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METHOD AND DEVICE FOR COMMUNICATION UNDER WATER

The invention relates in the first place to a method for communicating with a device situated under water. When underwater communication via cables is impossible, communication takes place with acoustic signals, which is often unreliable or cannot be used.

Known from EP-0 485 071 is a light communication system which can be used under water. The transmitter and the receiver are herein disposed at a very short mutual distance. Only at this very short distance is it possible to transmit signals through the water.

The invention has for its object to provide a method and a communication device for reliable distance communication, if necessary in difficult conditions, for instance at great depth and/or in turbid water. This method and communication device are designated respectively in claims 1 and 2.

The invention also provides a control device as designated in claim 4.

The invention and the preferred embodiments will be described in the description following hereinafter with reference to a drawing, in which:

Figures 1 and 5 show perspective views of applications of the invention;

figure 2 shows a schematic view of a control device for the application of figure 1;

figure 3 shows details drawn in further detail of the control device of figure 2; and

figure 4 shows a variant of figure 2.

The invention is elucidated with reference to the embodiment shown in figure 1, wherein the data relating to the condition of an underwater pipeline 1 are transmitted to a computer 22 placed on board a vessel 2 floating on water.

In order to transport oil or gas a pipeline 1 is laid under water, for instance at a depth of 100-400 m. After a section of pipeline has been laid the conditions



of this pipeline 1 are measured by a measuring pig 4 being urged therethrough by pumping a fluid in arrow direction 5. Data relating to the condition of pipeline 1 is meanwhile picked up by means of optical pick-ups 6, coded in a coder 69 and stored in a computer 68 accommodated in the measuring pig 4. When this latter is situated outside pipeline 1 it transmits the picked-up information. For this purpose the information, which comes out of the computer 68 as electrical binary information, is converted by means of a converter 8 with control electronics into a pulse-position modulation coded signal, referred to hereinbelow as "PMCS", which controls an electronic switch 9 for transmitting a series of light flashes by a flash lamp 10. The converter 8 is provided with the necessary electronics comprising a protection against too frequent use of the flash lamp 10 per unit of time. A battery 11 is the power source for receiving and transmitting the information. The measuring pig 4 has two switches 9 which are arranged mutually opposite and held in the out-position for instance by means of an arm 19 which supports against the wall of pipeline 1 and which switches both move into the transmitting switch position when the measuring pig 4 has left the pipeline 1, so that the transmission of information is initiated. The light signal from flash lamp 10 of a light transmitter 72 is picked up by a light receiver 13 which comprises for instance a photodiode 73 and which is situated on board a remote controlled vehicle, referred to hereinafter as RCV 14, which is connected via a cable 25 to a vessel 2. The RCV 14 is located relatively close to the measuring pig 4 and is provided with the necessary drive propellers 15, a light transmitter 16, TV cameras 17 and a controllable gripper arm 18. The RCV 14 preferably has a receiver 13 and a light transmitter 16 on its front and its rear.

The PMCS from the light receiver 13 is carried via an amplifier 20 and cable 25 to the computer 22 present on vessel 2 and connected to a monitor 23, in which computer a decoder converts the PMCS into an electrical binary signal.



In order to avoid sea-water flowing into pipeline 1, the latter is closed off by means of a sluice 24 comprising two sluice sliding doors 26 for alternating hydraulic opening. These sluice sliding doors 26 are for instance controlled while applying the method for communicating according to the invention. The relevant device according to the invention comprises the light transmitter 16 placed on board the RCV 14 which transmits a PMCS as a series of light flashes which are received by an optodiode 55 of a light receiver 27, amplified by an amplifier 28 and decoded by a decoder 29. The thus obtained control signals 30 selectively switch relays 31 of hydraulic valves 32 to operate hydraulic cylinders 33 and drive the motors 93 of sluice sliding doors 26 and an electric switch 34 for the power supply to the relays 31. Lying close to the sluice 24 is a robust housing 35 (figure 3) in which a low, for instance atmospheric, pressure prevails and which is well sealed against the high local water pressures at depths of for example 100-400 m. Situated therein are the decoder 29 with interface 47 for valves 32, the switch 34 for the power supply and batteries 46. The valves 32 with relays 31, a hydraulic pump 36 and the oil container 37 are situated in a housing 38 in which the local pressure prevails. Electrical connections 50 and 51 are watertight and resistant to high pressure differences.

Figure 3 shows that the hydraulic pump 36, its motor 39, the electrical junction box 40 thereof, the valves 32 with their relays 31 and the hose connections 41 are situated in the oil container 37 of fixed volume, which oil container 37 communicates via a connection 43 with an elastic container 44 which is located inside an open screen 45.

Figure 3 also shows the housing 56 of receiver 27 which is sealed against high water pressures and which consists of a robust cylinder 52 in which an optodiode 55 is disposed behind a thick transparent plate 53 provided with seals 54, which optodiode is connected to the amplifier 28. The signal connection 58 is arranged sealed with seal 59 in a cover 61 embodied with seals 60.



Figure 3 also shows how the light transmitters 16 and 4 are constructed from a robust cylindrical housing 62 with a transparent plate 63 which is sealed with seals 64, wherein a xenon lamp 10 is arranged in a reflector 66. Further situated in this housing 62 are the converter 8 and the amplifier 9. The transmitter 16 is connected via cable 25 to the control device 3 which is present on board vessel 2 and which comprises a keyboard 65 and a converter 67 which converts the control signal from the keyboard into a binary signal.

In preference the housing 35 also contains a computer 68 which is connected to decoder 29 and which is also supplied with data from a coder 69 which converts into binary signals incoming measurement data relating to for instance the pressure in pipeline 1 measured by manometer 70 and the position of the sluice doors 26 picked up by pick-up 96. Computer 68 is connected to a light transmitter 71 corresponding with light transmitter 4. The signals transmitted by transmitter 71 are received by light receiver 13 which corresponds with light receiver 27.

Figure 4 shows a variant of figure 2, in which identical components are designated with the same reference numerals. The difference from figure 2 is the fact that instead of a transmitter 71 and light receiver 16 a battery 171 of lights 173 is applied which transmits the necessary return signals as normal light.

The device according to the invention as in figure 5 consists for instance of a manned vessel 83 with a light transmitter 81 and a light receiver 85 which inspects an oil or gas pipeline 86 lying on the sea-bed. This pipeline is provided from place to place with a closing valve 87 and pressure gauges 88 or pick-ups for other measurement data. Pipeline 86 is also provided with a light receiver 89 and a light transmitter 90 which are embodied as the above mentioned light receiver 27 and light transmitter 71 and provided with the housings 35 and 38 shown in figure 3. The closing valve 87 can be closed by means of a hydraulic cylinder 92.

Since the flash lamp only transmits the light in a very short period, for instance 200 milliseconds in each



case, but preferably 100 milliseconds or less, a very strong light is transmitted each time for a very short duration which can thereby span a considerable distance under water, for instance from several decimetres to
5 hundreds of metres. The power to be supplied to the flash lamp is for instance 0.1 Watt, preferably 0.5 Watt and more preferably in the order of magnitude of 1 Watt or more.





CLAIMS

1. Method for communicating with a device (4, 24, 86) situated under water, **characterized in that** at least one signal is transmitted between at least one transmitter (16) with flash lamp and at least one receiver (27) in the form of a series of light flashes recognizable as code, wherein said transmitter (16) and/or said receiver (27) are/is arranged under water.

2. Method as claimed in claim 1, **characterized in that** this is applied in the operation of a gas or oil pipeline (1, 86) located under water.

3. Communication device for communicating under water with application of the method of claim 1 or 2, **characterized by** at least one transmitter (16) with flash lamp for transmitting and at least one receiver (27) for receiving a series of light flashes recognizable as code, which transmitter (16) and/or receiver (27) are/is adapted to be kept under water.

4. Communication device as claimed in claim 3, **characterized by** a converter (8) converting an electrical signal into a pulse-position modulation coded signal (PMCS); a gas discharge tube (10), for instance a xenon lamp, connected to the converter; a receiver (55), for instance a photodiode, disposed at a distance; and a decoder (21) connected to the receiver (55) for converting the pulse-position modulation coded signal (PMCS) into an electrical signal.

5. Control device for controlling an apparatus (87) situated under water, which control device is provided with the communication device of claim 4, **characterized by** at least one input member connected to the converter (8) for inputting a control signal and by at least one control means (92) connected to the decoder (21) for controlling a function of the apparatus (87).

6. Control device as claimed in claim 5, **characterized in that** for two-way communication a second light transmitter (71) is present at the light receiver (27) and a second receiver (13) is present at the first light





transmitter (16), which second transmitter (71) and second receiver (13) are adapted for transmitting respectively receiving a series of light flashes recognizable as code.

- 5 7. Control device as claimed in claim 5 or 6, characterized in that this is connected to an oil or gas pipeline (1, 86) arranged under water.

