SUMMARY OF INVENTION

[0004a] According to a first aspect of the present invention, there is provided a downhole measurement apparatus comprising: a tool collar including a logging tool and an exposed pocket; an outsert fixably and removably coupled into the exposed pocket; a detector mounted in the outsert, wherein the detector is calibrated in the pocket for multiple different tool collars; and a retention member coupled to the outsert in the pocket to secure the outsert in the pocket and maintain the detector calibration.

[0004b] According to a second aspect of the present invention, there is provided a downhole measurement apparatus comprising: a tool collar including a logging tool and an exposed pocket; an outsert fixably and removably coupled into the exposed pocket; a detector mounted in the outsert, wherein the outsert is radially calibrated in the pocket; and a stabilizer coupled to the tool collar to deflect the radially calibrated outsert toward an earth formation.

[0004c] According to a third aspect of the present invention, there is provided a downhole measurement apparatus comprising: a tool collar including a logging tool and an exposed pocket, the logging tool including a logging source; an outsert fixably and removably coupled into the exposed pocket; and a detector mounted in the outsert; wherein the outsert is radially calibrated in the pocket; wherein the detector is axially calibrated relative to the logging source;

wherein the radial and axial calibrations are maintained across multiple different tool collars.

BRIEF DESCRIPTION OF THE DRAWINGS

[0005] For a detailed description of exemplary embodiments of the disclosure, reference will now be made to the accompanying drawings in which:

[0006] Figure 1 shows a schematic side view of an exemplary drill string and bottom hole assembly including a MWD/LWD drill collar assembly;

[0007] Figure 2 is a schematic view, partly in cross-section, of a sensor tool conveyed by wireline;

[0008] 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;

[0009] Figure 4 is a cross-section view of a section of wired drill pipe;

[0010] Figure 5 shows a perspective view, in partial phantom, of an exemplary nuclear measurement tool in accordance with principles disclosed herein;

[0011] Figure 6 shows a top view of the tool of Figure 5;

[0012] Figure 7 shows a cross-section view of the tool of Figure 6 taken at the section 4-4;

[0013] Figure 8 shows a cross-section view of the tool of Figure 6 taken at the section 5-5;

[0014] Figure 9 shows a perspective view of the nuclear source holder of the tool of Figures 5, 6 and 8;

[0015] Figure 10 shows another perspective view of the source holder of Figure 9;

[0016] Figure 11 shows another perspective view, in cross-section, of the source holder of Figure 9;

[0017] Figures 12-14 are perspective views of an alternative embodiment of a nuclear measurement tool including an integrated source holder portion in accordance with principles disclosed herein;

[0018] Figure 15 is a perspective view of the nuclear measurement tool of Figures 12-14 including an alternative off-center stabilizer;

[0019] Figure 16 is a perspective view of finger retention mechanisms for the outserts of the previously shown nuclear measurement tools;

[0020] Figure 17 shows a perspective view of an embodiment of a retained sensor package having a source emitting window and a detector window;

[0021] Figure 18 shows a perspective view of a detector window of an embodiment of a detector window assembly in accordance with principles disclosed herein;

[0022] Figure 19 shows a perspective view of a ring of the detector window assembly;

[0023] Figure 20 shows a perspective view of the assembled detector window including the components of Figures 18 and 19;