

Aug. 17, 1954

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2,686,566

OIL WELL SAMPLING DEVICE

Filed June 21, 1951

2 Sheets-Sheet 1

Fig. 1

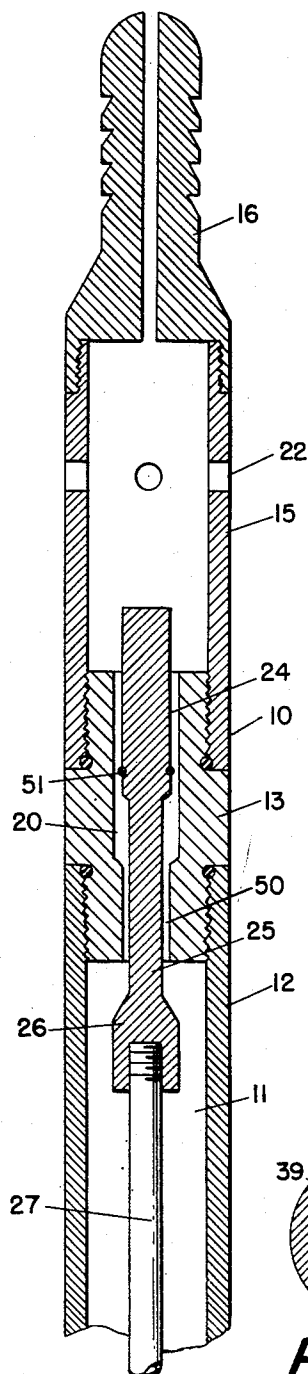


Fig. 2

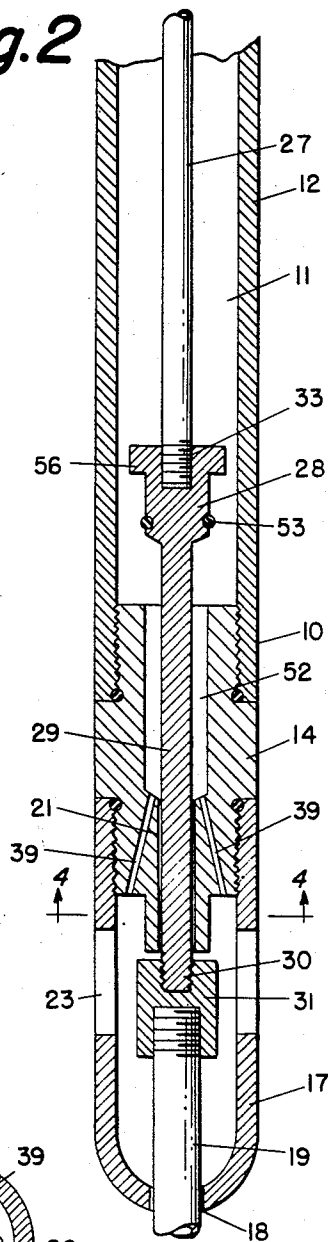
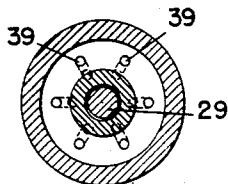


Fig. 4

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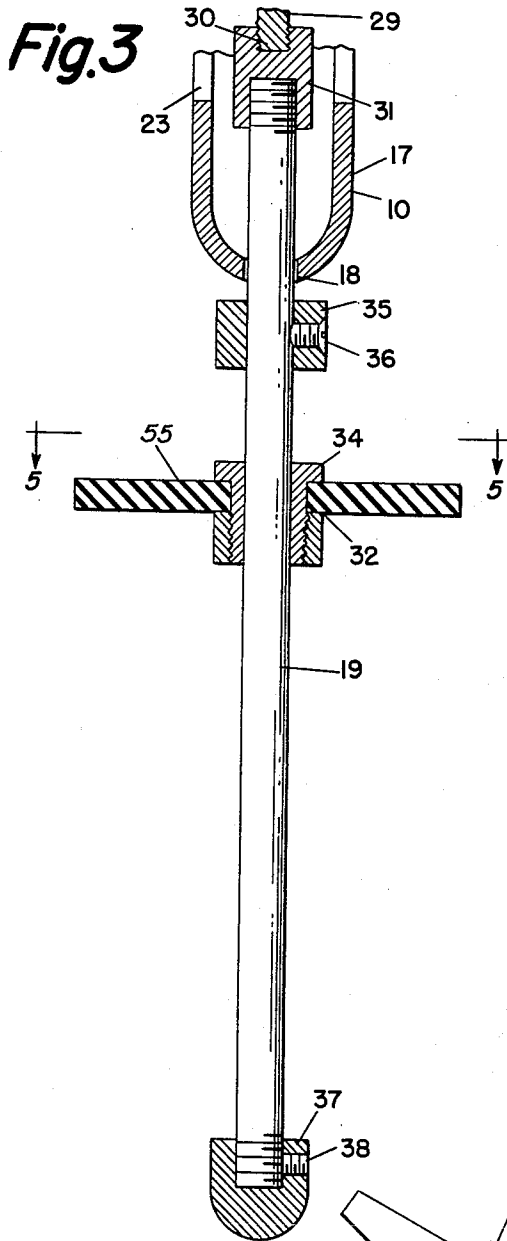
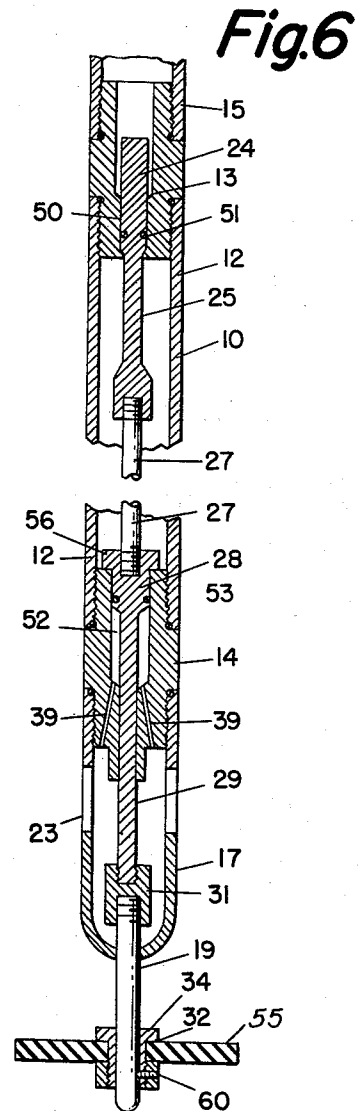
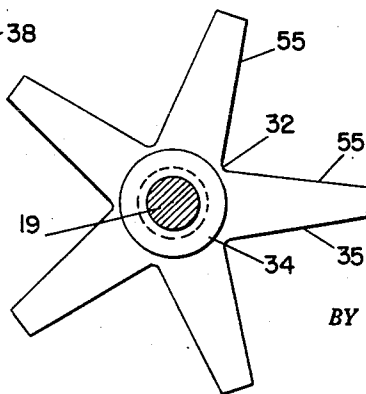
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OIL WELL SAMPLING DEVICE

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6 Claims. (Cl. 166—165)

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This invention relates to an apparatus for obtaining samples from oil reservoirs for determining the characteristics, such as the compressibility, gas content, and the shrinkage loss to be expected upon producing the oil from the reservoir and delivering it to a conventional surface storage tank.

Analysis of fluid produced from a well will show different characteristics from an exact sample of fluid taken directly from the fluid reservoir, such as an oil reservoir at the bottom of a well. The produced fluid undergoes changes due to loss of gas or lighter constituents during its passage from the reservoir, and hence the produced fluid does not give, upon analysis, the proper data on which to base reservoir engineering calculations.

One method which has been used to obtain samples from fluid reservoirs is to utilize a tubular member having a sample chamber which is provided with valves adjacent its upper and lower ends. As the tubular member is lowered through the tubing to the fluid reservoir the sample chamber receives a true sample when the valves are opened and the sample is retained in the chamber when the valves are closed. Difficulty has heretofore been experienced in constantly maintaining the valves in closed position in order to retain the true sample in the sample chamber as the device is withdrawn from the tubing. It is to this general type of sampling device that my invention is directed and by my invention a valve arrangement is provided which will insure that the valves remain closed, regardless of temperature and other conditions existing during the removal of the device from the tubing, and for a sufficient length of time to permit the transfer of the sample to a testing point where the true characteristics of the fluid existing in the reservoir can be determined.

In general, my invention comprises an elongate housing having upper and lower valves, each consisting of a valve body providing a valve seat and a cooperating valve plug, with an elongate compartment therebetween providing a chamber for receiving a fluid sample. The elongate housing terminates below the lower valve body in a fluid inlet section and at its upper end above the upper valve body in a fluid outlet section. The valve bodies are provided with axial passageways which effect communication between the inlet and outlet sections and the sample chamber permitting, when the valves are open, the continuous flow of fluid through the sample chamber. The upper and lower valve plugs are interconnected by a rod positioned within the sample chamber and are

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adapted to be reciprocated within the axial passageways of the valve bodies to simultaneously place the valves in closed or open position and permit or stop the flow of fluid through the sample chamber. Resilient rings are provided on each of the valve plugs to provide an effective seal with the axial passageways in the valve bodies, and the axial passageways provide in effect elongate cylindrical valve seats permitting the valves to remain closed even though the valve plugs move within the passageways during removal of the device from the well tubing. A valve actuating shaft extends through the inlet section of the housing and is arranged to move the valve plugs to open or closed position. To this end a flexible actuator is mounted on the shaft exteriorly of the housing and is of sufficient diameter to frictionally contact the tubing wall and be flexed downwardly or upwardly in accordance with the inward or outward movement of the device through the tubing and to permit movement of the valve seats relative to the valve plugs in accordance with such movement. During the inward movement of the device through the tubing, the valve plugs will be held in the upper position and out of the valve seats as shown in Figures 1 and 2 while in the reverse movement of the device, the valve plugs will be held in their lower position within the cylindrical valve seats.

For a more detailed description of the invention, reference may be had to the accompanying drawings in which:

Figure 1 is a longitudinal section through the upper end portion of the device and showing details thereof.

Figure 2 is a view in continuation of Figure 1 and of the lower end portion of the device showing details thereof.

Figure 3 is a view showing details of elements positioned exteriorly of the lower end portion of the device.

Figure 4 is a view taken on the line 4—4 of Figure 2.

Figure 5 is a view taken on the line 5—5 of Figure 3.

Figure 6 is a view on reduced scale of a slightly modified form of the invention with elements in different positions from that shown in Figures 1, 2, and 3.

Referring to Figures 1, 2, and 3 which taken together show one form of the composite sample device indicated generally at 10. The device comprises an elongate housing made up of several cylindrical members interconnected by internal couplings or elements known in the oil fields as

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"subs" which are arranged to additionally function as valves and, exteriorly of the device, an actuator is provided to operate the valves to open or closed position.

In Figures 1 and 2, 11 indicates a sample chamber which is formed by a tubular member 12 having screw threadedly secured at its upper end a coupling 13 and in its lower end another coupling 14. The coupling 13 is in turn screw threadedly to an upper cylinder 15 which has as its upper end a cap 16 arranged to receive a wire line for lowering the device into the well tubing. The coupling 14 receives a lower cylinder 17 having an aperture 18 at its lower end for the reception of an actuating shaft 19, the function of which will later be described. The couplings 13 and 14 are provided with axial passageways 20 and 21 respectively while the upper and lower cylinders 15 and 17 are apertured at 22 and 23 respectively for permitting fluid to flow through the device. For example when the device is lowered into a well any liquid encountered will enter cylinder 17, which is the inlet section of the device, pass through coupling 14, the sample chamber 11 and out through cylinder 15, which is the outlet section of the device. The couplings 13 and 14 are arranged to provide valve seats and to receive valve plugs which are in open position during passage of the device into well tubing and in closed position when the device is withdrawn in order to retain a sample of fluid within the sample chamber.

A valve plug 24 having a valve stem 25 extends through passageway 20 and terminates in a screw threaded end portion 26 for the reception of the upper end of a connecting rod 27 positioned within the sample chamber 11 and which has its lower end secured to a valve plug 28. The valve plug 28 is positioned within the sample chamber and has a valve stem 29 which extends through the axial passageway 21 of the coupling 14 and terminates in a screw threaded end portion 30, positioned within the inlet section 17. The valve plug 28 is screw threaded to receive the lower end of the connecting rod 27 and the lower end 30 of its valve stem 29 is interconnected with the actuating shaft 19 through a connecting block 31. As shown in Figure 3, the actuating rod 19 extends through the aperture 18 in the inlet section 17 and is provided with an actuator 32 which preferably is of rubber or some suitable material which may be flexed when in frictional contact with the inner wall of the well tubing. The flexible actuator 32 is mounted in a stuffing nut 34 in order to permit the shaft 19 to move relative thereto. At the upper end, directly below the lower end of the inlet section 17, is provided an upper stop 35 fixed to the actuating shaft 19 by means of a set screw 36, and at the lower end, shaft 19 is provided with a lower stop 37 which is secured to the shaft by set screw 38.

Since the valve stem portion 29 of valve plug 28 is disposed in close fitting relation with the passageway 21, a plurality of additional openings 39 shown clearly in Figure 4 are provided for the passage of fluid from the inlet section 17 into the sample chamber 11.

The axial passageway 20 in coupling 13 terminates in a reduced portion 50 which forms a cylindrical valve seat for upper valve plug 24 and the valve plug is provided with an annular sealing ring 51 preferably formed of rubber or other flexible material. The axial passageway in coupling 14 terminates at its upper end in

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an enlarged portion 52 providing a cylindrical valve seat for the lower valve plug 28 which is also provided with an annular flexible sealing ring indicated at 53. The aperture 18 and axial passageway 21 function as guides to maintain the valve plugs 24 and 28 aligned axially of the housing.

In Figure 5 is shown a plan view of the valve rod actuator 32 which as indicated, is preferably provided with a plurality of lateral fingers 55. The actuator is constructed of material which is capable of being flexed so that as the device is lowered into the well tubing, it will be flexed downwardly when in frictional contact with the tubing, and the valve shaft 19 will move downwardly through the stuffing nut 34 until the upper stop 35 is reached, and when the device is pulled outwardly of the tubing, the actuator 32 will be flexed upwardly, and the actuating shaft 19 will move through the stuffing nut 34 until the lower stop 37 is reached.

From the description of the device so far, it will be noted that the valve plugs 24 and 28 are in the position shown in Figures 1 and 2 which would be the condition existing when the device is lowered into the well tubing, and the valve actuator 32 is flexed downwardly which would cause the valve actuating shaft 19 to move relative to the actuator 32 until the upper stop 35 is reached at which time the couplings 13 and 14 and elements connected therewith will move downwardly and the valve plugs 24 and 28 will become unseated. During the downward movement of the device into the well, any fluid contacted will pass into the inlet section 17, passageways 39 in coupling 14, the sample chamber 11, passageway 20 in coupling 13, and exit through the apertures in the outlet section 15. Thus the sample chamber is continuously purged during downward travel and, upon reaching the depth from which a sample is desired, will contain fluids representative of the well fluids at that depth. Upon upward movement of the device, the flexible actuator 32 will flex upwardly through the frictional contact of its fingers with the tubing, and the shaft 19 will move upwardly through the actuator until stop 37 is reached at which time, through the various connections the couplings 13 and 14 will move upwardly relative to the rod and shaft until the valve plugs 24 and 28 enter the cylindrical valve seats 50 and 52 respectively to seal the sample chamber and maintain liquid therewithin. At this time the sample chamber 11 will contain a true sample of oil from the reservoir which has been encountered.

The lower valve plug 28 is of greater cross-sectional area than the upper valve plug and, for example, may be provided with a shoulder 56 so that as long as the pressure within the sample chamber is greater than the external pressure on the device, the sample chamber will be maintained closed, and completely seal the sample within the chamber.

It will be understood, of course, that the fingers 55 of the actuator 32 will extend laterally a sufficient distance and be of sufficient rigidity to make certain that it will be frictionally held by the tubing wall in order that it will contact the stops 35 and 37 when the shaft 19 is moved with respect thereto. The particular arrangement of actuating shaft and actuator shown in Figure 3 is provided in order that the actuator 32 may be knocked loose in case it becomes hung up in the tubing by raising the device a distance

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insufficient to cause the valves to close and then dropping it against the actuator. The device is operated in the manner of a jar, that is, by raising the device to its upper limit of motion until the lower stop 37 contacts the actuator 32 and dropping it until the upper stop 35 contacts the actuator 32 a series of impacts are produced which may be repeated until the actuator becomes movable with respect to the tubing.

The cylindrical valve seats 50 and 52 are of particular importance in the present invention since with this arrangement the valve plugs 24 and 28 may move within the cylindrical seats during removal of the device from the tubing and still maintain an effective seal. This provision is necessary since it is apparent that the connecting rod 27 will vary in length over a small range due to the great temperature difference existing between the surface and the bottom of the well tubing. Also, the actuating shaft will elongate slightly as the device is drawn from the well tubing due to its being subjected to an increasing tensile force which is required to maintain the upper valve in the seated position. The valve sealing rings 51 and 53 respectively, when the valve plugs are in seated position, will wipe the surfaces of the cylindrical seats free of any solid particles such as sand, rust or the like and thus provide a clean surface on which to establish an effective seal. In actual construction of the device, the valve plugs 24 and 28 are so arranged relative to the valve seats 50 and 52 that the seal rings, when the valves are in closed position, will be positioned about midway within the valve seats in order to allow for the contraction and expansion of the connecting rod 27 and still maintain a proper seal.

Figure 6 is a view of the device showing a slightly modified valve actuating mechanism. In this figure the valve plugs 24 and 28 are shown in closed position with their valve sealing rings 51 and 53 respectively positioned some distance within the cylindrical valve seats 50 and 52. The remainder of the other structure shown in Figure 6 is similar to Figures 1, 2, and 3 with the exception of the modified arrangement of valve actuator. In view of this, only the valve actuating arrangement will be described in detail.

Valve actuating shaft 19 in this figure has the flexible valve actuator 32 secured thereto by means of stuffing nut 34 and set screw 60. In the present arrangement, the valve actuator 32 will function in a manner similar to that described in connection with Figure 3 in that as the device is introduced in the well tubing, the actuator 32 is flexed downwardly pulling the shaft 19 downwardly at which time the couplings 13 and 14 with elements connected thereto will move downwardly and the valve plugs 24 and 28 become unseated. When the device is moved upwardly the actuator 32 will flex upwardly and the valve plugs 24 and 28 will resume seated position. The valve actuating arrangement shown in Figure 6 will function effectively, but does not have the advantage of the construction shown in Figure 3 wherein, as heretofore explained, provision is made for knocking the valve actuator 32 loose from the tubing by utilization of the upper and lower stops 35 and 37. In Figure 6, when the valve actuator 32 becomes hung up in the tubing, it can be released only by a pulling or pushing action on the device.

Since the function of the actuator 32 is to frictionally grip the inner wall of the tubing

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and permit movement of the valve seats relative to the valve bodies it may be constructed of other material than rubber or other generally understood, flexible material. It is essential that the actuator be constructed with openings therein or provided with fingers as shown in the drawings in order to provide for frictional engagement with the tubing while permitting fluid to flow through the actuator and into the sample chamber.

I claim:

1. A device adapted to be lowered into and removed from well tubing for obtaining a sample from a fluid reservoir within a well which comprises an elongate housing having spaced upper and lower valve bodies providing a fluid sample chamber therebetween, said valve bodies having axial passageways extending therethrough to be in communication with the sample chamber and with the exterior of the device and forming valve seats, an upper valve plug and a lower valve plug adapted to seat respectively in said valve seats, said lower valve plug having greater horizontal cross sectional area than the upper valve plug, a rod interconnecting said valve plugs, a shaft depending from the lower valve plug, an actuator on said shaft positioned exteriorly of the housing and adapted to frictionally engage the tubing wall, said actuator during lowering of the device into the tubing maintaining said valve plugs removed from the valve seats and permitting fluid to flow through the sample chamber and during removal of the device from the well tubing, maintaining said valve plugs closed with respect to the valve seats in order to retain a fluid sample within the sample chamber.

2. A device adapted to be lowered into and removed from well tubing for obtaining a sample from a fluid reservoir within a well which comprises an elongate housing having spaced upper and lower valve bodies providing a fluid sample chamber therebetween, said valve bodies having axial passageways extending therethrough to be in communication with the sample chamber and with the exterior of the device and forming elongate valve seats, an upper elongate valve plug and a lower elongate valve plug adapted to seat respectively in said valve seats, said lower valve plug having greater horizontal cross-sectional area than the upper valve plug, a rod interconnecting said valve plugs, a shaft depending from the lower valve plug, an actuator on said shaft positioned exteriorly of the housing and adapted to frictionally engage the tubing wall, said actuator during lowering of the device into the tubing maintaining said valve plugs out of the elongate valve seats and permitting fluid to flow through the sample chamber and during removal of the device from the well tubing maintaining said valve plugs within the elongate valve seats in order to retain a fluid sample within the sample chamber.

3. A device adapted to be lowered into and removed from well tubing for obtaining a sample from a fluid reservoir within a well which comprises an elongate housing having spaced upper and lower valve bodies providing a fluid sample chamber therebetween, said valve bodies having axial passageways extending therethrough to be in communication with the sample chamber and forming elongate cylindrical valve seats, an apertured fluid inlet section and an apertured fluid outlet section at the lower and upper ends respectively of the housing, an upper valve plug and a lower valve plug adapted to seat respec-

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tively in said valve seats, said lower valve plug having greater horizontal cross-sectional area than the upper valve plug, a rod interconnecting said valve plugs, a shaft depending from the lower valve plug having an outer end portion extending through the inlet section, an actuator on said outer end portion of the shaft and adapted to frictionally engage the tubing wall, said actuator during lowering of the device into the tubing maintaining said valve plugs out of the elongate valve seats and permitting fluid to flow through the sample chamber and during removal of the device from the well tubing maintaining said valve plugs within the elongate valve seats in order to retain a fluid sample within the sample chamber and said outlet section being adapted to removably receive a line for lowering the device into and removing the device from the well tubing.

4. A device as in claim 1, further characterized by said actuator being movably mounted on said shaft and said shaft having cooperating stops secured thereto one above and one below the actuator providing an arrangement whereby the actuator, when stuck in the tubing, can be loosened by raising the rest of the device and then dropping it to cause the upper stop on said shaft to strike against the actuator.

5. A device as in claim 2, further characterized by said actuator being movably mounted on said shaft and said shaft having cooperating stops secured thereto one above and one below the

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actuator providing an arrangement whereby the actuator, when stuck in the tubing, can be loosened by raising the rest of the device and then dropping it to cause the upper stop on said shaft to strike against the actuator.

6. A device as in claim 3, further characterized by said actuator being movably mounted on said shaft and said shaft having cooperating stops secured thereto one above and one below the actuator providing an arrangement whereby the actuator, when stuck in the tubing, can be loosened by raising the rest of the device and then dropping it to cause the upper stop on said shaft to strike against the actuator.

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