**Apparatus and Method of Detecting Interfaces Between Well Fluids and For Detecting the Launch of a Device in Oilfield Applications**

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(57) Abrégé(suite)/Abstract(continued):
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APPARATUS AND METHOD OF DETECTING INTERFACES BETWEEN WELL FLUIDS AND FOR DETECTING THE LAUNCH OF A DEVICE IN OILFIELD APPLICATIONS

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The invention relates to an apparatus and method for use in the field of oil and gas recovery. More particularly, this invention relates to an apparatus having a first component such as a sensor and a second component such as a detectable device or material adapted to determine when a general interface region between two dissimilar fluids has passed a given point in a well. The invention also relates to a system having a first component, such as a detectable object or transponder, and a second component, such as sensor or sensor coil, adapted to determine when a device has passed a given point in the system.

Description of the Related Art

[0002] Cementing a wellbore is a common operation in the field of oil and gas recovery. Generally, once a wellbore has been drilled, a casing is inserted and cemented into the wellbore to seal off the annulus of the well and prevent the infiltration of water, among other things. A cement slurry is pumped down the casing and back up into the space or annulus between the casing and the wall of the wellbore. Once set, the cement slurry prevents fluid exchange between or among formation layers through which the wellbore passes and prevents gas from rising up the wellbore. This cementing process may be performed by circulating a cement slurry in a variety of ways.

[0003] For instance, it is generally known that a conventional circulating cementing operation may be performed as follows. First the liquid cement slurry is pumped down the inside of the casing. Once the desired amount of cement has been pumped inside the casing, a
rubber wiper plug is inserted inside the casing. A non-cementacious displacement fluid, such as drilling mud, is then pumped into the casing thus forcing the rubber wiper plug toward the lower end of the casing. Concomitantly, as the displacement fluid is pumped behind it, the rubber wiper plug pushes or displaces the cement slurry beneath it all the way to the bottom of the casing string. Ultimately, the cement is forced for some distance up into the annulus area formed between the outside the casing and the wellbore. Typically, the end of the job is signaled by the wiper plug contacting a restriction inside the casing at the bottom of the string. When the plug contacts the restriction, a sudden pump pressure increase is seen at the surface. In this way, it can be determined when the cement has been displaced from the casing and fluid flow returning to the surface via the casing annulus stops.

[0004] The restriction inside the bottom of the casing that stops the plug in this conventional cement circulation procedure is usually a type of one-way valve, such as a float collar or a float shoe, that precludes the cement slurry from flowing back inside the casing. The valve generally holds the cement in the annulus until the cement hardens. The plug and the valve may then be drilled out.

[0005] Further, it is known that the time the end of the cement slurry leaves the lower end of the casing (i.e. when the operation is complete) may be estimated, as the inner diameter, length, and thus the volume of the casing as well as the flow rate of the cement slurry and displacement fluids are known.

[0006] The conventional circulating cementing process may be time-consuming, and thus relatively expensive, as cement must be pumped all the way to the bottom of the casing and then back up into the annulus. Further, expensive chemical additives, such as curing retarders and cement fluid-loss control additives, are typically used, again increasing the cost. The loading of
these expensive additives must be consistent through the entire cement slurry so that the entire slurry can withstand the high temperatures encountered near the bottom of the well. This again increases cost. Finally, present methods of determining when the slurry leaves the lower end of the casing generally require attention and action from the personnel located at the surface and may be inaccurate in some applications. For instance, if the plug were to encounter debris in the casing and became lodged in the casing, personnel at the surface could incorrectly conclude the cement had left the lower end of the casing and job was completed. In other applications, the plug may accidentally not be pumped into the casing. Thus, in some applications, it is known to attach a short piece of wire to the rubber wiper plug. Personnel on the surface may then monitor the wire, and once the entire wire is pulled into the wellbore, the surface personnel know the plug has entered the casing. However, this system only verifies that the plug has entered the casing, not that the plug has reached the bottom.

[0007] A more recent development is referred to as reverse circulating cementing. The reverse circulating cementing procedure is typically performed as follows. The cement slurry is pumped directly down the annulus formed between the casing and the wellbore. The cement slurry then forces the drilling fluids ahead of the cement displaced around the lower end of the casing and up through the inner diameter of the casing. Finally, the drilling mud is forced out of the casing at the surface of the well.

[0008] The reverse circulating cementing process is continued until the cement approaches the lower end of the casing and has just begun to flow upwardly into the casing. Present methods of determining when the cement reaches the lower end of the casing include the observation of the variation in pressure registered on a pressure gauge, again at the surface. A restricted orifice is known to be utilized to facilitate these measurements.
[0009] In other reverse circulation applications, various granular or spherical materials of pre-determined sizes may be introduced into the first portion of the cement. The shoe may have orifices also having pre-determined sizes smaller than that of the granular or spherical materials. The cement slurry’s arrival at the shoe is thus signaled by a “plugging” of the orifices in the bottom of the casing string. Another, less exact, method of determining when the fluid interface reaches the shoe is to estimate the entire annular volume utilizing open hole caliper logs. Then, pumping at the surface may be discontinued when the calculated total volume has been pumped down the annulus.

[0010] In the reverse circulating cementing operation, cementing pressures against the formation are typically much lower than conventional cementing operations. The total cementing pressure exerted against the formation in a well is equal to the hydrostatic pressure plus the friction pressure of the fluids’ movement past the formation and out of the well. Since the total area inside the casing is typically greater than the annular area of most wells, the frictional pressure generated by fluid moving in the casing and out of the well is typically less than if the fluid flowed out of the well via the annulus. Further, in the reverse circulating cementing operation, the cement travels the length of the string once, i.e. down the annulus one time, thus reducing the time of the cementing operation.

[0011] However, utilizing the reverse circulating cementing operation presents its own operational challenges. For instance, since the cement slurry is pumped directly into the annulus from the surface, no conventional wiper plug can be used to help displace or push the cement down the annulus. With no plug, there is nothing that will physically contact an obstruction to stop flow and cause a pressure increase at the surface.
Further, unlike the conventional circulating cementing process where the inner diameter of the casing is known, the inner diameter of the wellbore is not known with precision, since the hole is typically washed out (i.e. enlarged) at various locations. With this variance of the inner diameter of the wellbore, one cannot precisely calculate the volume of cement to reach the bottom of the casing, even when using open hole caliper logs.

Other methods of determining when the cement slurry has reached the lower end of the wellbore are known. For instance, it is known that the restrictor discussed above may comprise a sieve-like device having holes through which the drilling mud may pass. Ball sealers -- rubber-covered nylon balls that are too large to go through those holes -- are mixed into the cement at the mud/cement interface. In operation, as the mud/cement interface reaches the lower end of the casing, the ball sealers fill the holes in the sieve-like device, and changes in pressure are noticed at the surface thus signaling the end of the operation. Again, erroneous results may be produced from this system. The wellbore is typically far from pristine and typically includes various contaminants (i.e. chunks of shale or formation rock that are sloughed off of walls of the wellbore) that can plug the holes. Once the holes are plugged, the flow of cement and drilling mud ceases, even though the cement interface has not reached the lower end of the casing. Also problematic is that fact that once any object is inserted into the casing, or annulus for that matter, its precise location of that object is no longer known with certainty. The accuracy of its whereabouts depends upon the quality and quantity of the instrumentation utilized at the surface.

From the above is can be seen that in either the conventional or reverse circulation cementing process, it is important to determine the exact point at which the cement completely fills the annulus from the bottom of the casing to the desired point in the annulus so that appropriate action may be taken. For instance, in the conventional circulation cement process, if
mud continues to be pumped into the casing after the mud/cement interface reaches the lower end of the casing, mud will enter the annulus thus contaminating the cement and jeopardizing the effectiveness of the cement job.

[0015] Similarly, in the reverse circulating cementing process, if cement -- or displacement fluids -- continue to be pumped from the surface once the mud/cement interface reaches the lower end of the casing, excessive cement will enter the interior of the casing. Drilling or completion operations will be delayed while the excess cement inside the casing is drilled out.

[0016] Thus, a need exists for a more accurate system and method of determining the location of an interface between two fluids with respect to the wellbore. Particularly, in a cementing operation, a need exists for a more accurate apparatus and method of determining when the mud/cement interface, or the spacer/cement interface, reaches the lower end of a casing. Preferably, the apparatus and method will not rely on manual maneuvering at the surface of the well. Further, the apparatus and method should be able to be utilized with both the conventional circulating cementing operation and the reverse circulating cementing operation. Further, this apparatus preferably does not rely heavily on manual operations, nor operations performed at the surface.

[0017] Further, there is a need for an apparatus that performs the function of detecting when the mud/cement interface, or spacer/cement interface, reaches the lower end of the casing and, once the cement slurry is detected, will prevent any more fluid from being pumped. The system should be capable of operation without manual intervention from the surface.

[0018] Further, as stated above, cementing a wellbore is a common operation in the field of oil and gas recovery. Generally, once a wellbore has been drilled, a casing is inserted and
cemented into the wellbore to seal off the annulus of the well and prevent the infiltration of water, among other things. A cement slurry is pumped down the casing and back up into the space or annulus between the casing and the wall of the wellbore. Once set, the cement slurry prevents fluid exchange between or among formation layers through which the wellbore passes and prevents gas from rising up the wellbore. This cementing process may be performed by circulating a cement slurry in a variety of ways.

[0019] As stated above, generally, in a conventional cementing operation, a cementing head is attached to the upper portion of the casing. A wiper plug is inserted into the cementing head. Liquid cement slurry is pumped down the cementing head forcing the wiper plug through the cementing head and into the casing. Once the desired amount of cement has been pumped inside the casing, another wiper plug, which had also been pre-inserted inside the cementing head, is released from the cementing head. A non-cementaceous displacement fluid, such as drilling mud, is then pumped into the cementing head thus forcing the second wiper plug into the casing.

[0020] It is important to determine that each wiper plug has been properly “launched,” i.e. that each wiper plug has left the cementing head. It is not uncommon for these wiper plugs to turn sideways and become lodged in the casing. If the plugs become lodged, excessive pressures may build up in the cementing head. Further, if the wiper plugs turn sideways, the cement may mix with the non-cementaceous displacement fluid such as drilling mud. If this happens, the resulting cement may be contaminated to the point that a remedial cementing job may be required. Such remedial cementing jobs are time consuming, expensive and generally not as effective as a primary cementing job.
To determine if each wiper plug has been successfully launched, it is known to attach a wire to each wiper plug. The length of the wire corresponds to the length of the cementing head. As the wiper plug descends into the cementing head, the wire follows. Operators at the surface may visualize the movement of the wire which lets them know the wiper plug is moving down the cementing head. When the wiper plug enters the casing, the end of the wire enters the cementing head and no further wire is visible at the surface. Thus, in some applications, it is known to attach a piece of wire to the rubber wiper plug. However, this system requires an operator to monitor the wire at the surface. Further, this system is subject to defects because the wires may become accidentally separated from the wiper plug before the wiper plug reaches the casing. In this situation, the operator cannot ascertain whether the wire is loose or whether the wiper plug is lodged. Thus, there is a need for an apparatus and method for determining for certain that these wiper plugs have been properly launched.

Another common operation in well drilling and completion operations is the isolation of particular zones within the well. In some applications, such as cased-hole situations, conventional bridge plugs can be used. In other applications, it is possible to prevent the flow of fluids into the casing or to block off a particular zone in the well as follows. The casing will contain perforations in its walls at the horizontal level of a particular zone. The perforations are of known diameter. Sealing balls, having a diameter slightly larger than the perforations, are launched into the casing as follows. The sealing balls are loaded into a commercially available ball launcher or ball injector, such as the model GN201 or 202 by BN Machine Works of Calgary, Alberta. The ball injector periodically inserts a sealing ball into fluid flowing through an intermediate pipe to which the ball launcher is inserted. Once inserted into the intermediate
pipe, the sealing balls travel through the conduit and finally are launched into the casing. The sealing balls then travel down the casing until the become lodged in the perforations.

[0023] As with the wiper plugs discussed above, occasionally the sealing balls will not properly launch. In some situations, the ball launcher or injector becomes jammed and the ball never leaves the injector. In other situations, an operator may fail to load any or a sufficient number of balls into the injector. In other situations, the injector may run out of balls. The result is that the operators erroneously believe the perforations are properly plugged and the desired zone is blocked off.

[0024] Prior art methods may also rely upon changes in pressure noticed at the surface to signal the arrival of the sealing balls in the perforations. However, these systems only signal the arrival of the sealing balls at the final destination; not the launch of the sealing balls. Thus, valuable time may elapse before it is realized that the sealing balls were improperly launched.

[0025] Thus, there is a need for a device that accurately verify that the sealing balls were properly launched from the ball injector.

**SUMMARY OF THE INVENTION**

[0026] The invention relates to a system and a method for determining the location of an interface between two fluids within a wellbore. A circulating cementing apparatus is described for cementing a casing in a wellbore. In some aspects, the apparatus comprises a first component disposed substantially on a lower end of the casing, a second component disposed substantially adjacent a fluid interface formed between a fluid and a cement slurry, the first component and the second component adapted to be in communication with each other as the second component is substantially adjacent the lower end of the casing, and a valve disposed within the casing, the
first component adapted to close the valve when the first component and the second component communicate as the fluid interface reaches the lower end of the casing.

[0027] In some embodiments, the first component is a sensor and the second component is a detectable device. In others, the sensor comprises a sensor coil adapted to be mountable within the inner diameter of the lower end of the casing or around an outer perimeter of lower end of the casing. Or the sensor may be housed within a rubber wiper plug, the rubber wiper plug being adjacent the fluid interface.

[0028] In some embodiments, the detectable device is a transponder adapted to send a Radio Frequency Identification signal to the sensor coil. The transponder may be implanted into a protective device, such as a rubber ball. The apparatus may include a host electronics package, the host electronics package adapted to receive a signal from the sensor and to send to a signal to the valve to close the valve.

[0029] Also described is a fluid interface detecting system for cementing a casing in a wellbore, the system comprising a means for traveling within the wellbore along the casing, the means for traveling being adjacent a fluid interface, being defined between a cement slurry and a fluid; a means for sensing the means for traveling, the means for sensing being positioned on a lower end of the casing, the means for sensing adapted to detect the means for traveling as the means for traveling approaches the lower end of the casing; and a valve disposed within the casing, the means for sensing closing the valve when the means for sensing detects the means for traveling as the fluid interface approaches the lower end of the casing.

[0030] Also described is a method of cementing a casing having a lower end in a wellbore, using a reverse circulating cementing process, comprising placing the casing into the wellbore, the wellbore being filled with a fluid, the casing having a first component located at the
lower end of the casing, the casing having a valve, pumping cement down an annulus defined between the outer perimeter of the casing and the wellbore, the cement contacting the fluid at a fluid interface, the fluid interface containing a second component, the first and second components adapted to be in communication when the second component reached the lower end of the casing, the pumping of the cement continuing until the first component and the second component communicate, and closing the valve by sending a signal from the first component to the valve, thus halting the flow of fluid through the casing in the wellbore, the cement being positioned in the annulus. In some embodiments, the first component is a sensor and the second component is a detectable device.

[0031] The invention also relates to a system and a method for detecting the launch of a device. In some embodiments, a system for detecting the launching of a device, is described having a first component disposed within the device, the device adapted to travel through a conduit and into wellbore, a first end of the conduit in fluid communication with an upper end of the wellbore. The system includes a second component, the first component and the second component adapted to be in communication with each other as the first component becomes substantially adjacent the second component thus detecting the launch of the device. The first component may be a sensor and the second component may be a detectable object, or the first component may be a detectable object and the second component may be a sensor.

[0032] The device being launched may be a wiper plug or a sealing ball. The the conduit may be connected to an upper end of a casing within the wellbore, and the second component is disposed substantially adjacent the first end of the conduit. In some embodiments, the sensor is a sensor could mounted within the outer diameter of the first end of the conduit. The detectable object may be a transponder adapted to send a Radio Frequency Identification signal to the
sensor coil, the transponder modulating to send a unique identification number to the sensor coil. In other aspects, the transponder resonates at a frequency, the sensor coil being tuned to resonate at the frequency of the transponder. The frequency of the transponder may be 134.2 kHz. In some embodiments, the system may include host electronics in communication with the sensor coil, the host electronics displaying the unique identification number of the transponder.

[0033] In some embodiments, the device being launched is a sealing ball and the first end of the conduit is connected to the upper end of the wellbore by an intermediate pipe. The second component is disposed on the intermediate pipe. In some embodiments, the sensor further comprises a sensor coil adapted to be mountable within the inner diameter of the intermediate pipe. In others, the sensor further comprises a sensor coil adapted to be mountable around an outer perimeter of the intermediate pipe.

[0034] In some aspects, the detectable object is a transponder adapted to send a Radio Frequency Identification signal to the sensor coil. The transponder may modulate to send a unique identification number to the sensor coil, for instance at a frequency, the sensor coil being tuned to resonate at the frequency of the transponder. In some aspects, this frequency is 134.2 kHz. The system may include host electronics in communication with the sensor coil, the host electronics displaying the unique identification number of the transponder. The transponder may be implanted into the sealing ball.

[0035] Also described is a method of detecting the launching of a device, comprising providing the device with a first component; passing the device through a conduit, the conduit being in fluid communication with an upper end of a wellbore; providing a second component, the first and second components adapted to be in communication with each other as the second component is substantially adjacent the first component; and providing a signal from the first or
second component to a host electronics package when the second component is substantially adjacent the first component, thus detecting the launch of the device. The method may further include providing a detectable object for the first component and providing a sensor for the second component.

[0036] In some aspects, the method includes providing a transponder for the detectable object and providing a sensor coil for the sensor. Also described is the step of providing a wiper plug with a transponder therein, a first end of the conduit being connected to an upper end of a casing within the wellbore, the sensor coil being adapted to be disposed on a perimeter of the first end of the conduit.

[0037] The step of passing the device through a conduit may include passing the wiper plug through a cement manifold, and pumping a fluid down the conduit behind the wiper plug to force the wiper plug into the casing. The method may include providing a sensor coil for the sensor and a transponder adapted to send a Radio Frequency Identification signal from the transponder to the sensor coil.

[0038] In some embodiments, the step of providing the device further comprises providing a sealing ball with a transponder therein, a first end of the conduit being connected to the upper end of the casing by an intermediate pipe, the sensor coil being adapted to be disposed on a perimeter of the intermediate pipe. In others, the step of passing the device through a conduit further comprises passing the sealing ball plug through a sealing ball injector.

**BRIEF DESCRIPTION OF THE DRAWINGS**

[0039] Figures 1A and 1B show one embodiment of the present invention used in conjunction with the conventional circulating cementing operation.
Figures 2A and 2B show one embodiment of the present invention used in conjunction with the reversed circulating cementing operation.

Figure 3 shows an embodiment of the present invention that utilizes an sensor coil and a transponder.

Figure 4 shows a transponder of one embodiment of the present invention.

Figure 5 shows an embodiment of the present invention that includes the sensor coil located within the casing.

Figure 6 shows an embodiment of the present invention that includes a rubber wiper plug.

Figure 7 shows an embodiment of the present invention that includes a hematite sensed by a magnetic sensor.

Figure 8 shows an embodiment of the present invention that includes and isotope sensed by a Geiger counter.

Figure 9 shows an embodiment of the present invention utilizing a pH sensor capable of sensing a fluid having a pH value different than drilling mud and cement.

Figure 10 shows one embodiment of the present invention utilizing a resistivity meter and fluids having different resistivity readings.

Figure 11 shows an embodiment of the present invention utilizing a photo detector and a luminescent marker.

Figure 12 shows one embodiment of the present invention prior to the launching a device, such as a wiper plug, into the well.

Figure 13 shows one embodiment of the present invention in which one device, such as a wiper plug, is launched into the well.
Figure 14 shows an embodiment of the present invention in which a second device, such as a wiper plug, is launched into the well.

Figure 15 shows a first component, such as a transponder, located within a device, such as a sealing ball, of one embodiment of the present invention.

Figure 16 shows an embodiment of the present invention that includes a ball injector, a first component such as detectable object or transponder, and a second component such as sensor or sensing coil.

Figure 17 shows an embodiment of the present invention in which a device, such as a sealing ball with a detectable object such as a transponder, has been launched.

While the invention is susceptible to various modifications and alternative forms, specific embodiments have been shown by way of example in the drawings and will be described in detail herein. However, it should be understood that the invention is not intended to be limited to the particular forms disclosed. Rather, the intention is to cover all modifications, equivalents and alternatives falling within the spirit and scope of the invention as defined by the appended claims.

DESCRIPTION OF ILLUSTRATIVE EMBODIMENTS

Illustrative embodiments of the invention are described below as they might be employed in the oil and gas recovery operation. In the interest of clarity, not all features of an actual implementation are described in this specification. It will of course be appreciated that in the development of any such actual embodiment, numerous implementation-specific decisions must be made to achieve the developers’ specific goals which will vary from one implementation to another. Moreover, it will be appreciated that such a development effort might be complex and time-consuming, but would nevertheless be a routine undertaking for those of ordinary skill
in the art having the benefit of this disclosure. Further aspects and advantages of the various embodiments of the invention will become apparent from consideration of the following description and drawings.

[0058] Embodiments of the invention will now be described with reference to the accompanying figures. Referring to Figures 1A and 1B, one embodiment of the present invention is shown being utilized with the conventional circulating cementing process described above. The cement slurry 12 is shown being pumped from the surface 18 into the casing 20. As shown in Figure 1A, the cement slurry 12 pushes the drilling mud 36 down the casing toward the reservoir 14 and up an annulus 10 formed between the outer diameter of the casing 20 and the wellbore 30. As shown in Figure 1A, the cement slurry 12 is approaching lower end 26 of casing 20. In Figure 1A, valve 34 is shown in its open position thus allowing fluid to pass through the casing 20.

[0059] Figure 1B shows that embodiment of Figure 1A after a predetermined amount of cement slurry 12 has been pumped into the casing 20. Once this predetermined amount of cement slurry 12 has been pumped into the casing 20, and prior to the pumping of non-cementaceous displacement fluid, such as drilling fluid 36 is pumped into the casing, a detectable device or material 60 is placed in the cement slurry substantially adjacent the fluid interface 16 formed between the cement slurry 12 and the non-cementaceous fluid, such as drilling fluid 36. As the displacement fluid, such as drilling fluid 36, continues to be pumped into the casing, the fluid interface approaches a sensor 50 placed near the lower end 26 of casing 20. As the fluid interface 16 reaches the lower end 26 of casing 20, sensor 50 and detectable device or material 60 interact -- as more fully described herein -- and the fluid interface detecting system 70 causes valve 34 to close. Valve 34 is shown in its closed position in Figure 1B. The closing of valve 34
causes a sudden increase in pump pressure is seen at the surface to further affirm that the cement slurry 12 is at the desired location in annulus 10 and is ready to set. A two-way valve (not shown) may be utilized to prevent fluid flow in either direction when closed.

[0060] It should be mentioned that the fluid interface 16 is not necessarily a discreet plane formed be the cement slurry 12 and the non-cementacious displacement fluid, such as drilling fluid 36. Typically, some mixing will naturally occur between the cement slurry and the non-cementacious displacement fluid as the cementing process occurs. However, generally, this area of mixing of the two fluids is limited to a few linear vertical feet in a typical cementing operation.

[0061] Figures 2A and 2B show an embodiment of the present invention being utilized in the reverse circulating cementing operation described above. As shown in Figures 2A and 2B, a first component, such as sensor 50, is mounted adjacent the lower end 26 of casing 26. As shown in Figure 2A, the cement slurry 12 is being pumped directly down the annulus 10 which is formed between casing 20 and wellbore 30. In this embodiment, a second component such as detectable device or material 60, is placed in the cement slurry 12 near the fluid interface 16 formed between the cement slurry 12 and the drilling mud 36. Return fluids, such as drilling mud 36, are shown concurrently circulating up the inside of the casing 20. Cement slurry 12 is pumped into annulus 10 until the fluid interface 16 between cement slurry 12 and the drilling mud 36 reaches the lower end 26 of casing 20. Once the fluid interface 16 reaches the lower end 26 of casing 26, the first component, such as sensor 50 of the fluid interface detecting apparatus 70 interacts with the detectable device or material 60 – as more fully described herein. The fluid interface detecting system 70 then closes a valve 34 inside casing 20 to prevent the cement slurry 12 from further entering the casing 20.
Each other, the closing of valve 34 causes return flow of drilling mud 36 up the casing 20 to abruptly cease. The closing of valve 34 may also cause an increase in the surface pumping pressure in the annulus 10. These surface indications may then be used as additional positive indications of the proper placement of cement and hence the completion of the job.

Depending upon a given application, the sensor 50 may detect the detectable device 60 as it first approaches the lower end of the casing 20, i.e. while the detectable device 60 is in the annulus. However, in a preferred embodiment shown in the reverse circulating cementing operation, the detectable device 60 travels the length of casing 20 and enters the lower end 26 of casing 20 before being detected by sensor 50.

The following embodiments of the present invention may be utilized with the conventional circulating cementing process, the reverse circulating cementing process, or any other process involving fluid flow; however, only the reverse circulating cementing process is shown in the figures discussed unless otherwise stated. Further, the remaining figures show valve 34 in its closed position with the arrows showing the direction of fluid flow just immediately prior to the closing of valve 34; however, it is understood that as the fluids are flowing during the cementing operation, valve 34 is open as shown in Figures 1A and 2A.

In one embodiment shown in Figure 3, the fluid interface detecting apparatus comprises a sensor 50 and a detectable device or material 60. In one embodiment, the detectable device or material 60 comprises a Radio Frequency Identification (“R.F.I.D.”) device such as a transponder 62 that is molded into any object, such as rubber ball 80 as shown in Figure 4, which serves to protect the transponder from damage, among other things. Transponders 62 may (or may not be) molded or formed into any protective coating, such as being encapsulated in glass or ceramic. Transponders 62 may be any variety of commercially-available units, such as that
offered by TEXAS INSTRUMENTS, part number P-7516. The rubber ball 80 may be molded from a material that is designed to be neutrally buoyant in cement. (i.e. having a specific gravity substantially similar to the designed cement slurry). The balls 80 are introduced into the leading edge of the cement slurry 12 at the surface as the cement is being pumped into the well (i.e. either into casing 20 for the conventional circulating cementing operation or into the annulus 10 in the case of the reverse circulating cementing operation). Thus, the balls 80 and thus the transponders 62 are placed at the fluid interface 16 between the cement slurry 12 and the drilling mud 36. Several balls 80 with transponders 62 may be used for the sake of redundancy.

[0066] In this embodiment shown in Figure 3, the sensor 50 may be comprised of a sensor coil 52. In this embodiment, the sensor coil 52 is attached to the casing 20 to be cemented. The sensor coil 52 is shown on the lower end 26 of casing 20. The coil is shown on encircling the outer diameter of casing 20; however, the coil may also be attached on the inner diameter of the casing instead. The sensor coil 52 may be any type of sensor coil, such as ones that are commercially available from TEXAS INSTRUMENTS, “Evaluation Kit,” part number P-7620. The sensor coil 52 may be tuned to resonate at the design frequency of the R.F.I.D. transponders 62. In some embodiments, this frequency is 134.2 Khz.

[0067] In this embodiment, a host electronics package 90 is electrically connected to the sensor coil 52 and continually sends a signal from the sensor coil 52 through the drilling mud and/or cement slurry seeking the R.F.I.D. transponders 62. Each transponder 62 has a unique identification number stored therein. When any R.F.I.D. transponder 62 passes near the sensor coil 52, that transponder 52 modulates the radio frequency field to send its unique identification numbers back to the host electronics package 70 via the sensor coil 52.
[0068] The host electronics 90 package is also in electrical communication with a valve 34. When the transponder 62 is detected by the host electronics package 90 via the sensing coil 52, the host electronics package 90 then sends a signal to close a valve 34 located in the casing 20. The closing of valve 34 in the casing 20 prevents cement flow into the casing 20. Further, the addition of fluid -- i.e. drilling mud 36 in the case of the conventional circulating cementing operation and cement 12 in the case of the reversing circulating cementing -- at the surface ceases. As an added safeguard, the completing of the cementing operation may be detected as a rapid rise in pressure at the surface.

[0069] It should be mentioned that in this embodiment, as is the case in all the embodiments shown, the sensor 50 may be mounted on the inside or on the outside of casing 20. For example, the sensor coil 52 is shown to be attachable to the inner diameter of casing 20 in Figure 5.

[0070] It should also be mentioned that in the case of the conventional circulating cementing operation, transponders 62 may be embedded in a plug 22 placed at the fluid interface 16 as shown in Figure 6.

[0071] In some embodiments, as shown in Figure 7, the sensor 50 comprises a magnetic sensor 54 attachable to the lower end 26 of casing 20. In these embodiments, the detectable device or material 60 may be comprised of Hematite 64, which is an iron oxide or other ferrous materials detectable by magnetic sensor 54.

[0072] In some embodiments, as shown in Figure 8, the sensor 50 comprises a Geiger counter 56. In these embodiments, the detectable device or material 60 may be comprised of any solid or liquid radioactive isotope 66 tagged in the cement slurry near the mud/cement interface.
For example, radioactive isotope 66 may be comprised of any short-lived (like 20-day half-life) isotopes such as Ir-192, I-131, or Sc-46.

In some embodiments, as shown in Figure 9, the sensor 50 comprises a pH sensor 57. In these embodiments, the detectable device or material 60 may be comprised of any fluids 67 having a pH that is different from each other. In some embodiments, this fluid may be comprise of fresh water drilling mud and cement.

In some embodiments, as shown in Figure 10, the sensor 50 comprises a resistivity meter 58. In these embodiments, the detectable device or material 60 may be comprised of any fluids 68 with a change in resistivity such as hydrocarbon-based spacer fluid, or a fresh water based spacer fluid, or a brine fluid.

In some embodiments, as shown in Figure 11, the sensor 50 comprises a photo receptor 59. In these embodiments, the detectable device or material 60 may be comprised of luminescent markers 69.

In some embodiments, the fluid interface detecting apparatus comprises a means for sensing, as well as means for traveling along the casing, the means for traveling being adjacent the fluid interface. The means for sensing may be comprised, for example, of the sensor coil 52, the magnetic sensor 54, the Geiger counter 56, the pH sensor 57, the resistivity sensor 58, or the photo receptor 59, each described above. Further, the means for traveling through the wellbore may be comprised, for example, of the transponder 62, the hematite 64, the isotope 66, the fluid having a pH different than that of the cement 67, a fluid having a resistivity different from the mud or cement 68, or luminescent markers 69 placed in the fluid interface, each as described above.
It will be appreciated by one of ordinary skill in the art, having the benefit of this disclosure, that by placing sensors at different locations on the casing, activities (other than when the mud/cement interface approaches the lower end 26 of casing 20) may be more accurately monitored in a timely fashion than with current methods.

Referring to Figure 12, one embodiment of the present invention is shown being utilized with a cementing process. Devices, such as cement plugs or wiper plugs 300 and 400 are shown within a conduit, such as a cement manifold 100. Cement manifold 100 has a first end connected to casing 900 in wellbore 940 in this embodiment.

In some embodiments, the wiper plugs 300 and 400 may be molded from rubber. Within each wiper plug 300 and 400 are first components, such as transponders 500 and 520. Transponders 500 and 520 may be commercially available Radio Frequency Identification Devices ("RFID") such as those commercially available, from Texas Instruments, model P-75160, for example. Transponders 500 and 520 may be molded into the wiper plugs during manufacture. Or the RFID transponders 500 and 520 may be implanted into the wiper plugs by drilling a hole in the wiper plug, placing the transponder in the wiper plug, and then filling the hole with a rubber potting compound.

Shown adjacent the first end of the manifold is a second component, here a sensor such as sensor coil 600. This sensor coil 600 may be any commercially available sensor, such as that by Texas Instruments model RI-ANT-G01E, which operates as described hereinafter. Sensor coil 600 may be mounted on a perimeter of the first end of the cement manifold or mounted within an internal diameter of the cement manifold 100.
Sensor 600 is in electrical communication with host electronics package 200. Host electronics package may be any number of commercially available systems, such as that provided with the evaluation kit from Texas Instruments, model P-762000.

Cement manifold 100, or cementing head, is shown having three inlets: a lower inlet 120, a middle inlet 140, and an upper inlet 160.

In operation during a typical oilwell cementing operation, the wiper plugs 300 and 400 are loaded into the cementing head 100 as shown in Figure 12. The fluid inlets 120, 140, and 160 are then opened and closed at the appropriate time as a fluid, such as cement or drilling mud, for example, is pumped into the well. Circulation of fluid through the appropriate inlet will launch the wiper plugs 300 and 400 into the casing in the wellbore.

For instance, typically the lower inlet 120 is opened to circulate the well with drilling fluid to condition the hole, such as removing excessive cuttings or cleaning up the wellbore. Once the wellbore is ready to be cementing, the lower inlet 120 is closed and cement is pumped though inlet 140. As shown in Figure 13, cement slurry 180 forces first wiper plug 300 down out of the cement manifold and into the casing. As will be understood, first wiper plug 300 separates the drilling fluid below from the cement above and acts as a squeegee to clean the inner diameter of the cement manifold 100 as well as the casing 900 as it passes through each. Further, the wiper plug 300 preferably ensures the drilling mud does not mix with the cement.

After a given amount of cement slurry has been pumped, the slurry must be displaced all the way down the wellbore and up into the annulus between the casing and wellbore. To perform this task, the middle inlet 140 is closed and a fluid such as drilling fluid
and/or a spacer is pumped into upper inlet 160, which is opened. As shown in Figure 14, this forces second wiper plug 400 down out of the cement manifold 100 and into casing 900.

[0086] In this embodiment of the present invention, in order to insure that each wiper plug 300 and 400 left the cementing head 100 and started into casing 900 of wellbore 940 (i.e. that each wiper head 300 and 400 has been successfully “launched”), this embodiment of the present invention detects the RFID transponders 500 and 520 embedded into wiper plugs 300 and 400 as each plug passes sensor coil 600.

[0087] Sensor coil 600 is tuned to resonate at a designed frequency corresponding to the RFID transponders 500 and 520. In this embodiment, the preferred frequency is 134.2 kHz. Sensor coil 600 may be integral to cementing head 100, mounted within or without the first end of cementing head 100, or it may be designed into a small coupling section of pipe installed below the cementing head 100.

[0088] The host electronics package 200 continually sends a signal for the sensing coil 600 to seek the RFID transponders 500 and 520. When the RFID transponders 500 and 520 pass near the sensor coil 600, each transponder 500 and 520 modulates the RF field sending a unique identification number that is stored in the RFID transponder back to the sensor 600 and to the host electronics 200. The host electronics package 200 may display this information locally or forward this information to a computer for logging and analysis.

[0089] In this way, the successful launch status of each wiper plug is monitored without intervention at the surface. Should the wiper plugs 300 and 400 turn sideways and become lodged, no signal will be generated by the transponders 500 and 520 being sensed by the sensor coil 600. This informs the operator of a problem.
[0090] Referring to Figure 15, a device, such as a sealing ball 700, is shown having a first component, such as transponder 540. Transponder 540 may be any commercially-available unit, such as model number P-75160 available from Texas Instruments, which operate as detailed below. Sealing balls 700 are generally manufactured from rubber. Transponder 540 may be integrally molded within a sealing ball 700 during manufacture. Alternatively, the transponder 540 may be inserted into the sealing ball 700 after manufacture by drilling a hole in the sealing ball, imbedding the transponder 540 into the hold, and covering the hole with rubber potting compound, for instance.

[0091] As stated above, sealing balls are utilized in a typical oilwell process, as follows. Referring to Figure 16, the sealing balls 700 are shown within a conduit, such as ball injector 800. In this embodiment, ball injector 800 is connected to wellbore 940 -- which may or may not have a casing within -- via intermediate pipe 960. A fluid, such as cement, drilling mud, water, acid, fracturing fluid, or any other fluid, passes from frac pumps through the intermediate pipe 960 to the wellbore 940. In the embodiment shown in Figure 16, the fluid flows from left to right.

[0092] A second component, shown in this embodiment as a sensor, or more particularly, sensor coil 620, may be disposed on intermediate pipe 960. Sensor coil 620 may be disposed on an outer perimeter of intermediate pipe 960, or sensor coil 620 could be mounted to an inner diameter of intermediate pipe 960, for example. Sensor coil 620 is electrically connected to a host electronics package 220. Sensor coil 620 may be any type of commercially available unit, such as model number RI-ANT-G01E from Texas Instruments, which operate as described herein.
During a typical oilwell stimulating treatment, the sealing balls 700 are loaded into the ball injector 800. The ball injector 800 releases the sealing balls 800, one at a time, into the fluid stream as the fluid is being pumped into the wellbore 940. In operation, the ball injector 800 releases a sealing ball 700 into the fluid flowing through the intermediate pipe 960.

To ensure that each sealing ball 700 has left the ball injector 800 and started toward the wellbore 940 that may have casing 900, the embodiment of the present invention detects the RFID transponders 540 embedded into the sealing balls 700 as the balls 700 and transponders 534 pass sensor coil 620.

In this embodiment, sensor coil 620 is tuned to resonate at a design frequency of the RFID transponders 540. In this application, the frequency is 134.2 kHz.

Sensor coil 620 continually sends a signal seeking the RFID transponders 540. When an RFID transponder 540 passes near sensor coil 620, the transponder 540 modulates the RF field sending unique identification numbers, which are stored in the RFID transponders, to the host electronics 220 through the sensor coil 620. The host electronics package 220 may display the identification numbers locally or forward the information to a computer for logging and analysis.

In this way, an operator performing may insure that the balls have been successfully launched. If a signal from a given transponder 540 is not detected by sensor coil 620 within a given period of time, the operator will know that there is a problem with the sealing ball 700 having that given transponder 540, such as the ball was not loaded into the ball injector, or the ball has become lodged.

Although various embodiments have been shown and described, the invention is not so limited and will be understood to include all such modifications and variations as would
be apparent to one skilled in the art. The following table lists the description and the numbers as used herein and in the drawings attached hereto.

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<tr>
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CLAIMS:

1. A circulating cementing apparatus for cementing a casing in a wellbore, the apparatus comprising:
   a first component disposed substantially on a lower end of the casing;
   a second component disposed substantially adjacent a fluid interface formed between a fluid and a cement slurry, the first component and the second component adapted to be in communication with each other as the second component is substantially adjacent the lower end of the casing; and
   a valve disposed within the casing, the first component adapted to close the valve when the first component and the second component communicate as the fluid interface reaches the lower end of the casing.

2. The apparatus of claim 1 in which the first component is a sensor and the second component is a detectable device.

3. The apparatus of claim 2 in which the sensor further comprises a sensor coil adapted to be mountable within the inner diameter of the lower end of the casing.

4. The apparatus of claim 2 in which the sensor further comprises a sensor coil adapted to be mountable around an outer perimeter of lower end of the casing.

5. The apparatus of claim 4 in which the detectable device is a transponder adapted to send a Radio Frequency Identification signal to the sensor coil.

6. The apparatus of claim 5 in which the transponder is implanted into a protective device.

7. The apparatus of claim 6 in which the protective device is a rubber ball.
8. The apparatus of claim 4 further comprising a host electronics package, the host electronics package adapted to receive a signal from the sensor and to send to a signal to the valve to close the valve.

9. The apparatus of claim 4 in which the detectable device is housed within a rubber wiper plug, the rubber wiper plug being adjacent the fluid interface.

10. The apparatus of claim 2 in which the sensor further comprises a magnetic sensor and the detectable device further comprises a hematite, the magnetic sensor adapted to detect the hematite adjacent the fluid interface as the hematite approaches the lower end of the casing.

11. The apparatus of claim 2 in which the sensor further comprises a Geiger counter and the detectable device further comprises a radioactive isotope, the Geiger counter adapted to detect the radioactive isotope adjacent the fluid interface as the radioactive isotope approaches the lower end of the casing.

12. The apparatus of claim 11 in which the radioactive isotope has half life between one hour and one hundred days.

13. The apparatus of claim 12 in which the radioactive isotope has a half life of approximately ten days.

14. The apparatus of claim 2 in which the sensor further comprises a pH sensor and the detectable device further comprises a second fluid with a known pH, the pH sensor adapted to detect the known pH of the second fluid adjacent the fluid interface as the second fluid approaches the lower end of the casing.

15. The apparatus of claim 14 in which the pH of the second fluid is measurably different than the pH of the cement and of the first fluid.
16. The apparatus of claim 2 in which the sensor further comprises a resistivity sensor and the detectable device further comprises a second fluid with a known resistivity value different than that of the first fluid and of the cement slurry, the resistivity sensor adapted to detect the change in resistivity between the first and second fluids as the second fluid approaches the lower end of the casing.

17. The apparatus of claim 2 in which the sensor further comprises a photo receptor and the detectable device further comprises luminescent markers in the fluid adjacent the fluid interface, the photo receptor adapted to detect the luminescent markers as the fluid interface approaches the lower end of the casing.

18. The apparatus of claim 17 in which the fluid interface extends between one and twenty linear feet along the casing.

19. The apparatus of claim 18 in which the fluid interface extends two linear feet along the casing.

20. The apparatus of claim 1 in which the fluid is drilling mud.

21. The apparatus of claim 1 in which the fluid is water.

22. The apparatus of claim 1 in which the fluid is air.

23. A reverse circulating cementing apparatus for cementing a casing in a wellbore, the casing and the wellbore defining an annulus therebetween, the apparatus comprising:

   a sensor coil disposed substantially on a lower end of the casing, the sensor coil adapted to be mountable around an outer perimeter of lower end of the casing;

   a transponder device disposed substantially adjacent a fluid interface formed between a first fluid and a cement slurry, the sensor coil adapted to detect the transponder as the transponder approaches the lower end of the casing, the transponder being
implanted into a protective rubber ball, the transponder adapted to send a Radio
Frequency Identification signal to the sensor coil;
a valve disposed within the casing; and
a host electronics package host adapted to receive a signal from the sensor and to send to
a signal to the valve to close the valve, the host electronics package functionally
adapted to close the valve when the sensor coil detects the transponder and sends
a signal to the host electronics package when the fluid interface approaches the
lower end of the casing as the cement is pumped down the annulus.

24. A fluid interface detecting system for cementing a casing in a wellbore, the system
comprising:
   a means for traveling within the wellbore along the casing, the means for traveling being
   adjacent a fluid interface, being defined between a cement slurry and a fluid;
a means for sensing the means for traveling, the means for sensing being positioned on a
   lower end of the casing, the means for sensing adapted to detect the means for
   traveling as the means for traveling approaches the lower end of the casing; and
   a valve disposed within the casing, the means for sensing closing the valve when the
   means for sensing detects the means for traveling as the fluid interface approaches
   the lower end of the casing.

25. The fluid interface detecting system of claim 24 further comprising:
a controlling means, said controlling means adapted to receive a signal from the means
   for sensing and sending a second signal to the valve to close the valve.

26. The apparatus of claim 25 in which the fluid is drilling mud.
27. A method of reverse circulating cementing a casing having a lower end in a wellbore, comprising:

placing the casing into the wellbore, the wellbore being filled with a fluid, the casing having a first component located at the lower end of the casing, the casing having a valve;

pumping cement down an annulus defined between a perimeter of the casing and the wellbore, the cement contacting the fluid at a fluid interface, the fluid interface containing a second component, the first and second components adapted to be in communication when the second component reached the lower end of the casing, the pumping of the cement continuing until the first component and the second component communicate; and

closing the valve by sending a signal from the first component to the valve, thus halting the flow of fluid through the casing in the wellbore, the cement being positioned in the annulus.

28. The method of claim 27 further comprising providing a sensor for the first component and providing a detectable device for the second component.

29. The method of claim 28 further comprising providing a magnetic sensor for the sensor, and a hematite for the detectable device, the magnetic sensor adapted to detect the hematite adjacent the fluid interface as the hematite approaches the lower end of the casing.

30. The method of claim 28 further comprising providing a Geiger counter for the sensor, and a radioactive isotope for the detectable device, the Geiger counter adapted to detect the radioactive isotope adjacent the fluid interface as the radioactive isotope approaches the lower end of the casing.
31. The method of claim 28 further comprising providing a pH sensor for the sensor, and a second fluid with a known pH for the detectable device, the pH sensor adapted to detect the known pH of the second fluid adjacent the fluid interface as the second fluid approaches the lower end of the casing.

32. The method of claim 28 further comprising providing a resistivity sensor for the sensor, and a second fluid with a known resistivity value for the detectable device, the resistivity sensor adapted to detect the known resistivity value of the second fluid adjacent the fluid interface as the second fluid approaches the lower end of the casing.

33. The method of claim 28 further comprising providing a photo receptor for the sensor, and luminescent markers for the detectable device, the photo receptor adapted to detect the luminescent markers as the fluid interface approaches the lower end of the casing.

34. The method of claim 28 further comprising providing a sensor coil for the sensor and a transponder adapted to send a Radio Frequency Identification signal to the sensor coil for the detectable device.

35. The method of claim 34 further comprising:
   mounting the sensor on the perimeter of the lower end of the casing, wherein the sensor further comprises a sensor coil.

36. The method of claim 28 further comprising:
   implanting the detectable device into a protective device.

37. The method of claim 36 wherein the protective device is a rubber ball.

38. The method of claim 36 wherein the protective device is a glass covering.

39. The method of claim 36 wherein the protective device is a ceramic covering.
40. A method of conventional circulating cementing a casing having a lower end in a wellbore, comprising:

placing the casing into the wellbore, the wellbore being filled with a fluid, the casing having a first component located at the lower end of the casing, the casing having a valve;
pumping cement down the casing;
pumping the fluid down the casing, the fluid contacting the cement at a fluid interface, the fluid interface containing a second component, the first and second component adapted to be in communication when the second component reached the lower end of the casing, the pumping of the cement continuing until the first component and the second component communicate; and

closing the valve by sending a signal from the first component to the valve, thus halting the flow of fluid through the casing in the wellbore, the cement being positioned in an annulus defined between the outer perimeter of the casing and the wellbore.

41. The method of claim 40 in which the first component is a sensor and the second component is a detectable device.

42. The method of claim 41 further comprising:

mounting the sensor on the perimeter of the lower end of the casing, wherein the sensor further comprises a sensor coil.

43. A system for detecting the launching of a wiper plug into a wellbore, the system comprising:
a transponder implanted within the wiper plug, the wiper plug adapted to travel through a cement manifold and into a casing of a wellbore, the cement manifold in fluid communication with and connected to an upper end of the casing; and

a sensor coil adapted to be mountable on an outer perimeter of the cement manifold, the transponder adapted to send a Radio Frequency Identification signal to the sensor coil as the transponder in the wiper plug becomes substantially adjacent the sensor coil, thus detecting the launch of the wiper plug.

44. A system for detecting the launching of a sealing ball, the system comprising:

a transponder implanted in the sealing ball, the transponder adapted to travel through a sealing ball injector and into a wellbore, the sealing ball injector and the wellbore being connected by an intermediate pipe having a fluid to carry the transponder therethrough; and

a sensor coil adapted to be mountable around an outer perimeter of the intermediate pipe, the transponder adapted to send a Radio Frequency Identification signal to the sensor coil, the transducer and the sensor coil adapted to be in communication with each other as the transducer becomes substantially adjacent the sensor coil, thus detecting the launch of the transponder.

45. A system for detecting the launching of a device, the system comprising:

a first component disposed within the device, the device adapted to travel through a conduit and into a wellbore, the conduit in fluid communication with an upper end of the wellbore; and

a second component,
the first component and the second component adapted to be in communication
with each other as the first component becomes substantially adjacent the second
component thus detecting the launch of the device.

46. The system of claim 45 in which the first component is a sensor and the second
component is a detectable object.

47. The system of claim 46 in which the first component is a detectable object and the second
component is a sensor.

48. The system of claim 47 in which the first component and the second component are in
communication with each other as the first component passes by the second component as the
first component travels through the conduit.

49. The system of claim 48 in which the device is a wiper plug, a first end of the conduit is
connected to an upper end of a casing disposed within the wellbore, and the second component is
disposed substantially adjacent the first end of the conduit.

50. The system of claim 49 in which the sensor further comprises a sensor coil adapted to be
mountable within the inner diameter of the first end of the conduit.

51. The system of claim 49 in which the sensor further comprises a sensor coil adapted to be
mountable around an outer perimeter of the first end of the conduit.

52. The system of claim 51 in which the detectable object is a transponder adapted to send a
Radio Frequency Identification signal to the sensor coil.

53. The system of claim 52 in which the transponder modulates to send a unique
identification number to the sensor coil.

54. The system of claim 53 in which transponder resonates at a frequency, the sensor coil
being tuned to resonate at the frequency of the transponder.
55. The system of claim 54 in which frequency of the transponder is 134.2 kHz.

56. The system of claim 55 further comprising host electronics in communication with the sensor coil, the host electronics displaying the unique identification number of the transponder.

57. The system of claim 51 in which the transponder is implanted into the wiper plug.

58. The system of claim 51 in which the transponder is molded into the wiper plug.

59. The system of claim 51 in which the transponder is inserted into the wiper plug.

60. The system of claim 51 in which the conduit is a cement manifold.

61. The system of claim 60 in which the cement manifold includes an inlet through which a fluid is inserted behind the wiper plug to drive the wiper plug into the casing.

62. The system of claim 61 further comprising:
   a third component disposed within a second wiper plug, the second wiper plug adapted to travel through the conduit and into the casing, the third component and the second component adapted to be in communication with each other as the third component becomes substantially adjacent the first end of the conduit thus detecting the launch of the second wiper plug.

63. A system for determining the launching of a device, the system comprising:
   a transponder being located in the device, the device adapted to travel through a conduit and into a wellbore, the conduit in fluid communication with an upper end of the wellbore;
   and a means for sensing the transponder when the transponder becomes substantially adjacent the means for sensing.
64. The system of claim 63 in which the device is a wiper plug, a first end of the conduit is connected to an upper end of a casing disposed within the wellbore, and the means for sensing is disposed substantially adjacent the first end of the conduit.

65. The system of claim 63 in which the device is a sealing ball, the first end of the conduit is connected to the upper end of the wellbore by an intermediate pipe, and the means for sensing is disposed on the intermediate pipe.

66. The system of claim 64 or 65 further comprising a controlling means, said controlling means adapted to receive a signal from the means for sensing.

67. The system of claim 48 in which the device is a sealing ball.

68. The system of claim 67 in which a first end of the conduit is connected to the upper end of the wellbore by an intermediate pipe.

69. The system of claim 68 in which the second component is disposed on the intermediate pipe.

70. The system of claim 69 in which the sensor further comprises a sensor coil adapted to be mountable within the inner diameter of the intermediate pipe.

71. The system of claim 69 in which the sensor further comprises a sensor coil adapted to be mountable around an outer perimeter of the intermediate pipe.

72. The system of claim 71 in which the detectable object is a transponder adapted to send a Radio Frequency Identification signal to the sensor coil.

73. The system of claim 72 in which the transponder modulates to send a unique identification number to the sensor coil.

74. The system of claim 73 in which the transponder resonates at a frequency, the sensor coil being tuned to resonate at the frequency of the transponder.
75. The system of claim 73 in which frequency of the transponder is 134.2 kHz.

76. The system of claim 75 further comprising host electronics in communication with the sensor coil, the host electronics displaying the unique identification number of the transponder.

77. The system of claim 72 in which the transponder is implanted into the sealing ball.

78. The system of claim 72 in which the transponder is molded into the sealing ball.

79. The system of claim 72 in which the transponder is inserted into the sealing ball.

80. The system of claim 75 further comprising a host electronics package, the host electronics package adapted to continually send a signal seeking the transponder.

81. The system of claim 72 in which the conduit is a sealing ball injector.

82. The system of claim 81 in which the intermediate pipe contains a fluid which carries the sealing ball therethrough.

83. A method of detecting the launching of a device into a wellbore, comprising:

   providing the device with a first component;

   passing the device through a conduit, the conduit being in fluid communication with an upper end of the wellbore;

   providing a second component, the first and second components adapted to be in communication with each other as the first component is substantially adjacent the second component; and

   providing a signal from the first or second component to a host electronics package when the first component is substantially adjacent the second component, thus detecting the launch of the device.

84. The method of 83 further comprising:
providing a detectable object for the first component and providing a sensor for the second component, the first and second components in communication with each other when the detectable object passes the sensor, as the detectable object in the device travels through the conduit.

85. The method of 84 further comprising:

providing a transponder for the detectable object and providing a sensor coil for the sensor.

86. The method of 85 in which the step of providing the device further comprises providing a wiper plug with a transponder therein, a first end of the conduit being connected to an upper end of a casing disposed within the wellbore, the sensor coil being adapted to be disposed on a perimeter of the first end of the conduit.

87. The method of claim 86 in which the step of passing the device through the conduit further comprises passing the wiper plug through a cement manifold.

88. The method of claim 87 further comprising:

pumping a fluid down the conduit behind the wiper plug to force the wiper plug into the casing.

89. The method of claim 88 further comprising providing a sensor coil for the sensor, wherein the transponder is adapted to send a Radio Frequency Identification signal to the sensor coil.

90. The method of claim 89 further comprising sending Radio Frequency Identification signal from the transponder to the sensor coil.

91. The method of 85 in which the step of providing the device further comprises providing a sealing ball with a transponder therein, a first end of the conduit being connected to the upper
end of the wellbore by an intermediate pipe, the sensor coil being adapted to be disposed on a perimeter of the intermediate pipe.

92. The method of claim 91 in which the step of passing the device through the conduit further comprises passing the sealing ball plug through a sealing ball injector.

93. The method of claim 92 further comprising:

   pumping a fluid down the intermediate pipe behind the sealing ball to force the sealing ball into the wellbore.

94. The method of claim 93 further comprising sending Radio Frequency Identification signal from the transponder to the sensor coil.
FIG. 2B