Abstract:
The invention relates to apparatus for detecting a parameter of a pipeline such as the leakage of fluid therefrom. The apparatus includes a device which is provided of at least two parts and with a smooth continuous outer surface so as to allow the device to be carried along the pipeline to be checked by the fluid of the flow alone with a minimum of contact and possible dislodgement of debris from the pipeline wall. The device includes a cavity in which detection apparatus is housed and allows signals indicative of its position to be sent to the surface. Apparatus is also provided for launching and retrieving the device to and from the pipeline.
Pipeline Leak Detection Apparatus

The invention to which this application relates is a device and method which can be used to detect the location of one or more leaks within a pipeline, by passing said device along the interior of the pipeline.

The provision of leaks within pipelines which carry fluids and, more typically, liquids, is well known. For example, in the water industry, the leaks can cause significant loss of water and also, can lead to the water company in charge of the pipeline, coming under adverse pressure, especially in periods of water shortage. There is therefore a need to be able to determine, firstly, the occurrence of a leak along a length of pipeline and, secondly, to accurately determine the location of the pipeline. However, in practise, conventionally, it has been the case of visually inspecting the earth above a buried pipeline, to try and identify indications of leakage of fluid therefrom or alternatively, to excavate the pipeline which is an expensive and time consuming operation and may not lead to the identification of the leak.

It is also known from other prior art to provide detection devices which can pass along the interior of a pipeline. Many of said devices require contact with the interior surface of the pipeline to guide the device along the same in a predicted manner. This leads to two problems, firstly, the contact of the device with the interior wall of the pipeline, means that additional propulsion is required to force the device along the pipeline and furthermore, the contact with the interior wall, can cause a dislodgement of debris which may cause contamination to the fluid being passed along the pipeline and therefore be unacceptable to the pipeline operator.
In recognition of this, it is known to provide a device in the form of a sphere or ovoid, which is designed to have substantially neutral buoyancy in the fluid of the pipeline in which the same is to be placed. This neutral buoyancy, and reduced size of the device, means that the same can be carried along the length of pipeline in a predicted manner, without the need for constant contact with the interior surfaces of the wall. The neutral buoyancy is also found to encourage the device to maintain movement along the length of pipeline and therefore resist the tendency for the same to become snagged in parts of the pipeline such as, for example, valves, outlets or the like.

An example of this type of device is described in the patent Application GB2412438 and the device is required to have at least two channels or passages between the external surface and an interior cavity. The interior cavity is the location for the majority of the components of the device with a first passage provided to allow a hydrophone, which is the device which detects a sound caused by a leakage, to be exposed to the external surface of the device. A second passage is provided to allow access to a control switch, so as to allow the components within the device and hence the operation of the device itself, to be switched on and off. Both of these passages represent potential problems in that they can allow leakage of the fluid from the pipeline into the cavity of the device and hence cause damage to the components in the cavity, potentially to such an extent as to cause the same to stop working.

It is also known to provide means within the device to allow the position of the device to be detected, at least at spaced intervals along the pipeline. This allows the position of the device to be monitored as it passes along the pipeline and therefore provide additional data which can be used to determine accurately, in combination with the speed of flow of the fluid, and the data
obtained from the hydrophone, the particular location of any leakages along the pipeline. A problem which is experienced is that the device can become damaged as it passes along the pipeline and/or the detection of the passage of the device as it passes along the pipeline can be susceptible to interference. A further problem is to allow the device to be launched into and retrieved from the pipeline in a controlled manner to ensure that the device is not damaged during this process and that it passes along the length of the pipeline in the appropriate manner.

An aim of the present invention is to provide a device of a type which can be supported and propelled by a fluid along a pipeline, such that the risk of damage to the same in use, is minimised and a further aim is to provide an improved method of detection of the location of the device as it passes along said pipeline. A yet further aim of the invention is to provide a system whereby, firstly, the device can be effectively introduced into the pipeline in a controlled manner so as to ensure that the device will pass along the pipeline and not be damaged, and also to ensure that the device can be retrieved from the pipeline subsequently at a location downstream thereof.

Apparatus for detecting at least one parameter of a pipeline, said apparatus including a device for movement along a pipeline, said device comprising a housing, said housing defining therein a cavity in which a plurality of detection components are located, and wherein said device is formed from at least two parts, wherein said parts are engageable in a sealed manner to form the device and form a continuous external wall of the device.

Typically the device is substantially spherical with a smooth continuous external wall surface.
The provision of the device with a continuous external surface, means that no passages or channels are provided between the external wall and the cavity of the device and therefore there is no opportunity for ingress of fluid.

In one embodiment, the device includes within the cavity, a switch, which switch can be operated using control means externally of the device. This therefore allows the device to be activated and/or deactivated once the device has been formed by the joining together of the two parts.

In one embodiment, the switch is moved between off and on positions, via a magnetic field which is generated between the switch and a location externally of the device.

In one embodiment, the device is moved to an on condition, prior to joining the parts together and thereafter is retained in the on position until a power supply within the cavity expires.

Typically, the power supply is provided within the cavity in the form of one or more batteries. In one embodiment the batteries may be recharged even with the device closed, possibly by inductance charging.

In one embodiment, the said parts of the device can be provided with matching threads so as to allow the same to be screwed together to form the sealed device. Alternatively, a bayonet fitting or other mechanical engagement means can be provided to allow the said parts to be engaged.

In one embodiment, the said device includes therein, an acoustic data recording circuit board which can act as a data storage means for data relating to acoustic noise occurring externally of the device in the fluid and pipeline.
In one embodiment, the device includes within the cavity therein, acoustic detection means in the form of one or more piezo planer members which are mounted adjacent to the wall of the housing.

In one embodiment, each of the said planer members are located in position, with respect to an insert plate which is positioned between the internal wall of the housing and the planer member. In one embodiment, the plate acts as a means for transmission of acoustic vibration, typically at a relatively high frequency, so as to allow the planer member to pick up and detect the occurrence of a leak within a pipeline along which the device is passing.

In one embodiment, the first and second planer members are mounted at opposing sides of the device and are maintained in said position by an elongate member which ensures that firstly, the planer members are retained in position and, furthermore, are pressed against respective insert plates so as to allow for the relative sensitive and accurate detection of vibration noise via said plates and the housing of the device.

In one embodiment, the device includes, within the cavity, a coil and electro-magnetic circuit board, which coil is provided to allow the detection device to be used in conjunction with at least one coil mounted at a spaced location therefrom so as to allow the transmission of data signals from the device to the said further location to allow the presence of the detection device to be identified.

Typically, a first coil is provided at said further location to transmit signals to the coil held within the device and a second
coil is provided at said further, or another, location, to receive data signals from the coil provided within the device.

Typically, the data signals which are generated are such as to allow an indication of a particular location of the device in the pipeline to be provided.

Typically the further location of the coils is above ground in which the pipeline and hence detection device is located.

In one embodiment, the device is provided with substantially neutral buoyancy in the fluid which passes along a pipeline such that the device is carried by the fluid along the pipeline and the acoustic data which is collected, is used to generate an indication of any leakage which may be occurring from the pipeline and also to provide an indication of the particular location of the device and hence allow the calculation of the location of the leakage to be achieved. This arrangement allows the device to be carried by the fluid and therefore the device does not need to be provided with any guide means so as to guide the position of the same in the pipeline and also does not need to be provided with any propulsion means as the movement of the fluid allows the device to be propelled along the pipeline.

In one embodiment, the said further location or locations from and to which data signals are transmitted from the device, are provided at known positions along the length of the pipeline. These positions are typically fixed and are predetermined at spaced intervals along the length of the pipeline so that when the device passes that location, the signals transmitted from it are logged and hence the position of the device can be determined with respect to the pipeline and the time at which the signal is logged is also determined.
In one embodiment, the length of pipeline along which the device can pass, can be of a number of kilometres in length and therefore there is provided in accordance with the invention a non-destructive method of detecting the condition of a pipeline interior, via the device, which when provided in accordance with the current invention, is particularly resistant to damage and malfunction which therefore allows the reliability of the device to be significantly improved and hence the possible length of pipeline which can be tested in one pass of the device, to be reliably increased.

In one embodiment, the device is introduced into the pipeline, via a suitable opening such as, via a valve fitting on the pipeline and typically, the device will be moved to a switched-on condition, prior to introduction into the fluid.

In one embodiment, the device may include, within the cavity, a data transfer connection and a memory means which can be accessed at the end of use of the device and once the same has been removed from the pipeline. This data communication means can allow data which has been collected in the memory during the passage of the device along the pipeline, to be transmitted to and provided for further processing.

In one embodiment, the device is provided such that when it has been passed along the length of pipeline, the same is required to be accessed to allow access to data means within the cavity which requires breaking of the seal.

In a further aspect of the invention there is provided a device for movement along a pipeline, said device comprising a housing, said housing defining therein a cavity in which a plurality of detection components are located, and wherein said
device is formed from at least two parts, wherein said parts are engagable in a sealed manner to form the device and form a continuous external wall of the device.

In a yet further aspect of the invention, there is provided apparatus for the insertion of a pipeline detection device into a pipeline such that the device can thereafter move along the pipeline under the influence of the flow of fluid thereon, said apparatus connectable to an external port leading into the pipeline interior, said apparatus incorporating a chamber in which the device is located, said first chamber having positioned therein a movable plate internal, in connection with an elongate member which can be used to selectively move the plate and hence the device into position in the pipeline and wherein said apparatus further incorporates a retaining means located to contact the underside of the device in the chamber.

Typically, the chamber, has an opening which is positioned to face downstream of the fluid flow and through which the device is released from the apparatus into the fluid flow. Typically the chamber is provided so as to be able to fill with fluid from the pipeline and it is the retaining means which, until moved to the second position, prevents the device from entering and moving along the fluid.

Typically the retaining means will not be moved to the second position until certain predetermined parameters are met. In one embodiment, a parameter may be that the first chamber is required to be filled with the fluid of the pipeline, at least to a specific extent. In another embodiment, a parameter may be that the degree of turbulence within the first chamber is below a certain level. Once the specific conditions are met, the device can enter into the path of the fluid flowing along the pipeline. In this manner, so the device can be entered into the pipeline
fluid flow in a controlled manner and may do so with a minimum or no contact with the internal wall and pipeline.

In a further aspect of the invention, there is provided apparatus for the removal of the device from a pipeline, said apparatus including means for connecting to a port into the pipeline in a sealed manner, and collecting means to collect and retain the device as it reaches the location of said apparatus and wherein said apparatus further includes a detection means to detect the presence of said device in the catching means.

In one embodiment, the detection means are activated continuously or alternatively, may be activated when the presence of the device is believed to be at, or close to, the collecting means as a result of previous location detection as the device passes along the pipeline.

In one embodiment, the detection means is a camera such as an infra red camera. In one embodiment the camera utilises infra red light to improve poor light conditions. When the presence of the device is determined via the protection means, the apparatus can then be operated to lift the device which is retained in the collecting means from the fluid flow and into the apparatus whereupon the removal of the apparatus from the pipeline, ensures that the device is removed therewith.

In one embodiment, the collecting means is a net and/or a strap which depends inwardly into and across the fluid flow along the pipeline.

There is therefore provided in accordance with the invention, apparatus which can be used independently, although typically in combination, to allow the insertion and removal of the device to and from the pipeline. In particular, the problems of inserting
the device of a type described, which does not rely upon contact with the interior walls of the pipeline, means that the device can be inserted into and removed from the pipeline apparatus safely.

It should be noted that although the use of the device is of particular advantage in relation to the determination of the occurrence of leakages within a pipeline, the device can be used for other purposes in which the detection of acoustical noise is of advantage and there is a need to determine the particular location of the occurrence of the noise.

Specific embodiments of the invention will now be described with reference to the accompanying drawings, wherein:-

Figure 1 illustrates a pipeline in a schematic manner with the device in accordance with the invention in one embodiment, located therein;

Figure 2 illustrates a view of the device of Figure 1 illustrating the acoustical apparatus held within the cavity thereof;

Figure 3 illustrates the insertion apparatus in one embodiment;

Figure 4 illustrates the lower parts of the insertion apparatus of Figure 3;

Figures 5a and b illustrate the release mechanism;

Figure 6 illustrates the lower part of the device removal apparatus in accordance with one embodiment; and

Figure 7a-c illustrate one arrangement for catching the device.
Referring now to Figure 1, there is illustrated in schematic manner a use of the device and apparatus in accordance with the invention. In this arrangement, there is provided a pipeline 2 within the ground 4 and under the surface 6. The pipeline may be of a number of kilometres in length and includes an entry-port 8 and an exit port 10 for a device 12 which is provided to pass along the interior of the pipeline 2 along the passage 14 in the direction of fluid flow 16 along the pipeline. The device 12 is provided with substantially neutral buoyancy such that the flow of the fluid itself is sufficient to propel the device 12 from the entry port 8 to the exit port 10. The components of the device will be described in more detail subsequently but, do include an electromagnetic coil and control means, which coil facilitates the reception of data from a first coil 18 located in this case at each of a series of fixed locations 20 along the length of the pipeline. Although only two such locations are shown it should be appreciated that the number of locations and the spacing of the same can be selected with respect to the pipeline length, the size of the pipeline, the terrain of the ground above the pipeline or any other relevant parameters. It should also be appreciated that vehicle mounted or hand held variations of these fixed locations may be provided for specific requirements such as perhaps, finding the specific location of the device within the pipeline.

Data can also be transmitted from the coil within the device 12 to a second electromagnetic coil 22 at the fixed location 20. With the provision of these fixed locations, the device emits a signal 23 which is detected by the coil 22 at each fixed location when the device is within a given range of the fixed location. The reception of the signal is logged along with the time of signal reception and this data, allows the passage of the device along the pipeline to be tracked and which data can subsequently
be used in identifying the location of a leak, when used in conjunction with the acoustic data detected by the device.

It will readily be appreciated that the pipeline can thus be tested in accordance with the present invention without the need for the fluid flow to be altered as indeed the fluid flow is required to allow the propulsion of the device along the pipeline and also the device does not affect or contaminate the fluid flow. Firstly, the device is a self-contained unit and secondly, the device is not required to contact with the internal walls of the pipeline in order to control or guide the movement of the same and therefore the risk of dislodgement of contaminants is reduced with regard to conventional systems. The neutral buoyancy of the device is found to be achievable when the device has a diameter in the range of 45-90 mm more preferably in the range 60-80mm.

In use therefore, if the pipeline has a leak, as for example illustrated at location 26, the device, as it passes that location, will detect an acoustic noise caused by the leakage of fluid from the pipeline. The acoustic noise data can then be stored within the device in a memory for subsequent retrieval. At the same time, the device, via the coils 18 and 22, is indicating its location on the pipeline constantly or, more normally, at spaced intervals by emitting a signal, which is detected by the coil 22 above the surface and the particular location with respect to the pipeline logged. This data, in conjunction with the speed of flow of the fluid along the pipeline and the data relating to the time at which the leakage noise is detected, can be used and processed to determine a relatively precise location of the leakage point or points along the length of the pipeline and then action subsequently can then be taken to access the pipeline at the correct location and repair the leakage.
The communication between the first coil 18 and the coil within the device may be used to communicate with and control components within the device and thereby allow improved interaction with the device.

A more specific arrangement of the device interior cavity is shown in Figure 2 which is a cross section through the centre of the same. The device 12 is shown as including a housing 28, which defines a cavity 30 within the same. The housing 28 is typically formed of two parts, 32, 34 which, in one embodiment, are engaged at an interface via threaded formations 36 and are provided with at least one o-ring seal (not shown) located therebetween.

The threaded formations and sealing means mean that once the parts 32, 34 are engaged, the interior cavity 30, is sealed from ingress of fluid. Furthermore, and importantly as the external housing 28 does not have any passages or apertures provided therein, the cavity is entirely sealed from ingress once the parts 32, 34 are engaged.

Typically, within the cavity, there is provided a switch (not shown) which is provided to be operable from externally, 38 of the device which means that the device can be formed by joining the parts 32, 34 together then taken to the entry port 8 into the pipeline and then switched on prior to placing the device into the pipeline itself but without the need to gain access to the cavity or provide a switch connection on the exterior surface of the device.

Also provided in the cavity, are a power source (not shown) which may typically be batteries which, in one embodiment can be of the rechargeable type so as to allow the same to be charged prior to every passage of the device along a pipeline,
thereby rendering the device reusable. Alternatively, the device may be provided for a one-pipeline pass only in which case the power source provided is sufficient for the operation of the device for the duration of the passage of the device along the length of the pipeline. In any case, the power source is used to power the coil (not shown) within the device 12 and which coil allows the communication between the surface coils 18, 22 in a manner as already described. Associated circuitry can also be provided within the cavity 30 for controlling the operation of the electromagnetic coil and also for controlling the operation of a memory means in which data can be stored in the device for subsequent retrieval, such as for example, via a USB port, once the device has been taken from the pipeline via exit point 10. Thus, data which is collected during the passage of the device along the pipeline can be stored and then subsequently retrieved and processed as required.

Finally, provided within the device cavity 30 are acoustic detection means which, in accordance with the invention, are wholly enclosed within the cavity 30 which therefore avoids the need for any passages or apertures to the external surface of the cavity to be provided, which prevents the possibility of leakage through said apertures and passages occurring. In this case, the acoustical apparatus comprises a support member or bar 40 which extends along a central axis 42. At each end of the bar 40, there is located a mounting plate 44 and, on each of said mounting plates, there is provided a piezo electric planer member or disc 46 which is used to detect acoustical noise which is occurring externally of the device within the pipeline such as the noise which is caused by fluid leakage from the pipeline. The discs 46 are coupled to the external housing 28 via insert plates 48 which typically are formed of a soft plastics material and which allow the transmission of vibration representative of the acoustic noise in the pipeline to pass
through the housing 28 through the respective plates 48 and to the discs 46. The discs are connected to acoustical control circuitry and data representative of the acoustical data which is detected, can then be stored for subsequent retrieval.

Referring now to Figure 3 there is illustrated insertion apparatus 102 in accordance with one embodiment of the invention. The apparatus comprises an elongate member 104 which, at the outer end, has an operating handle 106 and holding means 108. The elongate member leads to a sealing plate or disc 110 which is mounted within a chamber 112 sealed from the remaining apparatus 116 via a sealing ring 118. The apparatus also includes attachment means 120 for attachment to a flange of an inlet into the pipeline (not shown). Typically the attachment means will be of a conventional form so as to fit to conventional flanges.

The sealing ring 118, means that the chamber 112 can be in the fluid communication with the fluid passing along the pipeline and indeed, the first chamber will typically fill with the fluid via apertures 122 such that the pipeline monitoring device 126 which is located therein, will effectively be held in the fluid when in the first chamber. A retaining means 130 is provided which retains the device within the chamber 112. When it is desired to place the device into the pipeline fluid flow the chamber is moved from the position shown in Figure 4 to the position shown in Figure 3. The elongate member 104 is advanced downwardly as indicated by arrow 138 so as to move the plate 110 down and hence the device 126 into the centre of the fluid flow of the pipeline. The chamber is provided with an exit opening 132 which can be located so as to face downstream of the pipeline fluid flow such that, when desired, the plate 110 may be moved upwardly to allow the device to leave the chamber 112 and be carried along the pipeline with the fluid.
flow. The device 126 when in the chamber 112, is introduced in a controlled manner into the fluid flow, so that the device can be introduced into the pipeline without the same having to contact the internal walls of the pipeline and, furthermore, without significant turbulence being caused to the flow of the fluid.

The release mechanism is shown in another form in detail in figures 5a and b. Initially, as shown in figure 5a the device 126 is held in place using two spring loaded clasps 150, 152 within the tube 154. Once the tube has been lowered into place in the pipeline force can be applied to the rod 156. This will cause the device 126 to exit the tube 154 and the clasps 150, 152 open, releasing the device 126 into the flow as shown in figure 5b.

Figures 6 and 7a-c illustrate the lower part of the apparatus which can be used to retrieve the device from the pipeline. The apparatus incorporates a net 140 which depends into the flow of the fluid from port into the pipeline downstream from where the device was introduced. The net extends across the flow of fluid and hence the internal cross sectional area of the pipeline so as to ensure that the device, will be caught by the net. In one embodiment carbon fibre strips 158 can be employed with the net to hold the same open. The strips can be strapped together at the top of the net and hinged at the bottom and the force applied by the liquid flow causes the carbon fibre strips to bow out, opening the net and filling the internal circumference of the pipe.

Typically, the Retrieval Mechanism as shown in figures 7a-c uses the same casing design and mechanical principals as the Launch mechanism, A first push rod 156 is locked into position with the Tube 154 hence allowing them to be lowered together until a camera 160 is positioned at the crown of the pipe line.
The next phases, as shown in figure 7b and c can use, for the larger pipes, three interlocking Push Rods, otherwise only two 156, 162 are required. The rods are inserted until the net is fully deployed as shown in figure 6.

To ensure the device is captured an infrared camera can be provided. The camera projects infrared light into the pipe enabling the user to view the mouth of the net, detects the presence of the device once collected by the apparatus and therefore allows the operator to be sure that the device has in fact been collected before operating the apparatus to remove the device from the pipeline.

There is therefore provided in accordance with the invention, a device which can be used as part of a leakage, or other event occurrence detection system and which device is provided as a self contained, integrated unit, thereby minimizing the opportunity for the ingress of fluid therein and therefore ensuring that the device is operable for the required duration of time. When one considers that the operation of the device is critical to the successful use of the detection system, the provision of a device in accordance with the present invention which can be relied upon to operate for a prolonged period of time, provides the opportunity for the device and the detection system to be used over lengths of pipeline of many kilometres. Thus, in addition to providing a detection system which is non-invasive and has reduced risk of contamination, there is also now provided a system which can be used over significant lengths of pipeline and, in many cases, on pipeline which is relatively inaccessible.
Claims

1. Apparatus for detecting at least one parameter of a pipeline, said apparatus including a device for movement along the pipeline, said device comprising a housing, said housing defining therein a cavity in which a plurality of detection components are located, and wherein said device is formed from at least two parts, wherein said parts are engagable in a sealed manner to form the device and form a continuous external wall of the device.

2. Apparatus according to claim 1 wherein the device is substantially spherical with a smooth continuous external wall surface.

3. Apparatus according to claim 2 wherein the device has no passages or channels between the external wall and the cavity of the device.

4. Apparatus according to claim 1 wherein the device includes within the cavity, a switch, which switch can be operated using control means externally of the device.

5 Apparatus according to claim 1 wherein the device is activated once the device has been formed by the joining together of the two parts.

6. Apparatus according to claim 1 wherein the switch is moved between off and on positions via a magnetic field which is generated between the switch and a location externally of the device.

7 Apparatus according to claim 1 wherein the device is moved to an on condition, prior to joining the parts together and
thereafter is retained in the on position until a power supply within the cavity expires.

8. Apparatus according to claim 1 wherein a power supply is provided within the cavity in the form of one or more batteries.

9 Apparatus according to claim 8 wherein the batteries can be recharged with the device closed by inductance charging.

10 Apparatus according to claim 1 wherein the said parts of the device can be engaged via any, or any combination of, matching threads and/or a bayonet fitting.

11 Apparatus according to claim 1 wherein the said device includes an acoustic data recording circuit board which stores data relating to acoustic noise occurring externally of the device in the fluid and pipeline.

12 Apparatus according to claim 1 wherein the device includes within the cavity acoustic detection means.

13 Apparatus according to claim 12 wherein acoustic detection means are one or more piezo planer members which are mounted adjacent to the internal wall of the cavity housing.

14 Apparatus according to claim 13 wherein each of the said planer members are located in position with respect to an insert plate which is positioned between the internal wall of the housing and the planer member.

15 Apparatus according to claim 14 wherein the insert plate acts as a means for transmission of acoustic vibration so as to allow the adjacent planer member to pick up and detect the noise of a leak within a pipeline along which the device is passing.
16. Apparatus according to claim 13 wherein first and second planer members are mounted at opposing sides of the device and are maintained in said position by a member passing between the same.

17 Apparatus according to claim 16 wherein the member acts to press each planar member against its respective insert plate.

18 Apparatus according to claim 1 wherein the device includes within the cavity a coil and electro-magnetic circuit, which coil is provided to allow the detection device to be used in conjunction with at least one coil mounted at a spaced location therefrom so as to allow the transmission of data signals from the device to the said location to allow the presence of the detection device to be identified.

19 Apparatus according to claim 18 wherein a first coil is provided at said location to transmit signals to the coil held within the device and a second coil is provided at said, or another, location, to receive data signals from the coil within the device.

20 Apparatus according to claim 19 wherein the data signals which are generated provide an indication of a particular location of the device in the pipeline.

21. Apparatus according to claim 18 wherein the said location of the coils is above the ground in which the pipeline and hence detection device is located.

22 Apparatus according to claim 1 wherein the device is provided with substantially neutral buoyancy in the fluid which passes along a pipeline such that the device is carried by the
fluid along substantially the central longitudinal axis of the pipeline.

23 Apparatus according to claim 22 wherein acoustic data is collected by the device and used to generate an indication of any leakage of fluid occurring from the pipeline and an indication of the particular location of the device to allow the calculation of the location of the leakage to be achieved.

24 Apparatus according to claim 1 wherein the device is carried by the fluid along the pipeline.

25 Apparatus according to claim 18 wherein the said location or locations from and to which data signals are transmitted from the device, are at known positions along the length of the pipeline.

26 Apparatus according to claim 25 wherein the positions are at spaced intervals along the length of the pipeline and when the device passes that location, the signals transmitted from it are logged along with the time at which the signal is logged.

27 Apparatus according to claim 1 wherein the device is introduced into the pipeline, via a valve fitting on the pipeline.

28 Apparatus according to claim 1 wherein the device includes a data transfer connection which can be accessed at the end of use of the device to allow data which has been collected in the memory during the passage of the device along the pipeline, to be further processed.

29 Apparatus according to claim 1 wherein the device is introduced to and retrieved from the pipeline at spaced positions along the pipeline via launch and retrieval apparatus
which protrude into the pipeline at said positions and can be controlled by a person externally of the pipeline to allow the controlled launch and retrieval of the device.

30 A device for movement along a pipeline, said device comprising a housing, said housing defining therein a cavity in which a plurality of detection components are located, and wherein said device is formed from at least two parts, wherein said parts are engagable in a sealed manner to form the device and form a continuous external wall of the device.

31 Apparatus for the insertion of a pipeline detection device into a pipeline such that the device can thereafter move along the pipeline under the influence of the flow of fluid thereon, said apparatus connectable to an external port leading into the pipeline interior, said apparatus incorporating a chamber in which the device is located, said first chamber having positioned therein a movable plate internal, in connection with an elongate member which can be used to selectively move the plate and hence the device into position in the pipeline and wherein said apparatus further incorporates a retaining means located to contact the underside of the device in the chamber.

32 Apparatus according to claim 31 wherein the chamber has an opening which is positioned to face downstream of the fluid flow and through which the device is released from the apparatus into the fluid flow.

33 Apparatus according to claim 31 wherein the chamber is provided so as to be able to fill with fluid from the pipeline and it is the retaining means which, until moved to the second position, prevents the device from entering and moving along the fluid.
34 Apparatus according to claim 31 wherein the retaining means will not be moved to the second position until certain predetermined parameters are met.

35 Apparatus according to claim 34 wherein a parameter is that the first chamber is required to be filled with the fluid of the pipeline, at least to a specific extent.

36 Apparatus according to claim 34 wherein a parameter is that the degree of turbulence within the first chamber is below a certain level.

37 Apparatus for the removal of the device from a pipeline, said apparatus including means for connecting to a port into the pipeline in a sealed manner, and collecting means to collect and retain the device as it reaches the location of said apparatus and wherein said apparatus further includes a detection means to detect the presence of said device in the catching means.

38 Apparatus according to claim 37 wherein the detection means are activated continuously.

39 Apparatus according to claim 37 wherein the detection means are activated when the presence of the device is predicted to be at, or close to, the collecting means as a result of previous location detection as the device passes along the pipeline.

40 Apparatus according to claim 37 wherein the detection means is a camera.

41 Apparatus according to claim 37 wherein when the device is detected the apparatus is operated to lift the device which is retained in the collecting means from the fluid flow and into the
apparatus whereupon the removal of the apparatus from the pipeline, ensures that the device is removed therewith.

42 Apparatus according to claim 37 wherein the collecting means is a net and/or a strap which depends inwardly into and across the fluid flow along the pipeline.
INTERNATIONAL SEARCH REPORT

PCT/GB2008/001916

A. CLASSIFICATION OF SUBJECT MATTER

INV. G01M3/00

According to International Patent Classification (IPC) or its both national classification and IPC.

b. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

GO1M

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the International search (name of data base and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
<thead>
<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>WO 02/052238 A (CANADIAN MINING INDUSTRY RES 0 [CA]; RANTALA PAUL A [CA]; MACKENZIE AN) 4 July 2002 (2002-07-04) abstract page 2, paragraph 3 - page 4, paragraph 3 page 5, paragraph 3 - page 8, paragraph 4 claims 1-12 figures 1-6</td>
<td>1-41</td>
</tr>
<tr>
<td>A</td>
<td>WO 2004/059274 A (MECON LTD [GB]; THOMPSON MARTIN [GB]; HARPER MARTIN FRANCIS LUCIEN [GB]) 15 July 2004 (2004-07-15) cited in the application abstract page 12, paragraph 3 - page 15, paragraph 3 claims 1-33 figures 1-5</td>
<td>1-41</td>
</tr>
</tbody>
</table>

X Further documents are listed in the continuation of Box C. X See patent family annex.

* Special categories of cited documents :

*A* document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claims) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"A" document member of the same patent family

Date of the actual completion of the international search: 2 October 2008

Date of mailing of the international search report: 15/10/2008

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040,
Fax: (+31-70) 340-3016

Authorized officer

Daman, Marcel

Form PCT/ISA/210 (second sheet) (April 2005)
<table>
<thead>
<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. X</td>
<td>GB 2 435 329 A (REED KEITH [GB]; BITHREY WILLIAM STEPHEN [GB]; MORACE GARY PARK [GB]); 22 August 2007 (2007-08-22) abstract figures 1-4 claims 1-36</td>
<td>1-41</td>
</tr>
<tr>
<td>Patent document cited in search report</td>
<td>Publication date</td>
<td>Patent family member(s)</td>
</tr>
<tr>
<td>----------------------------------------</td>
<td>-----------------</td>
<td>-------------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CA 2329504 A1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>US 2004025607 A1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ZA 200206067 A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>GB 2412438 A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>GB 2419948 A</td>
</tr>
<tr>
<td>GB 2435329 A</td>
<td>22-08-2007</td>
<td>NONE</td>
</tr>
</tbody>
</table>