

side and in a cross-section, when connected to the wellhead 1. The wellhead 1 will then be configured with a plurality of through holes or passages, 9, which passages 9 will then be so positioned as to lead in to each of the annuli A-C. The apparatus 8 comprises a sensor 10 and a flange assembly 11, which are fixedly connected to each other. The flange assembly 11 is constituted of a front flange portion 12 and a rear flange portion 13, which via a plurality of bolts 14a or the like are connected to each other. An end of the rear flange portion 13 will then be so configured that it overlaps an end of the front flange portion 12 when the front and the rear flange portion 12, 13 are assembled. Both the front and the rear flange portion 12, 13 will furthermore be configured with a groove or recess 16, in which recess 16 an O-ring 17 is arranged when the front and the rear flange portion 12, 13 are connected to each other, so as to provide a fluid-tight connection between them.

The flange assembly 11 is further configured with a through bore 14, in which bore 14 the sensor 10 and the associated electronics 15 are arranged. A second end (opposite the end that is connected to the rear flange portion 13) of the front flange portion 12 will then be configured with a contact face 18 for the sensor 10, the said contact face 18 forming a stop edge for the sensor 10. The sensor 10 will then similarly be configured with a face 19 that will bear against the contact face 18 in the front flange portion 12, such that the sensor 10 is positioned correctly in relation to the wellhead 1. The sensor 10 will furthermore, along a part of its length, be configured with a threaded portion 20, such that the sensor 10 can be screwed into the passage 9 in the wellhead 1. The passage 9 in the wellhead 1 will then be configured with a complementarily threaded portion (not shown).

The sensor 10 comprises a first electronic circuitry, e.g. in the form of an electronic printed circuit board 21, which via wires 22 is connected to a second electronic circuitry in the form of a separate main printed circuit board 23 arranged in the bore 14 in the front flange portion 12. Through this configuration, the sensor 10, comprising the electronic printed circuit board 21, will be separated from the main printed circuit board 23, the sensor 10 being arranged at the end of the front flange portion 12 which lies closest to the wellhead 1, whilst the separate main printed circuit board 23 will be arranged at an opposite end of the front flange portion 12, adjacent to the rear flange portion 13.

Between the sensor 10 and the separate main printed circuit board 23 there is disposed a pressure-tight element 24, for instance a ceramic element with wires 22 connecting the sensor 10 and the separate main printed circuit board 23 extending through the ceramic element.

In one embodiment, the wires 22 will, however, not run through the whole of the ceramic element 24, only a certain length into the ceramic element 24, such that wires 22 from sensor 10 and wires 22 to the main printed circuit board 23, when arranged in the ceramic element 24, will be located at a distance from each other.

The through bore 14 in the front flange portion 12 will along a part of its length be configured with a varying cross-section, which varying cross-section will be complementarily configured with the varying cross-section of the sleeve 25. A rear edge 26 of the varying cross-section in the through bore 14 will, when the sleeve 25 with the pressure-tight element 24, e.g. ceramic element, is arranged in the varying cross-section of the through bore 14, together with an end of the sleeve 25, form a tight connection between the front flange portion 12 and the sleeve 25. This arrangement may form a fireproof connection in the apparatus 8.

The rear flange portion 13 is configured with a through and threaded hole 27, so as to enable a cable lead-in 28, comprising a tensioning nut 29, to be connected to the threaded hole 27. Between the contact faces of the rear flange portion 13 and the cable lead-in 28 there is arranged a seal 30 in the form of an O-ring. An electric cable E is then passed through the cable lead-in 28 and connected to a connecting printed circuit board 31 in the through bore 14 in the flange assembly 11.

The separate main printed circuit board 23 and connecting printed circuit board 31 are, by means of a securing device 32, connected to a rear wall 33 of the front flange portion 12. The securing device 32 will further ensure that the main printed circuit board 23 and the connecting printed circuit board 31 are arranged at a distance from each other. Signals received from the sensor 10 will then be wirelessly transmittable from the main printed circuit board 23 to the connecting printed circuit board 31, in order thus, through the electric wire E, to be transmitted for processing on a floating structure (not shown).

The rear flange portion 13, which is an "open" sleeve, is, at an end opposite the end overlappingly connected to the front flange portion 12, configured for being connected to an end termination 34, such that the apparatus 8 can be closed or sealed at the end opposite the connection to the wellhead 1. The end termination 34 is then configured with a plurality of through openings 35, which through openings 35 are used for passage of bolts 36. An end termination in the rear flange portion 13 will then be configured with a plurality of threaded holes 37 for receipt and screw fastening of bolts 36.

The end termination 34 will on one side be configured with a projection 38, which projection 38 will be such that it essentially corresponds to the through bore 14, such that the projection 38 will extend a certain distance into the rear flange portion 13 when the end termination 34, via the bolts 36, is connected to the rear flange portion 13. A seal 39 in the form of an O-ring is arranged between the interior surface of the rear flange portion 13 and the exterior surface of the projection 38, one or both of these surfaces then being configured with a groove for receiving the seal 39.

Furthermore, the front flange portion 12, in a face A' which forms contact with the wellhead 1, is configured with a plurality of holes 41, such that bolts and nuts 42

can be used to fixedly connect the apparatus 8 to the wellhead 1. Face A' is further configured with a recess 43 for receiving a sealing element 44 such that a tight connection is provided between the apparatus 8 and the wellhead 1 when they are connected to each other.

Figure 3 shows another embodiment of the apparatus 8 according to the present invention, where the apparatus 8 is now configured so as to be able to transmit signals from the sensor 10 wirelessly. With the exception of how the transmission of signals takes place according to this embodiment, the general component composition of the apparatus 8 and its operating principle are the same as described for the first embodiment of the invention as shown in Figure 2, and so for the sake of simplicity they are not described again.

The embodiment shown in Figure 3 uses a wireless transmission of signals from the sensor 10, where the rear flange portion 13 will be configured with a through and threaded hole 27, so as to enable a wireless antenna 44 to be connected to the through and threaded hole 27. A securing device 32 is also used in this embodiment to connect the separate main printed circuit board 23 and the connecting printed circuit board 31 to the rear wall 33 of the front flange portion 12. However, the distance between the main printed circuit board 23 and the connecting printed circuit board 31 will now be greater than in the embodiment described with reference to Figure 2, seen in relation to the fact that a part of the wireless antenna 44 will extend a distance into the through bore 14 in the flange assembly 11. Signals received from the sensor 10 will then be wirelessly transmittable from the main printed circuit board 23 to the connecting printed circuit board 31, so as to be further transmittable wirelessly from the connecting printed circuit board 31 to the wireless antenna 44, in order to be further transmitted wirelessly for processing on a floating structure (not shown). For signal amplification, a plurality of signal amplifying units (not shown) may be provided between the wellhead and the floating structure.

To operate the sensor 10 and/or the wireless antenna 44 in the apparatus 8, a battery or a battery pack 45 is provided in the apparatus 8 when the apparatus 8 is assembled. This embodiment will mean that the battery or battery pack 45 can easily be replaced by unscrewing bolts 36 in the end termination 34 and removing the end termination 34 from the rear flange portion 13. The battery or battery pack 45 can in a suitable manner, for example, by means of wires etc. (not shown), be connected to the connecting printed circuit board 31.

The battery or battery pack 45 may also be connected to, or comprise a device (not shown) capable of ensuring that the battery or battery pack 45 is turned off and on at certain time intervals. The device can then turn the battery or battery pack 45 on for a pre-specified time unit (minutes, hours or days), so as to allow the desired number of measurements of, for example, pressure and temperature to be carried

PATENT CLAIMS

1. An apparatus for monitoring physical parameters in an oil and/or gas well, the apparatus being connectable to a wellhead of the oil and/or gas well, the apparatus comprising a flange assembly configured with a through bore and an end termination, in which through bore a sensor and associated electronics are arranged, wherein the sensor, including a first electronic circuitry, is connected to a second electronic circuitry via transmission devices that are passed through a pressure-tight element arranged in the through bore,
wherein the pressure-tight element includes a metallic disc, the transmission devices being electrical conductors passed through bores in the metallic disc, and wherein a glass, sapphire or a ceramic material surrounds each conductor and fluidly seals the space between each conductor and the corresponding bore in the metallic disc.
2. An apparatus according to claim 1, wherein the sensor includes a temperature transducer.
3. An apparatus according to claim 1, wherein the sensor includes a pressure transducer.
4. An apparatus according to claim 1, wherein the sensor includes a pressure and temperature transducer.
- ~~5. An apparatus according to one of the preceding claims, wherein the pressure-tight element is a ceramic element.~~
- ~~6. An apparatus according to one of the claims 1-4, wherein the pressure-tight element is a glass element.~~
- ~~7. An apparatus according to one of the claims 1-4, wherein the pressure-tight element includes a metallic disc, the transmission devices being electrical conductors passed through bores in the metallic disc, and wherein a glass, sapphire or a ceramic material surrounds each conductor and fluidly seals the space between each conductor and the corresponding bore in the metallic disc.~~
- ~~8. An apparatus according to claim 5, wherein the ceramic element is configured with at least one through-going area or portion of a mixture of a ceramic and one or more conducting materials, so as to provide a current passage through the ceramic element.~~
- ~~9. An apparatus according to claim 5, wherein the transmission devices are embedded in the ceramic element.~~
105. An apparatus according to one of the preceding claims, wherein the first electronic circuitry includes a first electronic printed circuit board, the second electronic circuitry includes a second printed circuit board, and

wherein the transmission devices include wires connected between the first electronic printed circuit board and the second printed circuit board.

446. An apparatus according to claim 405,
the flange assembly having a front flange portion 12 and a rear flange portion 13,
5 wherein the sensor, including the first printed circuit board, is arranged at an end of
the front flange portion which lies closest to the wellhead.

427. An apparatus according to claim 446,
wherein the second printed circuit board is arranged at an opposite end of the front
flange portion, adjacent to the rear flange portion.

10 438. Use of the apparatus according to any one of claims 1 to 42-7 in a
temperature and pressure monitoring system for monitoring an oil and/or gas well.

449. A wellhead for use with an oil and/or gas well, the well having a plurality of
casings, the casings defining a plurality of annuli,
the wellhead being configured with a plurality of through-holes, each leading into a
15 respective annulus of the well,
wherein each through-hole is connected to an apparatus as set forth in one of the
claims 1-427.