

by command signals from a control station transmitted on a guided microwave carrier via a pipe.

[0006] It is further known from WO 02/071643 A1 a communication device for transmitting signals between a substation control unit and a control unit of bay elements comprising transceiver devices connected to the substation and the bay element control units and a wave guide enclosing and connecting antennas of said transceiver devices. The transceiver devices produce electromagnetic radio frequency airwaves to communicate information between the control units. The disclosed solution is not particularly well suited for offshore use as water is not a good medium for transmitting high frequency electromagnetic waves.

[0007] Another example of communication arrangement along a pipeline is disclosed in US 6,515,592 B1 (Babour et al.). This invention is directed to power and signal transmission using insulated conduit. In one embodiment it is shown a sandwich solution in which an electrical current path is defined by a casing encapsulated by an insulator with a conductive layer for return of electrical current in a layer surrounding said insulator. The conductor - insulator - conductor configuration maintains the traditional signal loop of a feed and return path.

[0008] Yet another example of a communication system is disclosed in US 2005/0024231 A1 (Fincher et. al). This document proposes a system in which a conductive pipe receives a solid insulator layer on the interior running along the pipe and a suitable reflective shield forming an inner surface of the insulator layer. This sandwich configuration employs RF signals in the insulator layer.

[0009] Hence, according to one embodiment aspect of the invention it is provided an arrangement which in a secure fashion transmits data for automation, control or monitoring along a pipeline at a much higher bit rate than known from prior art indicated above.

Disclosure of Invention

[0010] According to an aspect of the invention, there is provided a~~The drawbacks indicated above is met by~~ communication arrangement for transmission of communication signals along a pipe line where the communication arrangement comprises:

a pipe with outer pipe walls made of a conductive material,
 a non conductivity coating surrounding said pipe ,
 an outer coating/layer or fluid that has conductive properties which encapsulates the non conductivity coating, and
 at least one radio frequency transmitter configured to excite an electromagnetic field in the non conductive coating where the non conductivity coating has dielectric properties and the field being associated with data signals and one radio frequency receiver configured to receive data signals in form of electromagnetic fields in the dielectric non conductivity coating.

[0011] It is further according to an embodiment~~the present invention~~ disclosed a communication arrangement where the non conductive coating is made of a polymer containing material.

[0012] In another embodiment~~aspect~~ according to the present invention it is disclosed a communication arrangement where the communication arrangement further comprises at each end of the pipe radio frequency transceivers.

[0013] In yet an embodiment according to the present invention it is proposed a communication arrangement where the communication arrangement further comprises at least one intermediate radio transceiver.

[0014] Still another embodiment discloses a communication arrangement where the transceivers and/or transmitters communicate in a multi hop fashion employing electromagnetic fields in the dielectric coating.

[0015] In still another embodiment it is disclosed a communication arrangement where the communication arrangement further comprises at least one intermediate node, where the node comprises a radio transceiver, an antenna and an adjacent power supply.

[0016] In still another embodiment it is disclosed that the power supply is at least one of: batteries, generators, sea water batteries or sea water generators.

[0017] In still another embodiment it is disclosed a communication arrangement where the at least one intermediate node, is embedded in the non conductivity coating.

[0018] In yet an embodiment it is disclosed a communication arrangement where the at least one intermediate node is configured to exchange data through

an interface with external data communication devices using electromagnetic field as a data carrier.

[0019] Another ~~embodiment~~~~aspect~~ according to the present invention discloses an arrangement for communication employing any combination of the arrangements indicated above.

[0020] Further advantageous ~~embodiments~~~~aspects~~ according to the present invention will be apparent from the accompanying dependent claims.

Brief description of drawings

[0021] To make the following description more readily understandable the following discussion will make reference to the accompanying drawings in which,

[0022] Figure 1 illustrates three alternative EM field paths and implementations

[0023] Figure 2 shows a pipe with EM-field communications along the pipe inside a coating in a multi-hop fashion, and

[0024] Figure 3 illustrates a radio transceiver inside the coating.

Mode(s) for Carrying Out the Invention

[0025] The invention will now be described with reference to the accompanying drawings, which are not to scale, however it shall be understood that the drawings are only meant to facilitate the understanding of the invention and they are in no way limiting the scope of the claimed invention.

[0026] In the following the wording modem and node may be used interchangeably, as to the mentioning of power supply any power supply known to the person skilled in the art shall be included in the interpretation of batteries, generators etc.

[0027] The present invention provides a robust, low-loss means for transmitting data along a pipeline 100,200,300. It provides fast and reliable communications paths along pipe-lines, either on-shore or off-shore. The basic principle and most obvious advantage will be best understood and appreciated in off-shore installations where pipe-lines are immersed in sea water, hence immersed in a fluid having conductive characteristics. Contrary to the traditional solutions of using traditional wired communication paths, pulse telemetry, acoustic telemetry through drill pipes or current coupled inductive couplers the present invention relies on

Claims

1. A communication arrangement for transmission of communication signals along a pipe line where the communication arrangement comprises:
 - a pipe ~~(100, 200, 300)~~ with outer pipe walls ~~(370)~~ made of a conductive material,
 - a non conductivity coating ~~(110, 210, 310)~~ surrounding said pipe ~~(100, 200, 300)~~
 - an outer coating/layer or fluid ~~(311)~~ that has conductive properties which encapsulates the non conductivity coating ~~(110, 210, 310)~~,
 - characterised in that the communication arrangement further comprises at least one radio frequency transmitter configured to excite an electro magnetic field ~~(143, 343)~~ in the non conductive coating ~~(110, 210, 310)~~ where the non conductivity coating ~~(110, 210, 310)~~ has dielectric properties and the field ~~(143, 343)~~ being associated with data signals,
 - and one radio frequency receiver configured to receive data signals in form of electromagnetic fields in the dielectric non conductivity coating ~~(110, 210, 310)~~.
2. A communication arrangement according to claim 1,
 - characterised in that the non conductive coating ~~(110, 210, 310)~~ is made of a polymer containing material.
3. A communication arrangement according to claim 1 or 2,
 - characterised in that the communication arrangement further comprises at each end of the pipe radio frequency transceivers ~~(321)~~.
4. A communication arrangement according to claim 3,
 - characterised in that the communication arrangement further comprises at least one intermediate radio transceiver ~~(321)~~.
5. A communication arrangement according to any of the previous claims,
 - characterised in that the transceivers and/or transmitters communicates in a multi hop fashion ~~(244)~~ employing electromagnetic fields in the

dielectric coating ~~(110, 210, 310)~~.

6. A communication arrangement according to any of the previous claims, characterised in that the communication arrangement further comprises at least one intermediate node ~~(120)~~, where the node ~~(120)~~ comprises a radio transceiver, an antenna and an adjacent power supply.
7. A communication arrangement according to claim 6, characterised in that the intermediate node ~~(120)~~ is configured to exchange data through an interface with external data communication devices using electromagnetic field as a data carrier.
8. A communication arrangement according to claim 6, characterised in that the power supply is at least one of batteries, generators, sea water batteries or sea water generators.
9. A communication arrangement according to claim 6 or 7, characterised in that the at least one intermediate node ~~(120)~~, is embedded in the non conductivity coating.