

[54] LIQUID SEPARATION IN A WELL

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3,324,803 6/1967 Kelley.....137/155 X

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417/61

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137/192, 404, 408, 399, 194; 417/61

[56] **References Cited**

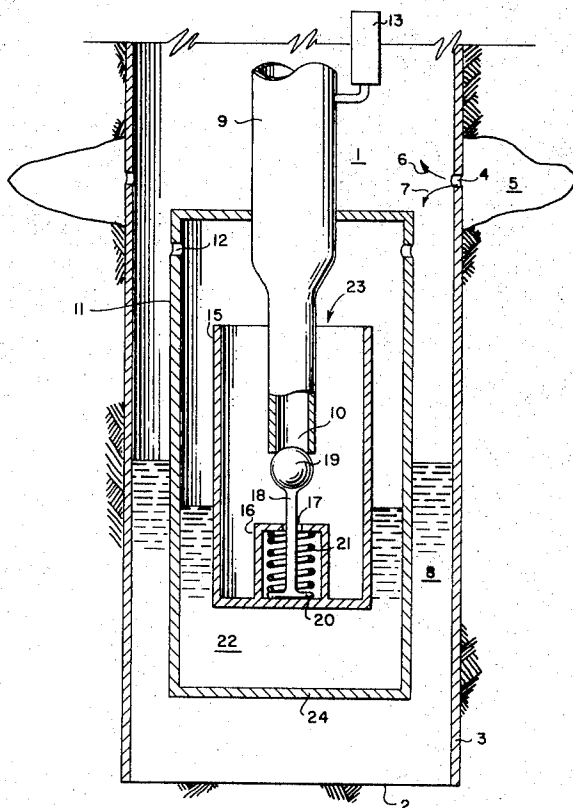
UNITED STATES PATENTS

2,378,748 6/1945 Booker.....137/185

[57] **ABSTRACT**

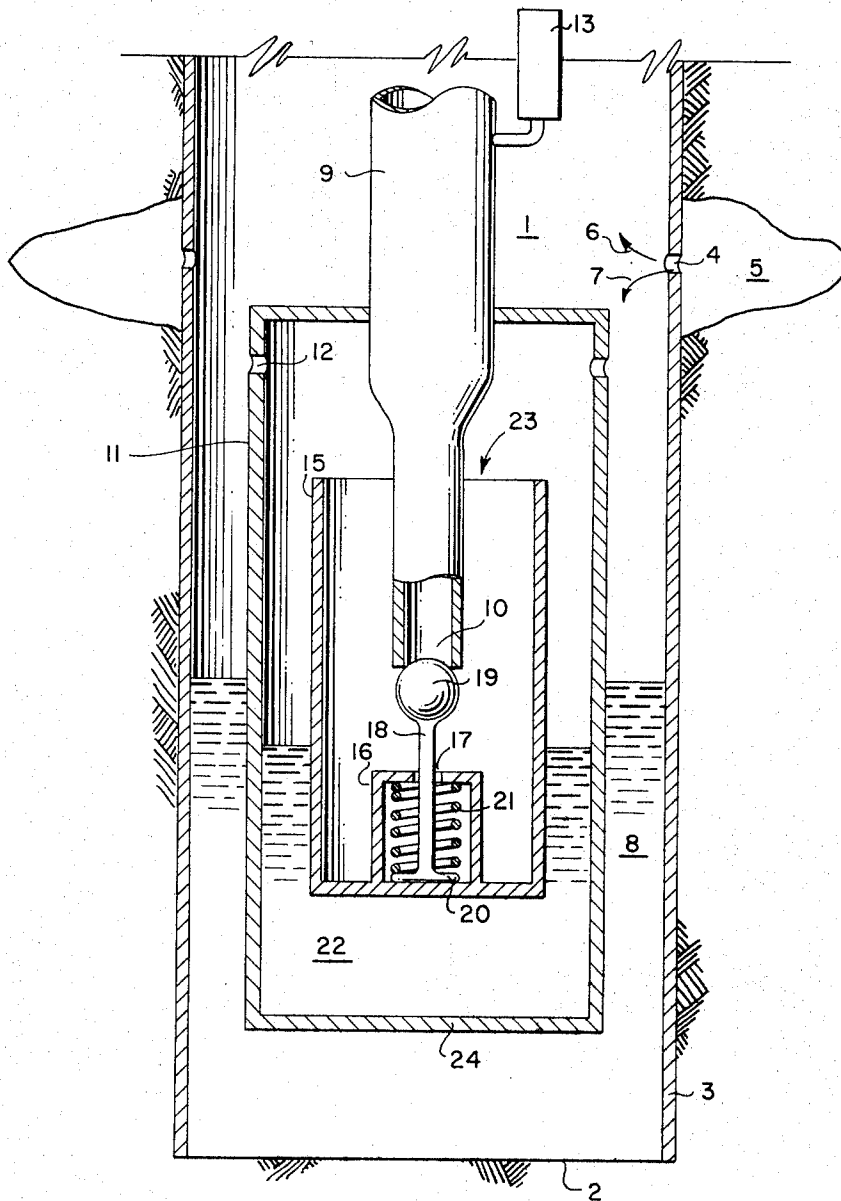
Liquid is separated from gas in a well bore using a liquid container which floats in the well bore liquid and operates a valve which communicates with the interior of the tubing of the well. The valve is resiliently and movably mounted on the container so that the container must move a substantial distance to overcome the resiliency of the mounting and open the interior of the tubing to the liquid in the container.

3 Claims, 1 Drawing Figure



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LIQUID SEPARATION IN A WELL

BACKGROUND OF THE INVENTION

Heretofore, floating liquid containers which carry a valve member to open and close communication between the container and the interior of the well tubing have been employed. However, the valve member has been rigidly fixed to the container so that the slightest movement of the container results in a movement of the valve member. When the valve member is in the closed position, this can mean that the valve member is unseated and reseated with the slightest movement of the container. This causes extreme wear and a substantial shortening of the usable life of the valve member and its seat. The wearing of the valve member also causes undesirable leakage of the valve.

SUMMARY OF THE INVENTION

According to this invention the valve member is movably and resiliently mounted on the liquid container so that the liquid container must move a substantial distance before the valve member is moved at all. This eliminates all of the wear on the valve member and its seat as described hereinabove.

This invention is useful in separating liquid from gas in the borehole of gas wells. This is desirable because the liquid, if allowed to accumulate in the borehole, can fill the borehole and rise above the position in the borehole where the gas enters same. This liquid can build up a sufficient liquid pressurehead on the gas entering the borehole to substantially decrease or even completely stop the entry of gas into the borehole. The device of this invention automatically opens the valve and admits liquid from the borehole to the interior of the well tubing when the container is sufficiently full of liquid. The device therefore automatically maintains the liquid level in the borehole below a point where entry of gas into the borehole will be interfered with.

Accordingly, it is an object of this invention to provide a new and improved device for separating liquid from gas in a well. It is another object to provide a new and improved device for controlling the amount of liquid present in a well bore. It is another object to provide a new and improved device for separating gas from liquid in a well bore and removing the liquid from the well bore separately from the gas. Other aspects, objects, and advantages of the invention will be apparent to those skilled in the art from the disclosure and the appended claims.

DETAILED DESCRIPTION OF THE INVENTION

The drawing shows apparatus in accordance with this invention.

More specifically, the drawing shows a well bore 1 with an earth bottom 2 and a conventional casing liner 3. Casing 3 is perforated at 4 to allow open communication between geologic strata 5 and well bore 1 so that gas can pass therethrough and upwardly as shown by arrow 6 while any liquid (oil, water, and the like) entering with the gas can pass downwardly in the direction of arrow 7 and collect in a body 8 in the bottom of the borehole.

Tubing 9, like casing 3, extends downwardly in the borehole from the earth's surface and terminates in aperture 10 which is an inlet means for admitting liquid

to the interior of tubing 9 for lifting to the earth's surface by means of conventional gas lift valves 13. One or more valves 13 are longitudinally dispersed along the length of tubing 9 as needed.

Tubing 9 carries a gas-liquid separator 11 at the bottom end thereof which is perforated around its upper periphery by a plurality of apertures 12.

Inside separator 11 is disposed liquid container 15. Container 15 carries in its lower end a housing 16 which has an aperture 17 therein aligned with inlet 10. Valve member 18 has a closure member 19 for seating on and closing inlet 10. Valve member 18 also has a flange means 20 which extends laterally at least in part beyond the area covered by aperture 17 thereby acting as a stop means for preventing valve member 18 from being removed from within housing 16. Interposed between the upper end of housing 16 which contains aperture 17 and flange means 20 is spring means 21, e.g., a coil spring. Spring 21 is biased so as to force flange 20 against the lower end of container 15 as shown in the drawing.

In operation, container 15, floating on liquid 22 therein, forces closure member 19 into seating engagement with the end of tubing 9 thereby closing inlet 10.

As the liquid level of body 8 rises in well bore 1, reaches, and passes through apertures 12 of separator 11, the liquid level of liquid 22 also rises until it reaches the upper open end 23 of container 15. When sufficient liquid has passed into container 15, it starts to settle downwardly toward lower end 24 of separator 11.

Heretofore, the slightest downward movement of container 15 caused member 19 to separate from contact with the seat on tubing 9. Then, when only a very small amount of liquid from the interior of container 15 had passed into tubing 9, container 15 rose pushing member 19 into contact with the seat of tubing 9. This procedure would be carried out repeatedly and cause very great wear on member 19 as well as the seat on tubing 9.

However, with this invention, container 15 must settle downwardly a substantial distance until spring 21 is sufficiently compressed to move member 19 away from contact with tubing 9 against the buoyant force of the liquid which tends to push member 19 upwardly against tubing 9. When spring 21 is sufficiently compressed to move member 19 away from engagement with the seat on tubing 9, sufficient liquid has entered tubing 15 so that a substantial amount of liquid passes into the interior of tubing 9 before container 15 floats upwardly a sufficient distance to again close inlet 10 with member 19.

Thus, although container 15 settles downwardly as liquid flows thereinto, inlet 10 is not opened until a substantial amount of liquid has collected in container 15, the amount being that which is sufficient to lower container 15 to the extent that spring 21 is compressed and any further downward movement of container 15 snaps member 19 away from tubing 9. By the time member 19 is snapped to an open position, a substantial amount of liquid has collected in container 15 for entry into tubing 9 before container 15 rises a sufficient distance to again close inlet 10 with member 19. In this manner inlet 10 is not opened until a substantial amount of liquid is present in container 15 thereby eliminating the great wear inducing action undergone when valve

member 18 is rigidly fixed to container 15 and opens inlet 10 as soon as container 15 settles downwardly the slightest distance followed by closing of inlet 10 as soon as the slight amount of liquid necessary to raise container 15 has passed into tubing 9. This type of wear inducing action takes place many times in the life of a device such as this, especially when only a slight amount of liquid is overflowing through open top 23 into container 15. It should be noted that this type of wear inducing action is completely eliminated by maintaining inlet 10 closed while container 15 moves away from inlet 10 and member 18 a substantial distance before overcoming the resiliency of spring 21 and opening inlet 10 with a snap-action caused by the sudden distention of spring 21.

Reasonable variations and modifications are possible within the scope of this disclosure without departing from the spirit and scope of this invention.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. In a device for separating gas from liquid in a well bore: a liquid container open at its top, arranged to float in liquid in the well bore, a valve; means connecting the container and valve; a tubing extending into the container having a valve seat; said valve being arranged to be urged against said seat by pressure in the well bore; the construction and arrangement being such that the container sinks responsive to an accumulation of liquid therein to move the valve from its seat permitting entry of liquid into the tubing from the container; the improvement comprising said means connecting the

valve and container comprising a resilient connection arranged to apply an increasing force to the valve opposing the force urging the valve against its seat as the container sinks responsive to the liquid accumulation, until such force applied by the resilient connection overcomes the opposing force to thereby move the valve from its seat.

2. The device according to claim 1 wherein said container moves away from said tubing inlet to remove said valve member from contact therewith thereby opening said tubing inlet, and said container carries a spring means which must be at least partially compressed by said container movement away from said tubing inlet before said valve member is removed from contact with said tubing inlet to open same.

3. The device according to claim 2 wherein said container carries a hollow housing having an aperture in alignment with said tubing inlet, said valve member extends through said aperture into the interior of said housing, the end of said valve member in the interior of said housing having a flange means, a spring means interposed between the end of said housing having said aperture and said flange means, said spring means being biased to normally urge said valve member away from said tubing inlet so that when said container moves a sufficient distance away from said tubing inlet to separate said valve member from contact with said tubing inlet said spring is sufficiently compressed to move said valve member to the open position with a snap-action.

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