITED STATES PATENTS
2,934,904 5/1960 Hendrix ------------------ 61--5
2,947,147 8/1960 Johnson ------------------ 61--5
2,961,841 11/1960 Giles ------------------ 61--5 X
3,003,322 10/1961 Jordan ------------------ 61--5
3,253,414 5/1966 Molique ------------------ 61--5 X

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