

Gamma Ray Analysis of a Neutron Activated metal part used in oil well production



by George Dowell

"Dear GEOelectronics,

*I have a fishing head cap for an Am²⁴¹Be (10Ci) well logging source, 348cpm at 1cm.
Remind me of your address and I'll send it off. I'd love to know what you find out about it."*

Background of the device to be tested:

Nuclear Well Logging-

The process of applying nuclear radiation, usually Gamma Rays and/or Neutrons to the areas surrounding a well hole, right through the casing or drill tube. Various sensors look for some type of bounceback radiation, which in turn is an indication of density, porosity or the presence of hydrogen atoms. Geologists call this a well log and it helps them to determine the important characteristics of that particular well.

Regulating agencies (NRC in USA) have strict rules about "losing" a source down a well. Usually a well tube collapses, breaks, twists, or otherwise is damaged preventing the nuclear tool from being retrieved. These "fishing" procedures can be very costly.

If a source is deemed "lost", the whole wellsite must be plugged with concrete and the whole operation abandoned, with a concrete marker and bronze plaque listing the dates, types of sources lost, depth etc. permanently installed over the well.

New methods have been developed that allow just the radioactive source to be retrieved rather than the whole downhole tool. Devices are attached to the top of the source carrier that can be engaged by a tool "fished" down the well, even through the drill pipe. Once latched onto the "fishing neck", upward pressure is applied to break a shear pin which holds the source carrier in place. Once the shear pin breaks, the slender source carrier can be retrieved, saving the well.

The main tool can then be abandoned once the radiation source is removed, and special drills bypass that spot to allow drilling to deeper depths or other well operations to continue.

The "fishing neck" is attached to the source carrier via this metal cap, which performs a number of functions as outlined in the below patent. LWD means Logging While Drilling, in which the sensors are actually just behind the drill collar, making drilling and logging a one-trip operation. Other methods are used called Wireline or Slickline. Reports can either be relayed to the surface real-time or stored on board the tool for playback upon retrieval.

The patent section concerning this "cap":

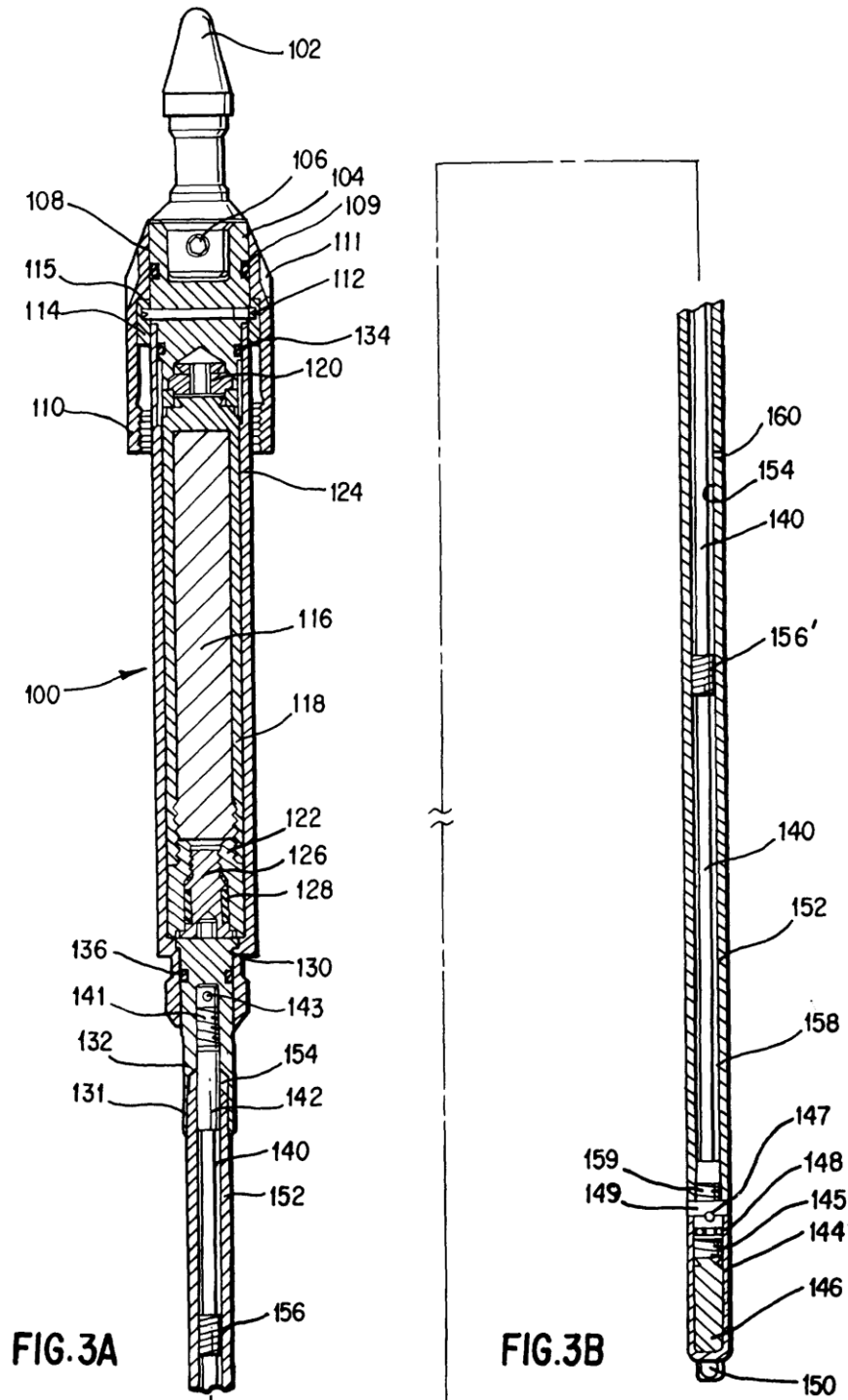
<<"In keeping with the objects of the present invention, LWD apparatus 10 is provided with an improved retrievable radiation source carrier assembly generally indicated as 100 which is shown in detail in FIGS. 3A and 3B. In FIG. 3A, the upper end of retrievable radiation source assembly 100 is provided with upstanding fishing head 102 that is connected to adapter 104 with pin 106. Downwardly-projecting cup-shaped end cap 108 surrounds adapter 104 and is fluidly-sealed in relation thereto with O-ring 109. The inner surface of lower end or skirt 110 of end cap 108 is provided with threads for releasably engaging end cap 108 to corresponding threads on the outer surface of centralizing member 86 (FIG. 2A) when source carrier 100 is inserted into source passageway 84 of LWD tool 10. A plurality of vertical slots or grooves 111 is provided on the upper outer surface of end cap 108 to provide a suitable place for engaging end cap 108 with a wrench to torque source carrier 100 in place.

Shear pin 112 laterally passes through a bore in adapter 104 and terminates at each end within shear ring 114 located below shoulder 115 of end cap 108. Neutron radiation source 116 is housed within source casing 118 which is secured by the lower end of adapter 104 and retaining nut 120 at its upper end and terminates with end plug 122 at its lower end. Source 116, casing 118, and end plug 122 are contained within source outer housing 124. Wipe test access plug 126, which is provided with seals 128 on the outer periphery thereof, is engaged within end plug 122 to allow access for conducting wipe tests as needed.">>

Patent link

<http://www.google.com/patents/EP0505260A2?cl=en>

Picture of the radioactive source carrier "Logging Tool Fishing Neck".
The cap in question is diagram reference #108.



Hard to XRF. the alloy is complex, made for downhole work. It has Co, Cr, a very little Fe, probably AL, Si, C, non magnetic. I was expecting Titanium maybe Tungsten. Stable cobalt 59 is irradiated by neutrons, slowed by the surroundings, absorbs a neutron becoming Co-60 the radioactive isotope.
Half Life = 5.27 Years.

Cap in closed lead shield.

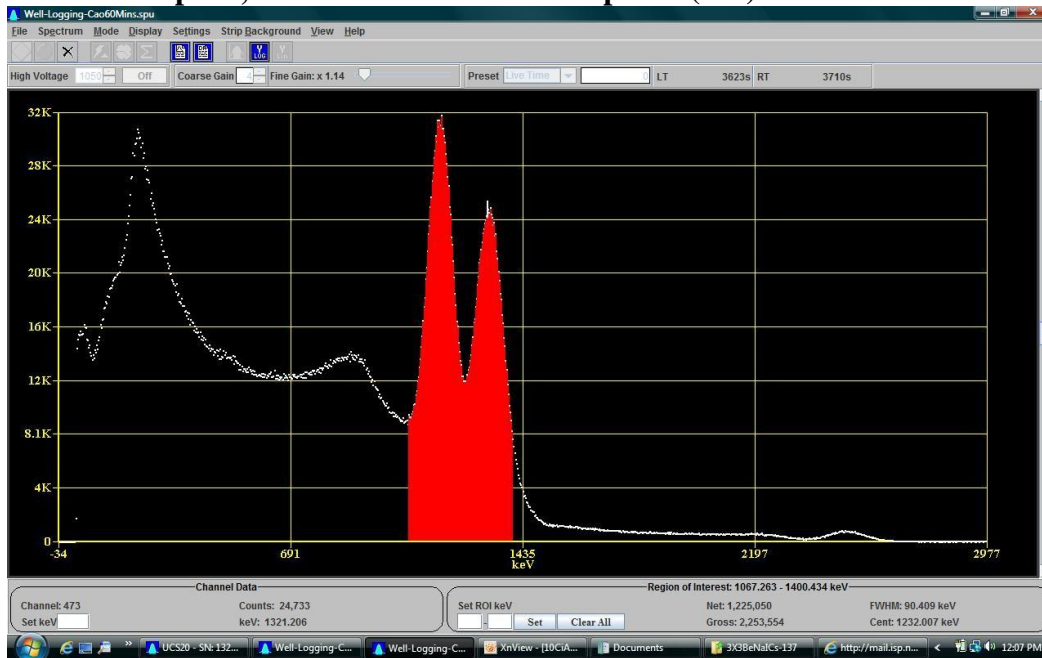


Cap being removed from the lead shield



Detail of Co-60 peaks after 10 minutes.

L to R: Co-60 Backscatter peak, 1173 and 1333 keV Photopeaks (red) 2506 Sum Peak



Detail of Sum Peaks, when an 1173 keV photon is detected at precisely the same time as a 1333 keV photon, their energies “add” or “sum” to create a false Sum Peak

