Jan. 12, 1960 J. W. HODGES 2,920,764

MEANS FOR REDUCING LIQUID LEVEL IN WELL TUBING

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Fig. 1

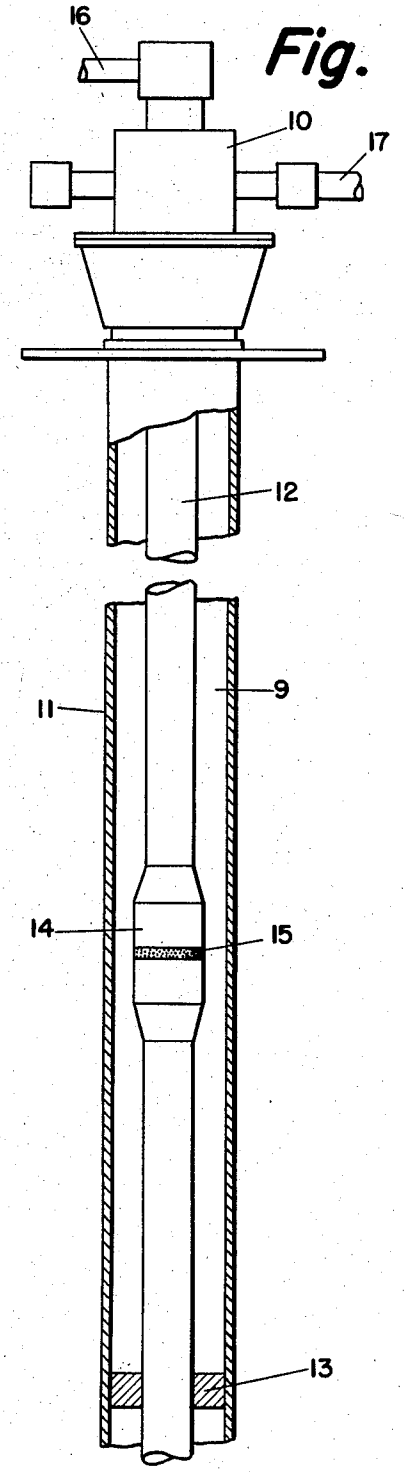

Fig. 3

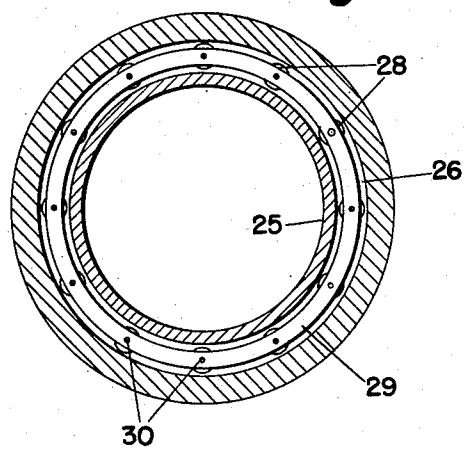

Fig. 4

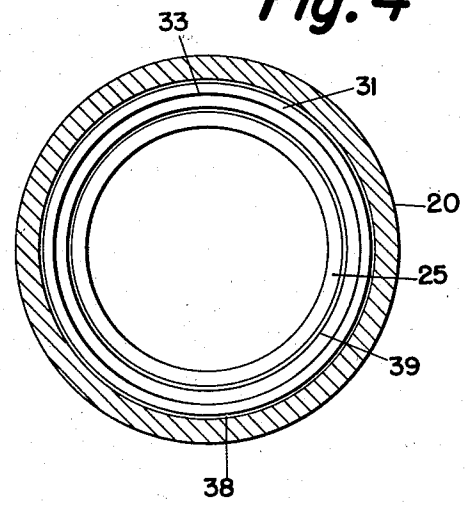

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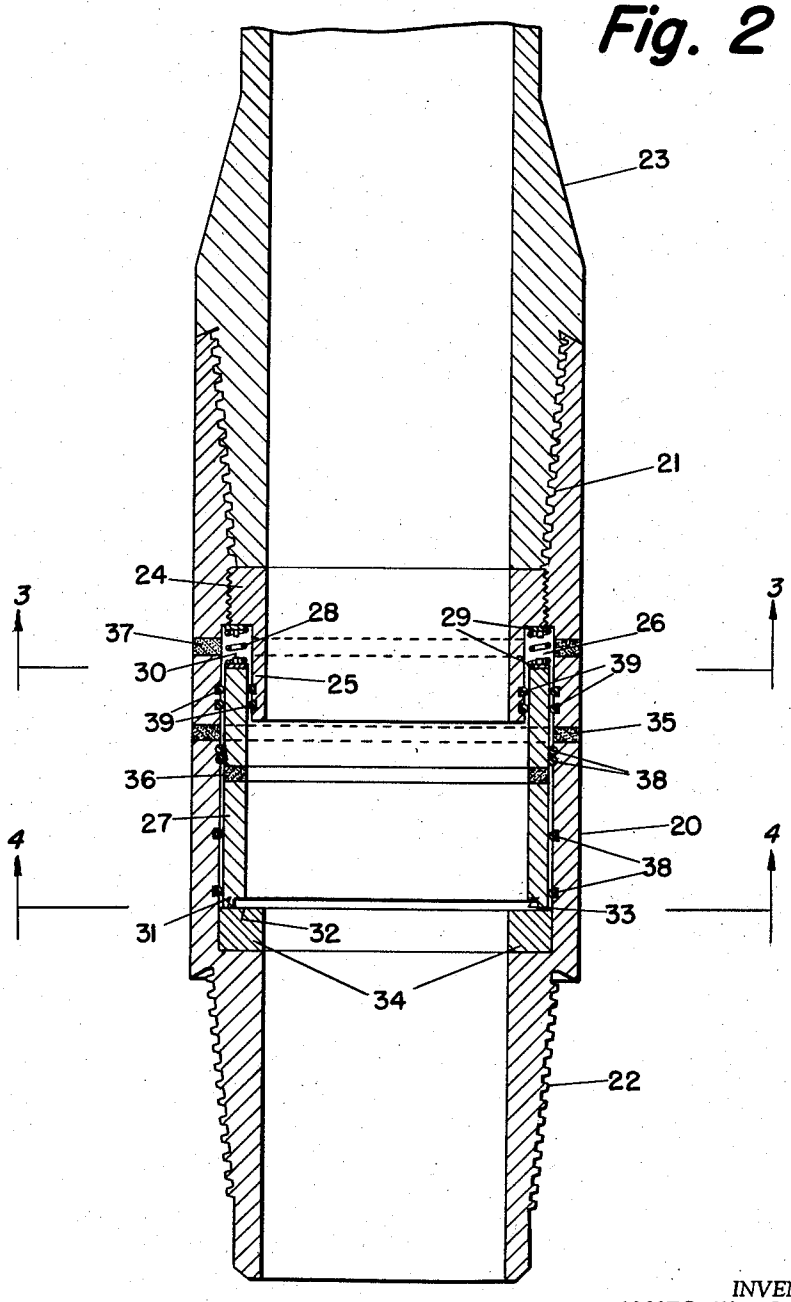
Fig. 2



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2,920,764

MEANS FOR REDUCING LIQUID LEVEL IN WELL TUBING

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Application July 2, 1958, Serial No. 746,276

4 Claims. (Cl. 210—429)

This invention relates to means for lowering the liquid level in an oil or gas well and more particularly is directed to a valved device adapted for insertion in a tubing string and which can be hydraulically operated to permit fluid withdrawal through the tubing wall.

In order for a completed oil or gas well to flow naturally it is essential that the pressure due to the hydrostatic head of liquid in the well be less than the reservoir pressure. In many cases after a completed well has been washed and the packer has been set between the tubing and casing, the reservoir pressure will be insufficient to overcome the hydrostatic head of the water column within the tubing and the well will not flow. In such cases it is necessary to reduce the water level in the tubing sufficiently to allow the well to flow. Also, during the course of producing a well, salt water generally will accumulate in the tubing and may increase the hydrostatic head sufficiently to stop the flow of oil. When this happens it likewise is necessary to remove water from the tubing so that production can be continued.

Various procedures are known for removing water from the tubing in a well. In some cases a device, which is run as a part of the tubing string at a suitable depth, is employed to function as a valve which can be opened to permit water to flow from the side of the tubing string into the annulus between the tubing and casing. These devices generally are sliding sleeve valves which have to be opened by means of a shifting tool that is run on a wire line. Use of the shifting tool is time-consuming and expensive and furthermore is injurious in cases where plastic-coated tubing is used in the well.

Another device for lowering the liquid level in well tubing is disclosed and claimed in my co-pending patent application Serial Number 659,873, filed May 17, 1957. This device comprises a spring loaded valve positioned in a housing located on the outside of the well tubing at a suitable depth above the packer. By applying gas pressure at the top of the tubing, the valve, which is pre-set to open at a given pressure, can be made to open and permit water to flow from the tubing into the annulus from which it is withdrawn from the well. However, this device cannot be used in wells having multiple tubing strings due to lack of space.

The present invention provides an improved device for unloading well tubing which is run as part of the tubing string and which therefore can be used in wells having multiple tubing strings. The device comprises a longitudinally slidable valve member which contains ports that can be brought into alignment with corresponding ports in the tube wall by the application of hydraulic pressure. The valve normally is closed but can readily be opened at any time it is desired to reduce the fluid level in the tubing merely by applying gas or air pressure to the tubing at the well head. After sufficient water has been forced from the tubing to lower the liquid level to the desired depth, application of the gas or air pressure is stopped and the valve then automatically closes.

The invention is described more specifically with reference to the accompanying drawings in which:

Fig. 1 is a schematic illustration partly in section of an oil well equipped with an unloading device according to the invention.

Fig. 2 is a sectional elevational view showing details of the unloading device.

Figs. 3 and 4 are cross-sectional views taken, respectively, on the lines 3—3 and 4—4 of Fig. 2.

Referring to Fig. 1, a well is shown including the well head or Christmas tree **10**, casing **11** and well tubing **12**. A packer is positioned between the casing and tubing as illustrated at **13**. An unloading device **14**, such as is described hereinafter in connection with Figs. 2–4, is located in the tubing **12** as part of the tubing string. The device has screened openings, indicated at **15**, through which fluid can flow out of the tubing into the annulus **9** between the tubing and casing. Gas or air can be supplied to the tubing through line **16** from a suitable pressure source such as a portable compressor (not shown). Liquid can be removed from the annulus **9** at the well head by means of line **17**.

The unloading device shown in Figs. 2–4 comprises a housing member **20** which has threads **21** and **22** at its ends for insertion in well tubing **23**. An internal collar **24** is threaded into the housing and has a projection **25** which forms an annular recess **26** with the housing. A sleeve valve member **27** is positioned in the housing with one end extending into recess **26** which contains compression springs **28** urging the valve member **27** outwardly of the recess or downwardly for the position of the device as shown in Fig. 2. Guide rings **29** carrying positioning pins **30** maintain the springs **28** in proper position. The lower end of valve member **27** has rib **31** at its outer edge which abuts against a shoulder **32** in housing **20**. This permits the lower end of the valve member to have an open faced area **33** against which hydraulic pressure can be applied when the valve member is spring pressed to its lowermost position. Preferably the shoulder **32** contains one or more magnets **34** which aid springs **28** in returning the valve member to closed position after the application of hydraulic pressure has been stopped.

The housing **20** is provided with an opening through which fluid can pass when the valve is in open position. Such opening can comprise a series of circumferential ports in the housing. However, it is distinctly preferable to form the opening by means of a permeable band of sintered metal as indicated by numeral **35**. This construction will allow passage of fluid while preventing any solid material from entering the tubing from the annulus. In the valve member **27** another sintered metal band **36** preferably is provided for cooperation with band **35** to form a flow channel for the tubing fluid when the valve is opened. The two bands are so spaced from each other that they are out of alignment when the valve is closed but are brought into alignment as valve member **27** is forced upwardly against springs **28** when pressure is applied at the top of the well tubing. Between the housing **20** and valve member **27** O-ring packing means **38** are provided to guide the valve member while preventing fluid leakage and additional O-rings **39** are positioned in recess **26** to prevent leakage into the chamber containing springs **28**.

The housing **20** preferably has means for equalizing pressure between recess **26** and the annulus between the tubing and well casing. The preferred manner of doing this is, as shown in Fig. 2, to position another sintered metal band **37** in the housing adjacent the upper part of recess **26**. This allows fluid to pass out of the recess as the valve member **27** moves upwardly while preventing solid matter from entering the recess from the annulus.

While the use of such pressure equalizing means is preferred to facilitate the valve operation, it is not essential since recess **26** alternatively can contain air or other gas which is compressed as the valve member **27** moves upwardly.

Whenever it becomes desirable to reduce the fluid level in the well tubing, gas or air is admitted to the top of the well tubing under sufficient pressure to cause valve member **27** to move upwardly by virtue of the resulting hydraulic force applied to its open faced end **33**. This brings the porous metal band **36** into alignment with band **35** and allows fluid to flow from the tubing into the casing annulus. Fluid is withdrawn from the annulus at the top of the well until the level in the tubing has been lowered to the desired depth. Admission of air or gas into the tubing is then stopped and production of oil or gas from the well can be resumed.

The device shown in Fig. 2 can be employed with either end in an upward position without affecting its operation. Reversal of the position shown in Fig. 2 merely requires slightly more force from the springs **28** in order to lift instead of lower the valve member **27** to its closed position.

I claim:

1. A device adapted for insertion in a string of well tubing to permit fluid withdrawal through the tubing wall which comprises a housing member having a passage therethrough, means within the housing forming an annular recess therewith, a sleeve valve member positioned adjacent the inner wall of the housing and slidable in said recess, spring means in the recess pushing against the end of the valve member therein, an abutment providing an end of travel for the other end of the valve member while permitting an exposed end face, and packing means for preventing fluid leakage along the valve member into said recess, said housing and said valve member having wall openings normally out of alignment with each other when the valve member is at said end of travel but positioned for alignment when the valve member slides toward said recess due to hydraulic pressure applied to said exposed end face.

2. A device according to claim 1 including magnetized means adjacent said end of travel for exerting an attractive force on said valve member.

3. A device according to claim 1 in which said wall openings are provided by sintered metal bands in the walls of the housing and sleeve valve member.

4. A device according to claim 1 in which said wall openings are provided by sintered metal bands in the walls of the housing and sleeve valve member, and which includes another opening in the housing wall providing pressure equalization between the recess and outside the housing and further includes magnetized means adjacent said end of travel for exerting an attractive force on said valve member.

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