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Wellbore conveyor device

Description

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The present invention refers to a wellbore conveyor device for conveying media from a wellbore.

- 10 Wellbore conveyor devices are known from the prior art in different configurations. Such conveyor devices are used in wellbores and particularly employed for oil production. The wellbore conveyor devices are lowered towards and near the ground of the wellbore into the wellbore and pump the medium to be conveyed to the surface via a line guided through the wellbore. The pump used herein is normally driven by an electric
- 15 drive. This poses the problem of sealing a shaft which connects the electric drive to the pump. Since the wellbore conveyor device is normally arranged at a very great depth, sealing must be ensured over a long period of time because an exchange of a seal requires very great efforts and specifically also leads to production loss. So far multiple

series-connected glands have therefore been used in the prior art to perform sealing on the shaft. If one of the glands fails, the subsequent gland will carry out sealing. Thus, up to seven glands are used in series. This system has basically turned out to be useful, but the use of a multitude of successively connected glands leads to a relatively large overall length, and a relatively long shaft is especially also needed for connecting the electric drive to the pump.

US 2011/0194949 A1 discloses an alternative solution using a mechanical seal as the sealing unit. With the help of a spring element and a bellows, a rotating seal ring is here pressed against a seat ring. Furthermore, a sleeve which is adjustable in axial direction of the shaft is provided for achieving a permanent contact pressure between the sealing partners. On account of this adjustability, said mechanical seal is subject to high wear, so that the long-term lifetime of up to five years desired by the operators cannot be achieved.

It is therefore the object of the present invention to provide a wellbore conveyor device which while being of a simple structure and easily producible at low costs allows a reliable sealing of a shaft in a wellbore, and a very long lifetime of several years has here to be ensured.

This object is achieved by a wellbore conveyor device with the features of claim 1. Sub-claims show preferred developments of the invention.

By comparison, the wellbore conveyor device according to the invention for conveying media from a wellbore with the features of claim 1 has the advantage that a very long lifetime of several years can be ensured for a mechanical seal unit, so that an application in a deep wellbore is safely possible. The wellbore conveyor device of the invention further shows a very compact structure and requires only minimal connection lines between the wellbore conveyor device and the earth's surface. To this end the invention suggests a mechanical seal unit with a mechanical seal which carries out sealing on a shaft connecting a drive and a pump unit. The drive is preferably an electric drive. According to the invention an independent supply means is provided that supplies the mechanical seal with a barrier medium for blocking and/or lubricating a sealing gap between a rotating and a stationary seal ring of the mechanical seal. The independent

supply means is here integrated together with the pump, the mechanical seal unit, the shaft and the drive into a compact conveying unit, the conveying unit being fully submersible in the wellbore. Hence, no supply lines for feeding the independent supply means and the mechanical seal, respectively, from the earth's surface are needed.

- 5 Hence, as a connection to the earth's surface, the wellbore conveyor device of the invention just comprises a pump line, via which the medium to be conveyed is pumped to the earth's surface, and a power line which supplies the electric drive with electrical power when an electric drive is used. Hence, owing to the independent supply means integrated into the wellbore conveyor device a fluid supply of the mechanical seal can
- 10 be provided and particularly a barrier medium for the mechanical seal, so that during operation a sealing gap can be permanently maintained between the rotating seal ring and the stationary seal ring, which is sealed by means of the barrier medium. Hence, with the present invention it is possible for the first time to use a mechanical seal assembly in a deep wellbore, which can independently ensure an operation of several
- 15 years.

- Preferably, the supply means of the wellbore conveyor device is arranged at an end of the compact conveying unit. A short distance between the drive and the pump can thereby particularly be ensured and thus also a short shaft length of the shaft
- 20 connecting the pump and the drive. Preferably, the supply means is here arranged on a free end of the conveying unit. The free end is here preferably the end of the conveying unit which is arranged at the lowest point in the wellbore.

- Further preferably, the drive is arranged in axial direction of the conveying unit between
- 25 the supply means and the mechanical seal unit. This arrangement makes it possible to position the pump over the drive, so that particularly a conveying path of the medium to be conveyed through the wellbore conveyor device into a conveying line can be very short.

- 30 Preferably, the independent supply unit comprises a first chamber for receiving the barrier medium, a second chamber which is filled with the medium, and a bellows which separates the first chamber from the second chamber in a media-tight manner. The second chamber is here connected to an outside of the wellbore conveyor device, so that a pressure which corresponds to the pressure of the medium to be conveyed in the

wellbore (ambient pressure) prevails in the second chamber. The second chamber is preferably filled with the medium to be conveyed. Alternatively, the second chamber is filled with a viscous medium which is more viscous than the medium to be conveyed, for instance grease.

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Particularly preferably, the independent supply unit comprises a piston element which is arranged on the bellows such that the bellows and the piston element form a cup-shaped unit. The first chamber is here arranged in the interior of the cup-shaped element. The second chamber is provided between the outside of the cup-shaped unit and a housing of the supply unit. The housing preferably comprises an opening via which a connection is established with the outside of the wellbore conveyor device, so that a pressure in the second chamber corresponds to an external pressure in the wellbore and the medium contained in the wellbore is contained in the second chamber. The use of the piston element in the independent supply means makes it possible to set a defined pressure in the first chamber containing the barrier medium, said pressure being always higher than the pressure in the second chamber, i.e., the wellbore pressure. The mechanical seal is thereby permanently acted upon with a higher pressure than the wellbore pressure, resulting in a safe sealing.

To ensure a higher pressure in the first chamber than in the second chamber at all times, the independent supply unit further comprises a biasing element which permanently biases the barrier medium in the first chamber. The biasing element is preferably a spring, particularly a spiral spring. The biasing element particularly preferably acts on the piston, so that damage to the bellows can be reliably prevented.

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Preferably, the drive is an electric drive.

A connection line between the supply means and the mechanical seal unit extends through the electric drive for a particularly compact construction. Alternatively, the connection line could also be guided as a bypass around the electric drive.

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Preferably, the independent supply means further comprises a third chamber, the third chamber being sealed in a completely media-tight manner. The third chamber is preferably filled with an incompressible medium and particularly preferably with oil.

Further preferably, a pressure in the third chamber is equal to or greater than a pressure in the first and/or second chamber. The third chamber is preferably arranged on the outside of the bellows of the independent supply means, whereby the bellows is stabilized.

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According to a further preferred configuration of the present invention the wellbore conveyor device further comprises a separator for separating gaseous constituents from the medium to be conveyed. The separator is here also integrated into the compact conveying unit. Preferably, the separator is directly arranged in front of the pump.

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The wellbore conveyor device of the invention is preferably used for oil production. The wellbore conveyor device according to the invention can particularly also be used at very great depths and can have a lifetime of five years or more. An even longer lifetime can be guaranteed when the sliding surfaces of the seal rings are preferably diamond-coated.

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Preferred embodiments of the invention are now described in detail with reference to the accompanying drawing. In the drawing,

20 Fig. 1 is a schematic representation of a wellbore conveyor device according to a first embodiment of the invention;

Fig. 2 is a schematic, partly cut view of an independent supply means and a mechanical seal unit of the device of Fig. 1; and

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Fig. 3 is a schematic, partly cut view of a wellbore conveyor device with an independent supply means according to a second embodiment of the invention.

30 A wellbore conveyor device 1 according to a first preferred embodiment of the invention is described in detail hereinafter with reference to Figs. 1 and 2.

The wellbore conveyor device 1 is arranged in a wellbore 8 to convey a medium 9 located within the wellbore 8.

As can be seen in Fig. 1, the wellbore conveyor device 1 comprises an electric drive 2 which drives a pump 3 via a shaft 4. A motor compartment in which a motor M of the electric drive is arranged is sealed by means of a mechanical seal unit 5 on the shaft 4.

5 Furthermore, the wellbore conveyor device 1 comprises an independent supply means 6 which supplies a mechanical seal 50 of the mechanical seal unit 5 with a barrier medium.

10 The mechanical seal comprises a rotating seal ring 51 and a stationary seal ring 52, with a sealing gap 53 being formed between the two seal rings. The independent supply means 6 is here connected via a connection line 12 to the mechanical seal 50 to supply the barrier fluid to the mechanical seal 50. Here, the connection line 12 passes through the electric drive 2 (cf. Fig. 1).

15 The wellbore conveyor device 1 further comprises a separator 10 which is arranged in front of the pump 3 and integrated into the wellbore conveyor device.

20 Furthermore, the separator 10 comprises a plurality of inflow openings 11 via which the medium 9 to be conveyed passes into the separator 10, so that gaseous constituents possibly contained in the medium 9 to be conveyed can be separated. The medium 9 freed of gaseous constituents is then conveyed by means of the pump 3 into a conveying line 7 leading to the earth's surface.

25 The independent supply means 6, the electric drive 2, the pump 2, the shaft 4 and the mechanical seal unit 5 form a compact conveying unit which is fully submersible in the wellbore. The components of the compact conveying unit are here arranged in series in axial direction X-X.

30 Fig. 2 shows the independent supply means 6 in detail. The independent supply means 6 is here arranged at a free end of the wellbore conveyor device 1. The supply means 6, the pump 3, the electric drive 2, the shaft 4 and the mechanical seal unit 5 form a compact conveying unit which is completely submersible in the wellbore 8.

The independent supply means 6 comprises a first chamber 61, a second chamber 62 and a bellows 67. Furthermore, the independent supply means 6 comprises a piston 64 and a biasing element 65, which is a spring in this embodiment. Furthermore, a connection opening 66 is provided in a housing 60 of the supply means 6, so that a connection is established between the second chamber 62 and the wellbore in which the medium 9 to be conveyed is positioned. Hence, the same pressure as in the wellbore 8 prevails in the second chamber 62.

The bellows 67 separates the first chamber 61 from the second chamber 62 in a media-tight manner. The piston 64 is here arranged on an open end of the bellows 67, so that the bellows 67 together with the piston 64 forms a cup-shaped unit which is arranged on an inside of the housing 60 of the independent supply means 6. The first chamber 61 is connected via an opening 13 in the housing 60 to the connection line 12 which leads to the mechanical seal 50.

The biasing element 65 is supported with one end on an inside of the housing 60 and with another end on the piston 64. The biasing element 65 thereby exerts a biasing force F on the piston 64. A first pressure P_1 in the first chamber 61 is thereby permanently greater than a second pressure P_2 in the second chamber 62. This ensures an overpressure on the mechanical seal 50, so that it is not possible that the medium passes from the outside through the sealing gap 53 of the mechanical seal 50. Hence, a maximum lifetime of the mechanical seal 50 can be achieved by using the barrier medium from the first chamber 61.

The first chamber 61 is here configured such that the barrier medium contained therein is sufficient for an operation period of several years. Hence, leakage through the sealing gap 53 to the outside (arrow L) can be compensated for several years.

Fig. 3 shows a wellbore conveyor device 1 according to a second embodiment of the invention, identical or functionally identical parts being designated by the same reference numerals as in the first embodiment. As can be seen in Fig. 3, the independent supply means 6 of the second embodiment comprises a third chamber 63 in addition to the first chamber 61 and the second chamber 62. The third chamber 63 is here sealed in a completely media-tight manner. The third chamber 63 is formed both

on the outside of the first chamber 61 and on the outside of the second chamber 62. As can be seen in Fig. 3, a first bellows 67 is arranged at a first side of the piston 64 and a second bellows 68 at a second side of the piston 64 opposite to the first side so as to form the first and second chamber. The third chamber 63 is here filled with a medium, preferably oil, and a third pressure P_3 in the third chamber 63 is greater than a first pressure P_1 in the first chamber 61 and greater than a second pressure P_2 in the second chamber 62. To ensure a mobility of the piston 64, the piston comprises a plurality of passage openings 64a. Furthermore, a biasing element 65 is provided to keep the barrier medium in the first chamber 61 under pressure. Alternatively, the second bellows 68 could also be configured as a biasing element. With this construction both the first bellows 67 and the second bellows 68 can thus be supported by the medium contained in the third chamber 63. Furthermore, an additional damping option for the bellows 67, 68 is achieved with the medium contained in the third chamber 63. Hence, especially also pressure variations inside the wellbore cannot damage the independent supply means 6.

Hence, the wellbore conveyor device 1 of the invention as described in the embodiments comprises an integrated independent supply means 6, so that a mechanical seal 60 can be operated without any damage for several years. There are no sealing problems whatsoever, and the independent supply means 6 also ensures that no medium to be conveyed, or the like, can pass into a motor compartment of the electric drive 2, which is normally filled with a dielectric. Hence, the electric drive can also last for several years. As a result, the wellbore conveyor device 1 can remain in the wellbore 8 for several years and fulfill conveying functions.

List of reference numerals

	1	wellbore conveyor device
	2	electric drive
5	3	pump
	4	shaft
	5	mechanical seal unit
	6	independent supply means
	7	conveying line
10	8	wellbore
	9	medium to be conveyed
	10	separator
	11	inflow openings
	12	connection line
15	13	opening
	50	mechanical seal
	51	rotating seal ring
	52	stationary seal ring
	53	sealing gap
20	60	housing
	61	first chamber
	62	second chamber
	63	third chamber
	64	piston
25	64a	passage openings
	65	biasing element
	66	connection opening
	67	first bellows
	68	second bellows
30	F	resilient force
	L	leakage
	M	motor
	P1	first pressure
	P2	second pressure
35	P3	third pressure
	X-X	axial direction

Patent claims

1. Wellbore conveyor device for conveying a medium (9) from a wellbore (8), comprising:
5 - a drive (2);
 - a pump (3);
 - a shaft (4) which connects the drive (2) to the pump (3);
 - a mechanical seal unit (5), comprising a mechanical seal (50) with a rotating seal ring (51) and a stationary seal ring (52), the mechanical seal (50) sealing
10 on the shaft (4); and
 - an independent supply means (6) which supplies the mechanical seal (50) with a barrier medium,
 - the independent supply means (6), the drive (2), the pump (3), the shaft (4) and the mechanical seal unit (5) forming a compact conveying unit which is
15 fully submersible in the wellbore.
2. Device according to claim 1, characterized in that the independent supply means (6) is arranged at an end of the compact conveying unit.
- 20 3. Device according to any one of the preceding claims, characterized in that the drive (2) is arranged in axial direction (X-X) of the wellbore conveyor device between the independent supply means (6) and the mechanical seal unit (5).
- 25 4. Device according to any one of the preceding claims, characterized in that the independent supply means (6) comprises a first chamber (61) for receiving the barrier medium, a second chamber (62) which is connected to an outside of the wellbore conveyor device, so that a pressure corresponding to the pressure of the medium to be conveyed prevails in the second chamber (62), and a bellows (67) which separates the first chamber from the second chamber (62) in a media-tight
30 manner.
5. Device according to claim 4, further comprising a piston element (64) which is arranged on the bellows (67) such that the bellows (67) and the piston element (64) form a cup-shaped unit, and the first chamber (61) is arranged in the interior

of the cup-shaped unit, and the second chamber (62) between the outside of the cup-shaped unit and a housing (60) of the independent supply means (6).

- 5 6. Device according to claim 4 or 5, characterized in that the independent supply means (6) further comprises a biasing element (64) for permanently biasing the barrier medium in the first chamber (61).
- 10 7. Device according to any one of the preceding claims, characterized in that the drive (2) is an electric drive.
8. Device according to claim 7, further comprising a connection line (12) which connects the independent supply means (6) to the mechanical seal unit (5), the connection line (12) extending through the electric drive (2).
- 15 9. Device according to any one of claims 4 to 8, characterized in that the independent supply means (6) further comprises a third chamber (63), the third chamber (63) being sealed in a media-tight manner relative to the first and second chamber (61, 62).
- 20 10. Device according to claim 9, characterized in that a third pressure (P3) in the third chamber (63) is equal to or greater than a first pressure (P1) in the first chamber (61) and equal to or greater than a second pressure (P2) in the second chamber (62) and/or that the third chamber (63) surrounds the first chamber (61) and/or the second chamber (62).
- 25 11. Device according to any one of the preceding claims, further comprising a separator (10) for separating gaseous constituents from the medium (9) to be conveyed, the separator (10) being integrated into the compact conveying unit.