if sealed, are dependent on the cover or sleeve or other external pressure case for sealing from the environment exterior of the tool. An insert is not accessible from an exterior of the tool. Some tools provide a pocket on the outside of the tool body and a sensor case that is placed in the pocket. Such a sensor case is accessible from an exterior of the tool, thus it is termed an "outsert." The outsert may be sealed by an external pressure case, such as a hatch that fits into the pocket opening and seals the pocket. However, such external pressure cases are unreliable.

[0006] The high capital and operating costs of measurement tools, particularly the MWD/LWD type, require that sensor packages provide easy removeability and replaceability of the sensors, flexibility to be used in measurement tools of various sizes, and robust sealing from the downhole environment. Despite the aforementioned advances, the current sensor packages are limited in such a way that this combination of parameters cannot be met.

SUMMARY

[0006a] In a first aspect, there is provided a downhole sensor apparatus comprising: a longitudinal body including an exterior pocket; and a sensor housing including at least one sensor to detect a downhole condition, wherein the sensor is pressure sealed in the housing; wherein the sensor housing is removably coupled to the body in the pocket at an electrical connection between the sensor and the body.

[0006b] In a second aspect, there is provided an apparatus comprising: a drill collar coupled to a downhole tool, the drill collar having a pocket with an interface; a sensor outsert containing a sensor sealed from an exterior of the outsert; and a connector to provide a sealed connection between the sensor outsert and the interface when the sensor outsert is disposed in the pocket.

[0006c] In a third aspect, there is provided an apparatus comprising: a tool body having an outer surface with a pocket therein, the pocket accessible from an exterior of the body; a pressure housing having a sensor hermetically sealed therein, the pressure housing to be disposed in the pocket; a connector to removably and sealingly couple the pressure housing to the body; and a seal-free cover to be disposed over the pressure housing.

[0006d] In a fourth aspect, there is provided a downhole sensor apparatus comprising: a sensor housing including at least one sensor to detect a downhole condition, wherein the sensor is pressure sealed in the housing; the sensor housing including an exterior electrical connector coupled to the sensor inside the pressure-sealed housing; and wherein the electrical connector is connectable to a second electrical connector while maintaining the pressure seal of the housing.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] For a detailed description of exemplary embodiments, reference will now be made to the accompanying drawings in which:

[0008] Figure 1 shows a schematic side view of an exemplary drill string and bottom hole assembly including a MWD/LWD drill collar assembly according to an embodiment in accordance with principles disclosed herein;

[0009] Figure 2 is a schematic view, partly in cross-section, of a sensor tool conveyed by wireline;

[0010] Figure 3 is a schematic view, partly in cross-section, of a sensor tool disposed on a wired drill pipe connected to a telemetry network;

[0011] Figure 4 is a cross-section view of a section of wired drill pipe;

[0012] Figure 5 shows a perspective, partially exploded view of a drill collar assembly according to an embodiment in accordance with principles disclosed herein;

[0013] Figure 6 shows another perspective, partially exploded view of the drill collar assembly of Figure 2;

[0014] Figure 7 shows a cross-section view of a sensor outsert according to an embodiment in accordance with principles disclosed herein;

[0015] Figure 8 is a cross-section view of an alternative interface connection between a sensor outsert and a drill collar;

[0016] Figures 9-12 are various views of another alternative interface connection between a sensor outsert and a drill collar;

[0017] Figure 13 shows a cross-section view of the drill collar assembly along section A-A of Figure 5 illustrating secured covers over sensor outserts;