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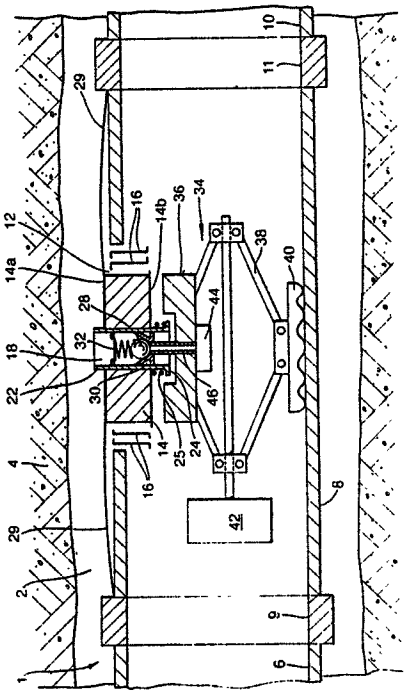
(54) Titre : Wellbore logging system.

(57) Abrégé : A logging system for use in a borehole formed in an earth formation, comprising a tubular element to be installed in the borehole, and a logging member including a conduit having an inlet opening and being movable in radial direction of the tubular element between a retracted position in which the logging member is substantially arranged within the tubular element and an extended position in which the logging member extends beyond the tubular element so that said inlet opening is in fluid communication with the earth formation when the tubular element is installed in the borehole, the logging system further comprising an activating device for moving the logging member between the retracted position and the extended position thereof.



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The invention relates to a logging system for use in a borehole formed in an earth formation.

Generally, in the practice of wellbore drilling each further section of a wellbore is drilled after the previously drilled wellbore sections are cased with wellbore casing. After completing drilling of the further section, a logging tool is lowered by wireline through the previously installed casing and into the newly drilled section so as to conduct a measurement of a downhole parameter. An example of such logging tool is a formation pressure test/sampling tool for measuring the pressure or composition of fluid present in the earth formation. Such tool is provided with a conduit which is pushed into the borehole wall a short distance so as to create fluid communication between the earth formation fluid and a fluid chamber of the tool.

A drawback of such wireline logging method is the required additional drilling rig time during lowering and operating the logging tool. A further drawback is that there is a danger that the logging tool gets blocked in the open wellbore section. Moreover, it may not be possible to insert the logging tool into a significant part of the newly drilled wellbore section, for example in case of a highly inclined or horizontal borehole sections. As a consequence valuable information on the surrounding formation cannot be obtained.

It is an object of the invention to provide an improved logging system which overcomes the drawbacks of the conventional system.

In accordance with the invention there is provided a logging system for use in a borehole formed in an earth formation, comprising a tubular element to be installed

in the borehole, and a logging member including a conduit having an inlet opening and being movable in radial direction of the tubular element between a retracted position in which the logging member is substantially arranged within the tubular element and an extended position in which the logging member extends beyond the tubular element so that said inlet opening is in fluid communication with the earth formation when the tubular element is installed in the borehole, the logging system further comprising an activating device for moving the logging member between the retracted position and the extended position thereof.

It is thereby achieved that that valuable drilling rig time is saved since the tubular element forms an integral part of the logging system and is to be lowered into the borehole anyway. Thus there is no need to separately lower a logging tool into the borehole by wireline during periods between lowering/installing the tubular element and drilling the further wellbore section. Also, lowering of the tubular element into highly inclined or horizontal wellbore sections can be done more easily than lowering of a wireline into such sections. A further advantage of the logging system according to the invention is that by moving the logging member to its retracted position the tubular element can be lowered into the borehole without being hampered by the logging system and without the risk of damage to the logging member. Further, by moving the logging member to its extended position after the tubular element is installed in the borehole, a characteristic of the earth formation fluid (e.g. pressure or composition) can be determined in a logging run.

Suitably the activating device is removably arranged within the tubular element. Thus, after lowering of the tubular element into the borehole and determination of

the fluid characteristic, the activating device can be removed from the tubular element and retrieved to surface so that the interior of the tubular element is free from obstacles in order to allow passage of wellbore tools or selected fluids through the tubular element.

Preferably the tubular element is one of a wellbore casing, a wellbore liner and a drill string.

The invention will be further described in more detail and by way of example with reference to the accompanying drawings in which

Fig. 1 schematically shows an embodiment of the logging system of the invention in a first mode of operation thereof; and

Fig. 2 schematically shows the embodiment of Fig. 1 in a second mode of operation thereof.

Referring to Figs. 1 and 2 there is shown a wellbore casing 1 arranged in a borehole 2 formed in an earth formation 4, which casing 1 has not yet been cemented in the borehole 2 but is suspended from a drilling rig (not show) at surface. The casing 1 includes an upper casing section 6, an intermediate casing section 8 connected to the upper casing section 1 by connector 9, and a lower casing section 10 connected to the intermediate casing section by connector 11. The intermediate casing section 8 is provided with an opening 12 in which a primary pad 14 and a telescoping member 16 are arranged. The pad 14 is of cylindrical shape and has an outer surface 14a facing the borehole wall and an inner surface 14b facing the interior of the casing section 8. At least an end part of the primary pad at the side of the outer surface 14a is made of elastomeric material.

The telescoping member 16 connects the primary pad 14 to the casing section 8, and is arranged to perform a telescoping movement in radial direction (of the casing 1) so as to move the primary pad 14 between a

retracted position wherein the primary pad 14 is located substantially within the outer radius of the casing section 8 and an extended position wherein the primary pad 14 extends beyond the outer radius of casing section 8 and the outer surface 14a contacts the wall of the borehole 2. Furthermore, the telescoping member 16 seals the primary pad 14 relative to the casing section 18.

The primary pad 14 is provided with a bore 18 extending in radial direction of the casing section 8, in which a conduit 22 is arranged in a manner allowing the conduit 22 to slide through the bore 18 a selected stroke. The conduit 22 has at its inner end a shoulder 24 which, when in contact with the inner surface 14a, prevents further outward sliding of the conduit 22. A compression spring 25, arranged between the shoulder 24 and the inner surface 14b of the primary pad 14, biases the conduit 22 to a radially inward position thereof. The conduit 22 is internally provided with a ball valve 26 including a ball 28 biased against a valve seat 30 by a spring 32. The ball valve 26 prevents flow of fluid from the exterior of the casing section 8 to the interior thereof when the ball 28 is biased against the valve seat 30.

The primary pad 14 is biased to its retracted position by a leaf spring 29 extending along the outer surface of the casing section 8 and being connected at opposite ends thereof to the casing section 8. The leaf spring 8 is provided with an opening (not shown) for passage of the conduit 22 therethrough as the conduit 22 slides outwardly through the bore 18.

An activating device 34 is removably arranged within the casing section 8 and latched to the casing wall by a latching assembly (not shown). The activating device 34 includes a secondary pad 36 of cylindrical shape and made

of elastomeric material, which secondary pad 36 is arranged concentrically relative to the primary pad 14 and a jack 38 arranged to bias the secondary pad 36 against the primary pad 14 so as to move the primary pad 14 between the retracted position thereof and the extended position thereof. The activating device 34 furthermore includes a support member 40 for supporting the jack 38 against the inner surface of the casing section 8, an electric motor 42 for operating the jack 38, a fluid chamber 44 provided with a fluid pressure gauge (not shown), an electronic control/memory unit (not shown) for controlling the electric motor 42 and the pressure gauge and for storing pressure readings of the pressure gauge, and a battery (not shown) for powering the control/memory unit and the electric motor 42. The secondary pad 36 is provided with a tube 46 extending concentrically through the secondary pad 36 and arranged to bias the ball 28 away from the valve seat 30 and to provide fluid communication between the conduit 22 and the fluid chamber 44 when the secondary pad is biased against the primary pad 14.

The primary pad 14, the secondary pad 36, and the conduit 22 are dimensioned such that, upon movement of the secondary pad 36 against the primary pad 14, the secondary pad 36 pushes against the conduit 22 which thereby slides in radially outward direction through the bore 18 and the opening of the leaf spring 29 until the shoulder 24 contacts the inner surface 14b of the primary pad 14.

Normal operation of the assembly referred to in Figs. 1 and 2 is hereinafter described, whereby Fig. 1 shows the primary pad 14 in the retracted position and Fig. 2 shows the primary pad in the extended position.

During normal operation the activating device 34 is latched into the casing section 8 by means of the

latching assembly, and the casing sections 6 and 10 are connected to casing section 8 by the respective connectors 9, 11. Then the casing 1, with the primary pad 14 in the retracted position, is lowered into the borehole 2. Lowering is stopped when the primary pad 14 arrives at a selected depth in the borehole where it is desired to conduct a pressure measurement of earth formation fluid such as oil or water. A wireless control system (not shown) at surface is then operated so as to induce the control/memory unit to operate the electric motor 42 so that the motor 42 induces the jack 38 to bias the secondary pad 36 against the primary pad 14. The primary pad 14 thereby moves from the retracted position to the extended position in which the outer surface 14a of the primary pad 14 is biased against the borehole wall (Fig. 2). Simultaneously the secondary pad 36 pushes against the conduit 22 so that the latter protrudes through the opening of the leaf spring 29 and extends a short distance into the borehole wall, and the tube 46 biases the ball 28 away from the valve seat 30 and thereby provides fluid communication between the conduit 22 and the fluid chamber 44. As a result the fluid chamber 44 communicates with fluid present in the earth formation. The control/memory unit then operates the fluid pressure gauge so as to measure the pressure of the formation fluid and to store the resulting pressure data in the electronic memory.

The electric motor 42 is then induced to retract the jack 34 so as to move the secondary pad 36 radially inward. As a result the primary pad 14 also moves radially inward due to the biasing force from the leaf spring 29. The primary pad 14 and secondary pad 36 remain in contact until the primary pad 14 reaches its retracted position. Further radially inward movement of the secondary pad 36 causes secondary pad 36 to become

displaced from the primary pad 14, and the tube 46 to become displaced from the ball 28 so that the spring 18 biases the ball 28 against the valve seat 30 thereby closing the ball valve 26.

If further earth formation fluid pressure measurements at different borehole depths are desired, the casing 1 is raised or lowered through the borehole 2 so as to relocate the primary pad 14 in the borehole 1 at the desired depths. The procedure as described hereinbefore is then repeated.

After completing the desired pressure measurements, a suitable retrieving device (not shown) is lowered through the casing 1 to the activating device 34 in order to unlatch the activating device 34 from the casing section 8 and to retrieve the activating device 34 to surface. The pressure data is then read out from the electronic memory at surface.

If no further earth formation fluid pressure measurements are to be conducted the casing 1 is cemented in the borehole 1. In case the borehole 2 is to be further drilled, the latching assembly is drilled out of the casing 1 before commencement of further drilling.

Instead of reading the pressure data from the electronic memory after retrieval of the activating device 34 to surface, the pressure can alternatively be read by extending a data transfer line (e.g. an electric conductor) from surface to the activating device 34 and transferring the data in the form of electric signals through the data transfer line to surface while the activating device 34 is still latched to the casing 1.

C L A I M S

1. A logging system for use in a borehole formed in an earth formation, comprising a tubular element to be installed in the borehole, and a logging member including a conduit having an inlet opening and being movable in radial direction of the tubular element between a retracted position in which the logging member is substantially arranged within the tubular element and an extended position in which the logging member extends beyond the tubular element so that said inlet opening is in fluid communication with the earth formation when the tubular element is installed in the borehole, the logging system further comprising an activating device for moving the logging member between the retracted position and the extended position thereof, wherein the tubular element forms one of a wellbore casing, a wellbore liner and a drill string.

2. The logging system of claim 1, wherein the logging member includes a pad which extends against the borehole wall when the tubular element is installed in the borehole and the logging member is in its extended position.

3. The logging system of claim 2, further comprising a telescoping member interconnecting the pad and the tubular element and being arranged to perform a telescoping movement so as to move the logging member between the retracted position and the extended position thereof.

4. The logging system of claim 2 or 3, wherein the pad forms a primary pad and the activating device includes a

secondary pad arranged to bias the logging member from the retracted position to the extended position thereof.

5. The logging system of claim 4, wherein the activating device is provided with a fluid chamber, and the secondary pad is provided with a tube arranged to provide fluid communication between said conduit and the fluid chamber when the secondary pad is biased against the logging member.

6. The logging system of claim 4 or 5, wherein said conduit is provided with a valve preventing flow of earth formation fluid into the tubular element when the valve is in the closed position, and wherein the secondary pad is arranged to open the valve when the secondary pad biases against the logging member.

7. The logging system of any one of claims 1-6, wherein the activating device is removably arranged within the tubular element.

8. The logging system of any one of claims 1-7, wherein the activating device is provided with means for determining a characteristic of earth formation fluid entering the conduit when said inlet opening is in fluid communication with the earth formation.

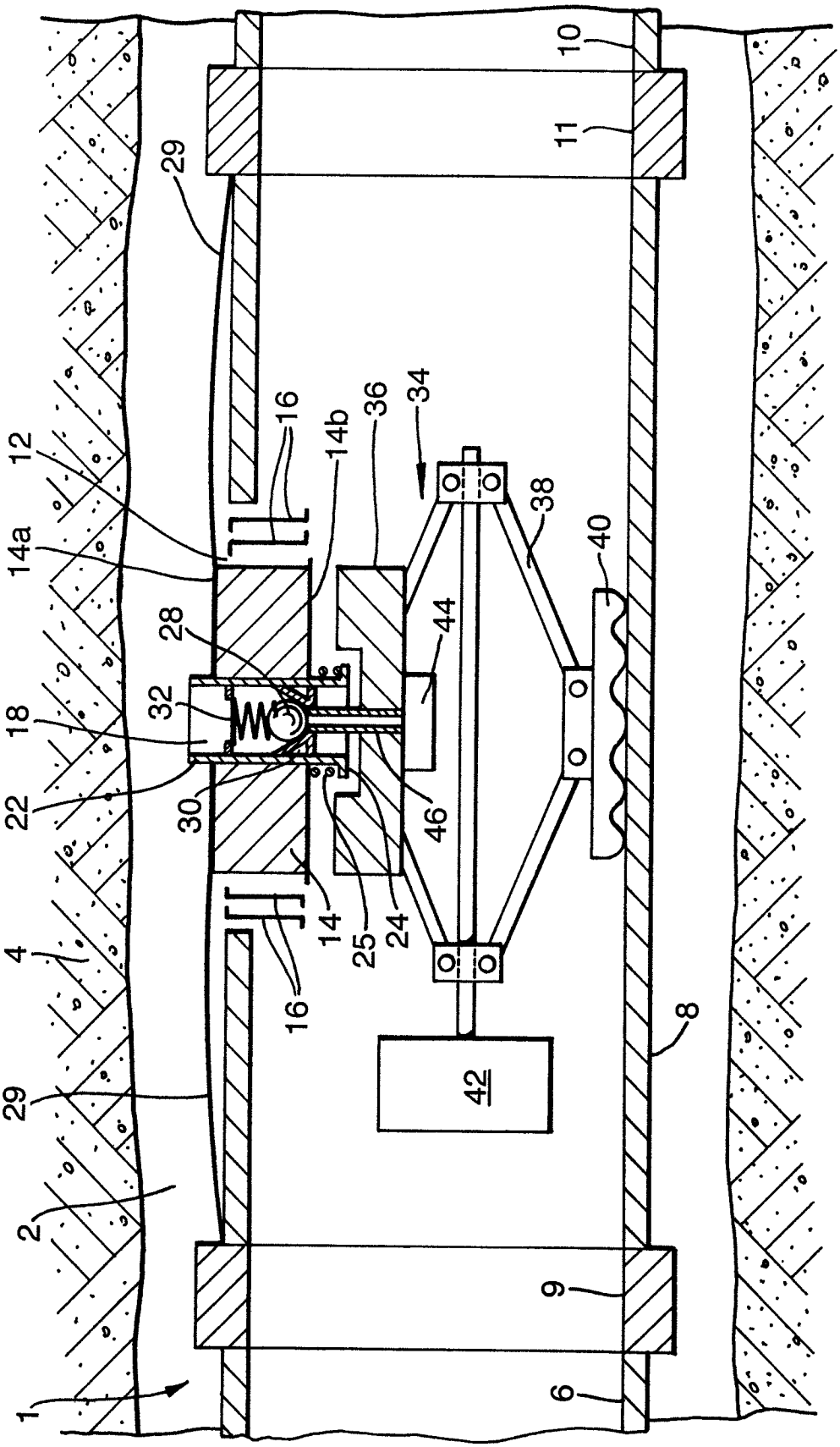
9. The logging system of claim 8, wherein said characteristic includes a pressure of the earth formation fluid entering the conduit.

10. The logging system of any one of claims 1-9, wherein at least one of the logging member and the activating device forms an RFT logging tool.

11. The logging system of any one of claims 1-10, wherein the tubular element is internally provided with a latching assembly for latching the activating device to the tubular element.

12. The logging system substantially as described hereinbefore with reference to the accompanying drawings.

Fig.1.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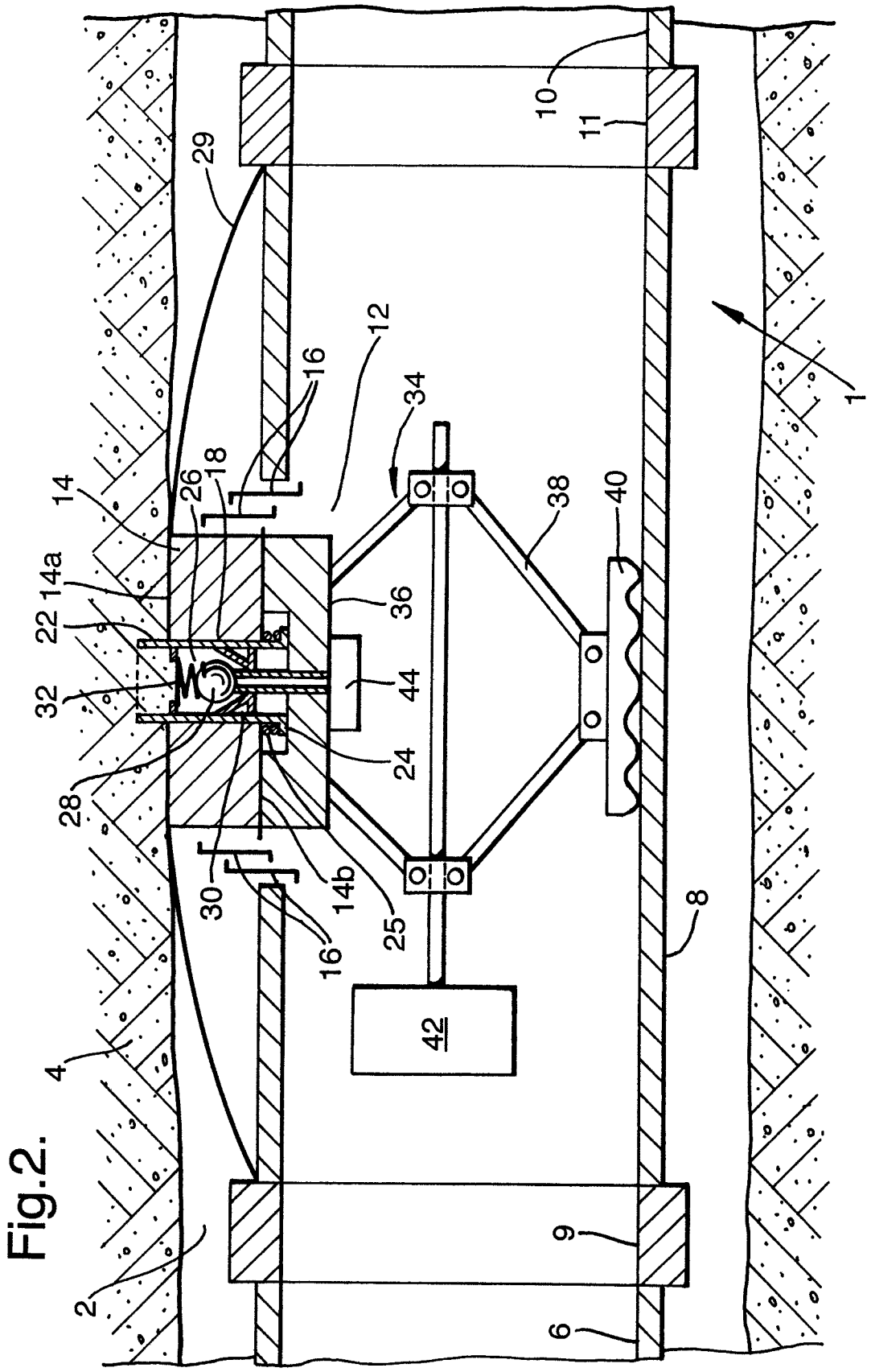
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Fig.2.