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EUROPEAN QUALIFYING EXAMINATION 2024

Paper A

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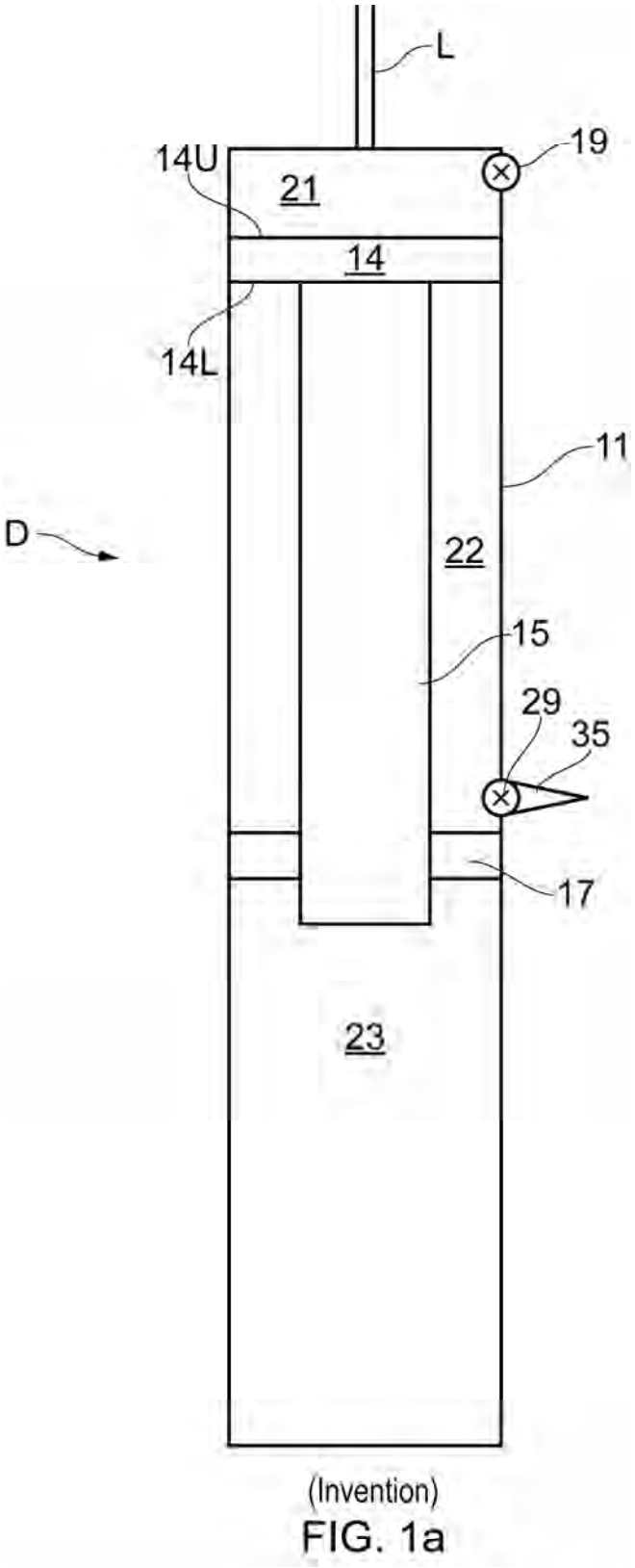
Content (6 pages „Client‘s letter“) only available on screen during the examination

Contentu (6 pages „Lettre du client“) uniquement visible sue l‘écran pendant l‘examen

Client’s drawings



(Invention)
FIG. 1a

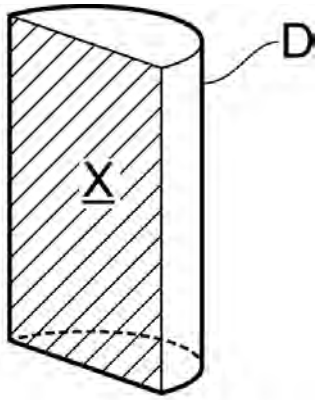


FIG. 1b

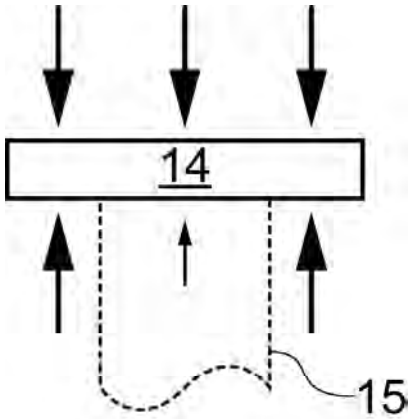
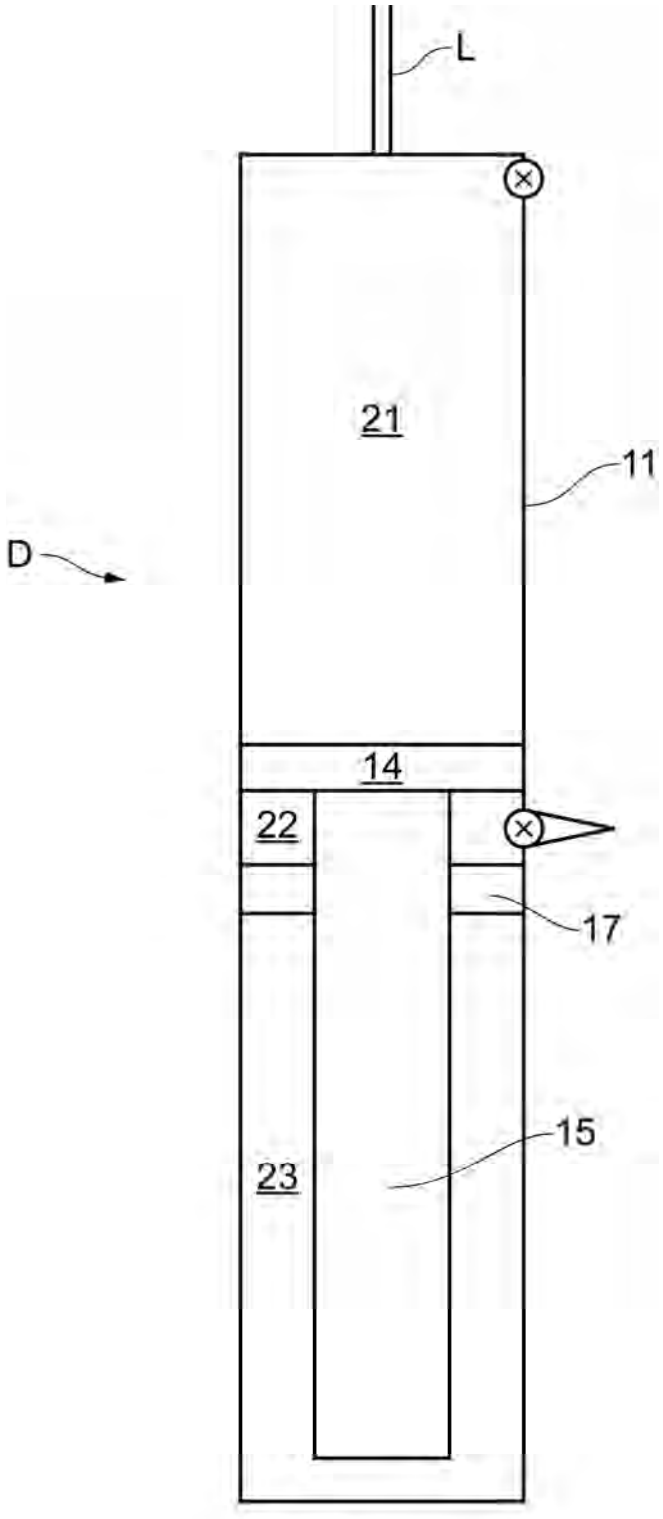


FIG. 1c



(Invention)
FIG. 2

Prior art D1

Extract from oilfield glossary

Acid treatment

[001] Acid treatment of wells can be used to remove debris that is inhibiting flow of fluids in the well. A pressurised container is deployed downhole and drives a piston to deploy acid into the well. See Figs. 1a and 1b, which show a device D' in a well W in a rock formation R, the well W having a metal casing C.

[002] The device D' is cylindrical in shape, as shown in Fig. 1b. Fig. 1a shows the section X taken through the cylinder-shaped device D'. The device D' has a container 1, separated and sealed by a moveable piston 4 into an acid chamber 2 and a very high-pressure gas chamber 3. When it is required to deploy the acid from the chamber 2 into the well W, a valve 9 is opened and the very high-pressure gas in the chamber 3 drives the piston head 4 towards a nozzle 5, thereby expelling the acid from inside the container 1 through the valve 9 and nozzle 5 to outside the container 1 and thus into the well. The device may be used to remove solids blocking flow paths in the well.

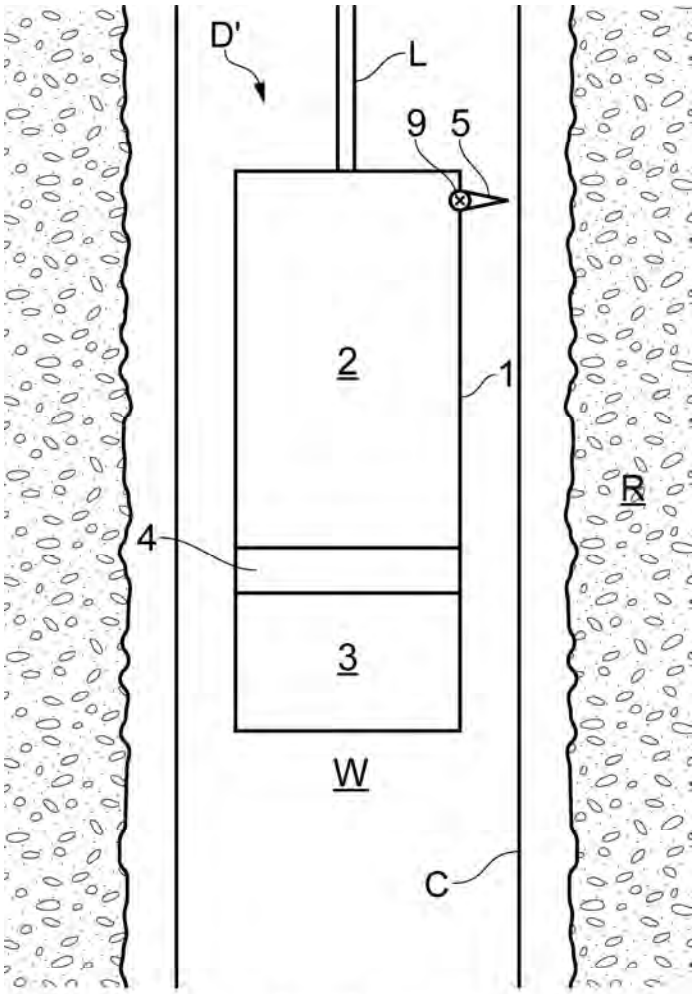


FIG. 1a (Prior Art)

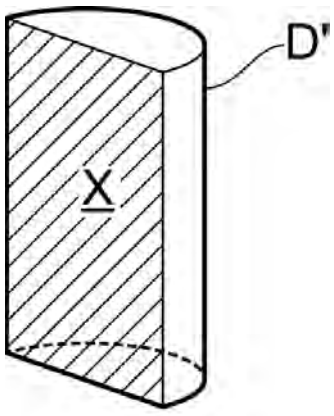


FIG. 1b

D2 Description

[001] Fig. 1a is a turbine apparatus to generate electricity in a well. Data transmitters in a well require power. Whilst batteries can be used, the high temperatures often found in wells cause them to deteriorate quickly. Instead, we propose a turbine device D'' in the form of a cylindrical container 101 having a first drive chamber 121, a second liquid chamber 122 and a third low-pressure chamber 123 for gas. The drive chamber 121 is open to the surrounding well via an opening 119 which can be any size.

[002] A piston 114, 115 moves in the container 101, depending on the relative pressures acting on it. The piston head 114 delineates the drive chamber 121 from the liquid-containing chamber 122 and seals them from each other.

[003] A static disc 117 generally delineates the second liquid chamber 122 from the third low-pressure chamber 123, but includes a neck 142 with a valve 143 which connects the second liquid chamber 122 and the third low-pressure chamber 123 for gas when the valve 143 is open and seals them from each other when the valve 143 is closed. The neck 142 also includes a turbine 141 with turbine blades.

[004] Before deployment, we evacuate the low-pressure chamber so that it is at 0.5 times atmosphere pressure (50 kPa). To be worthwhile, the pressure in the well at the depth of deployment should be at least 8 times atmospheric pressure (800 kPa).

[005] When power is required the valve 143 is opened, and the high pressure in the well, compared to the much lower pressure in the low-pressure chamber 123 for gas, drives the piston 114 down and drives the fluid through the turbine 141 and the valve 143. The consequential turbine rotation generates power, which can be stored by a capacitor 146 and used as required by a transmitter 145 to send signals back to the surface.

[006] The piston 114, 115 continues down towards the turbine 141 until a mechanical override in the form of a rod 115 then extends between the turbine blades to stop them turning and to prevent discharge of the capacitor 146 back into the turbine 141. The rod 115 then extends through the valve 143 into the low-pressure chamber 123 for gas to ensure it remains open as the apparatus is subsequently removed from the well. Fig. 1b shows the rod 115 between the blades of the turbine 141 in the neck 142. The piston head 114 eventually abuts the neck, as shown in Fig. 1b. The rod needs to be less than 7 cm in diameter to fit through the valve and between the turbine blades.

[007] The apparatus is then spent and can produce no more power. It can be recovered to the surface. When spent, the apparatus may still contain fluids at a similar high pressure to the conditions in which it operated in the well. As the apparatus is recovered to the surface, the pressure in the well at shallower depths is reduced and is even lower at the surface. Handling high-pressure containers at the surface is dangerous. Therefore, during transit out of the well, a valve 129 can be opened to allow fluids to be expelled from the container and reduce the pressure inside as it passes through lower-pressure/shallower parts of the well. The loose fitting of the rod 115 in the neck 142 ensures the former low-pressure chamber 123 for gas can also depressurise in this way, past the valve 143 and turbine 141 in the neck 142.

[008] The liquid used in the liquid chamber 122 can be oil, water, brine or acid.

[009] In an alternative embodiment, a control valve may be provided instead of the opening 119 to control ingress of fluid into the drive chamber 121.

[010] The turbine apparatus can be used in different wells, such as production wells, injection wells or geothermal wells.

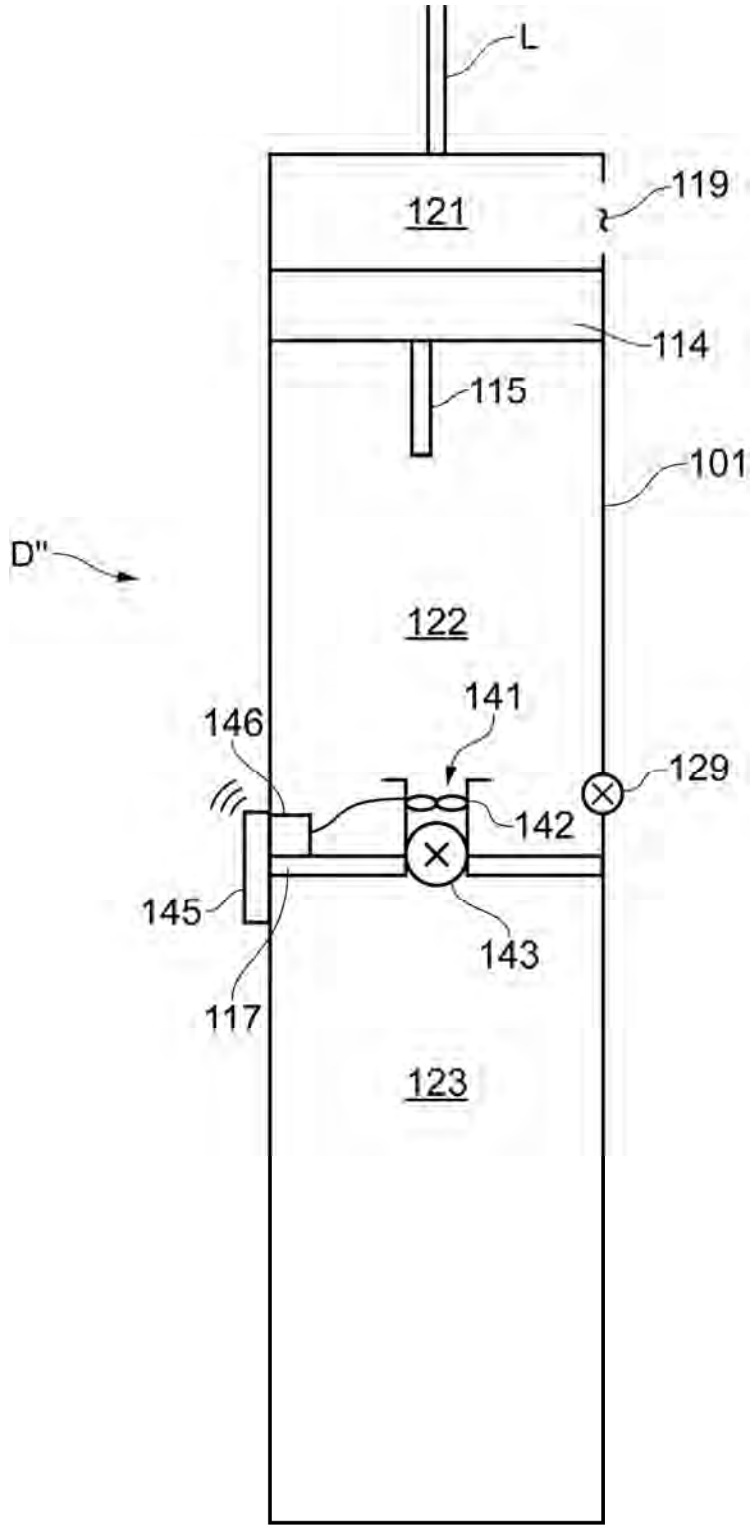


FIG. 1a

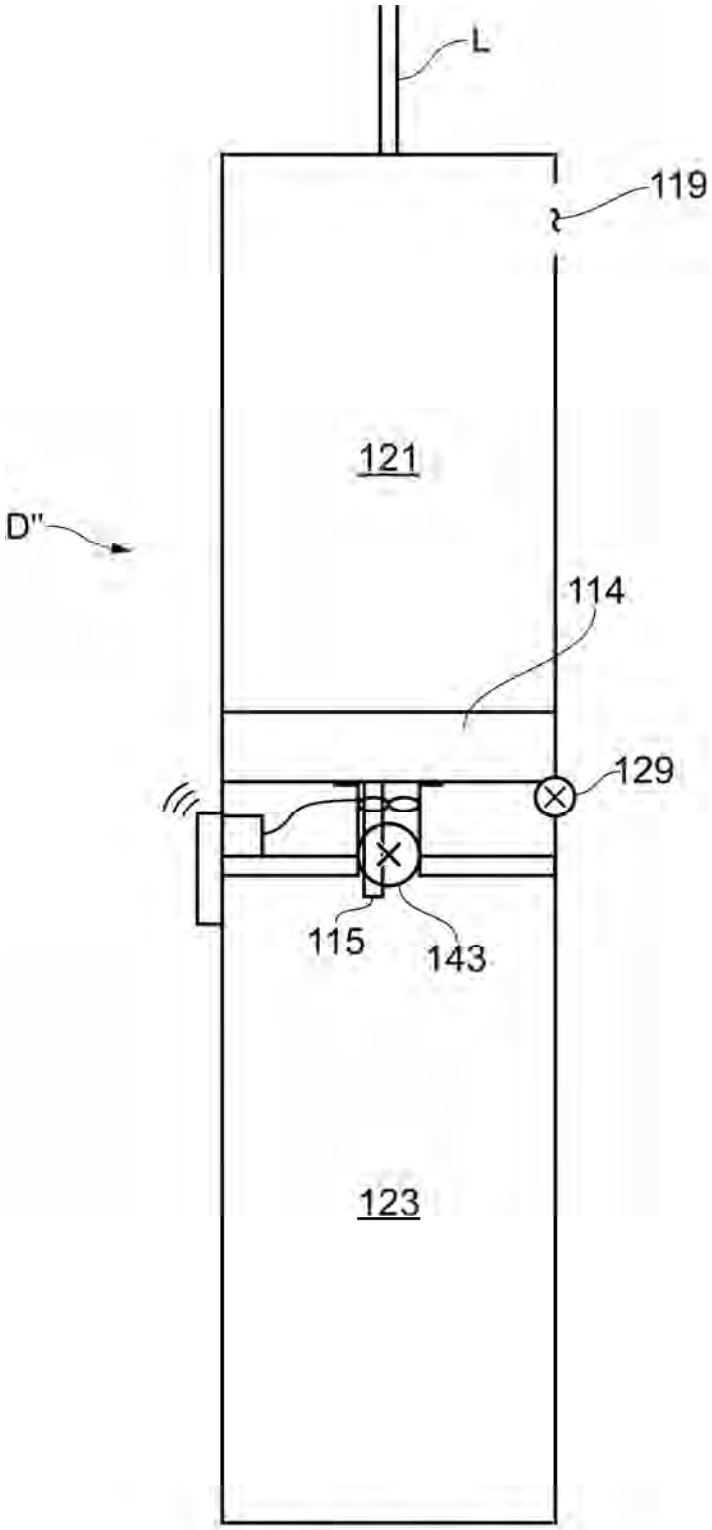


FIG. 1b