Each of these technologies has some drawbacks.

"*Mud-pulser*" technology, indeed, has transmission speed as well as reliability limitations since it may be necessary to transmit the same signal many times before receiving it correctly. The transmission capability of such technology depends on the characteristics of the drilling fluid and on the circulation flow rate of such a fluid.

"*Wired pipe*" technology suffers from high costs since the wires rods are very expensive; moreover, whenever it is necessary to add a rod to the drill string the wired connection is interrupted, thus preventing the communication from and towards the well bottom during these operations.

Acoustic telemetry technology suffers from potential errors in the transmission due to the operating noise of the bit or to the deviation of the wells from perfectly vertical.

"Through-the-ground" technology, due to the low frequencies used to be able to cover transmission distances of the order of kilometres, suffers from a very low transmission speed (equivalent to that of "mud pulser" technology) and from reliability problems due to passing through many formation layers with different electromagnetic propagation characteristics.

Embodiments of the present invention seek to avoid the aforementioned drawbacks and in particular to devise a system for bidirectional data transmission in a well for the extraction of formation fluids that is capable of ensuring a large amount of data transmissible in real time and a continuity of the transmission of data from and towards the well bottom, being independent

from the operating conditions of the drill string, from the drilling fluid present in a well and from the circulation flow rate of such a fluid.

There is disclosed a system for bidirectional data transmission in a well for the extraction of formation fluids.

Further characteristics of the system for bidirectional data transmission in a well for the extraction of formation fluids are also disclosed.

According to a first aspect of the present invention, there is provided a system for cableless bidirectional data transmission in a well for the extraction of formation fluids comprising:

- a plurality of rods connected to each other in succession so as to form a rod string, which extends from the surface to the bottom of said well, said rod string being associable with a plurality of sensors configured for continuously detecting a plurality of parameters relating to the fluids circulating in the well and to the rock formation surrounding the well and/or to safety devices or other remote-controlled well instrumentation;
- a plurality of communication modules applied at predefined distances along said rod string and configured for the transmission of signals from and towards the bottom of the well;
- each of said communication modules comprising:

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- at least one metal plate selected from:
  - a transmitting metal plate;
  - a receiving metal plate;
  - a transceiver metal plate;
- an electronic processing and control unit configured for processing signals to be transmitted by means of said at least one metal plate or signals received by means of said at least one metal plate;
- one or more supply batteries for feeding said metal plates and said electronic processing and control unit.

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According to a second aspect of the present invention, there is provided a method for cableless bidirectional data transmission in a well for the extraction of formation fluids comprising the following steps:

- arranging a system according to any of the previous claims;
- injecting into the fluid surrounding the rod string, by means of at least one metal plate of a first communication module, an electric current that carries an information signal;
- receiving, by means of at least one metal plate of a second communication module, at least a part of said injected electric current that has propagated through at least said fluid.

According to a third aspect of the present invention, there is provided a method for cableless bidirectional data transmission in a well for the extraction of formation fluids comprising the following steps:

- arranging a system according to any of the previous claims;

- generating, by means of at least one transmitting coil of a first communication module, a magnetic field that carries an information signal;

receiving, by means of at least one receiving coil of a second communication module, part of said magnetic field generated by said transmitting coil that is concatenated with said receiving coil, generating, at the terminals of said receiving coil, a voltage containing said information signal.

The characteristics and advantages of a system for bidirectional data transmission in a well for the extraction of formation fluids according to the present invention will become clearer from the following description, given as an example and not for limiting purposes, referring to the attached schematic drawings, in which:

- figure 1 is a schematic view of a drilling installation for the extraction of hydrocarbons comprising a system for bidirectional data transmission according to the present invention;

- figures 2a and 2b are two schematic partial section views of a first and of a second embodiment of a system for bidirectional data transmission according to the present invention;

- figures 3a and 3b are two schematic views of a first embodiment of a communication module housed in a rod like in figure 2a; figure 3c is a schematic view of a second embodiment of a communication module housed in a rod like in figure 2a; in particular, figure 3a is a section view along a plane parallel to the axis of the

CLAIMS

1) A system for cableless bidirectional data transmission in a well for the extraction of formation fluids comprising:

- a plurality of rods connected to each other in succession so as to form a rod string, which extends from the surface to the bottom of said well, said rod string being associable with a plurality of sensors configured for continuously detecting a plurality of parameters relating to the fluids circulating in the well and to the rock formation surrounding the well and/or to safety devices or other remote-controlled well instrumentation;
- a plurality of communication modules applied at predefined distances along said rod string and configured for the transmission of signals from and towards the bottom of the well;
- each of said communication modules comprising:
  - at least one metal plate selected from:
    - a transmitting metal plate;
    - a receiving metal plate;
    - a transceiver metal plate;
- an electronic processing and control unit configured for processing signals to be transmitted by means of said at least one metal plate or signals received by means of said at least one metal plate;
- one or more supply batteries for feeding said metal plates and said electronic processing and control unit.

2) System for cableless bidirectional data transmission in a well for the extraction of formation fluids

according to claim 1, wherein each of said communication modules comprises two transmitting metal plates and/or two receiving metal plates.

3) System for cableless bidirectional data transmission in a well for the extraction of formation fluids according to claim 1 or 2, wherein each of said communication modules comprises at least one transmitting coil and at least one receiving coil coaxial with respect to each other and coaxial with respect to the longitudinal axis of said rod string.

4) System for cableless bidirectional data transmission in a well for the extraction of formation fluids according to claim 3, wherein said at least one transmitting coil and said at least one receiving coil are superimposed with respect to each other.

5) System for cableless bidirectional data transmission in a well for the extraction of formation fluids according to any of the previous claims, wherein said communication modules are housed in compartments obtained on respective rods.

6) System for cableless bidirectional data transmission in a well for the extraction of formation fluids according to claim 5, wherein said plurality of rods comprises a plurality of drill or completion rods and a plurality of connecting or interconnection rods having a shorter length than that of said drill or completion rods, said communication modules being housed in compartments obtained on said connecting or interconnection rods.

7) System for cableless bidirectional data transmission in a well for the extraction of formation fluids according to any of the claims from 1 to 4, wherein said communication modules are housed in protection shells applied to the outer walls of said rods.

8) System for cableless bidirectional data transmission in a well for the extraction of formation fluids according to claim 7, wherein said transmitting metal plates and receiving metal plates are arc-shaped.

9) System for cableless bidirectional data transmission in a well for the extraction of formation fluids according to any of the previous claims, wherein, in each of said communication modules, said metal plates are electrically isolated from the metallic body of the respective rods.

10) System for cableless bidirectional data transmission in a well for the extraction of formation fluids according to any of the previous claims, wherein the distance between two communication modules along said rod string ranges from 1 to 100 m.

11) A method for cableless bidirectional data transmission in a well for the extraction of formation fluids comprising the following steps:

- arranging a system according to any of the previous claims;

- injecting into the fluid surrounding the rod string, by means of at least one metal plate of a first communication module, an electric current that carries an information signal;

- receiving, by means of at least one metal plate of a second communication module, at least a part of said injected electric current that has propagated through at least said fluid.

12) A method for cableless bidirectional data transmission in a well for the extraction of formation fluids comprising the following steps:

- arranging a system according to any of the previous claims;

- generating, by means of at least one transmitting coil of a first communication module, a magnetic field that carries an information signal;

receiving, by means of at least one receiving coil of a second communication module, part of said magnetic field generated by said transmitting coil that is concatenated with said receiving coil, generating, at the terminals of said receiving coil, a voltage containing said information signal.