The chief advantages of radioisotope thickness gauges are their ability to monitor thickness continuously and the fact that they do not touch the material being measured. In some applications, such as in paper manufacture, radioisotope gauges have replaced the traditional technique of hand sampling and weighing. The sampling procedure formerly used does not cover enough of the sheet to be statistically reliable, and the results are determined when it is too late to correct deviations from specifications. In this instance it is impractical to measure the thickness continuously with a mechanical caliper because the paper would be marred or torn by a contacting instrument. Continuous measurement with a radioisotope gauge permits adjustment of the machine variables to compensate for deviations from the target.

In other applications, such as measurement of the thickness of cold-rolled steel, caliper gauges can be used without damaging the product, but variations in the surface roughness or vertical movement of the rapidly moving metal can cause chattering of the mechanical contacts, which leads to inaccuracy.

Density gauges are another important type of process-control instrumentation using radioisotopes. These units are widely used to measure the density of a variety of liquids, slurries, powders, and granular solids. As in the transmission-type thickness gauges, the radioisotope source and detector are mounted on opposite sides of the material being measured, which is contained in a fixed geometry, usually by a pipe or small vessel. Since the thickness of material between the source and the detector is constant, variations in density cause changes in the intensity of radiation reaching the detector.

A third major type of radioisotope gauge is the level gauge (Figure 4). These instruments consist of a gamma source and radiation detector

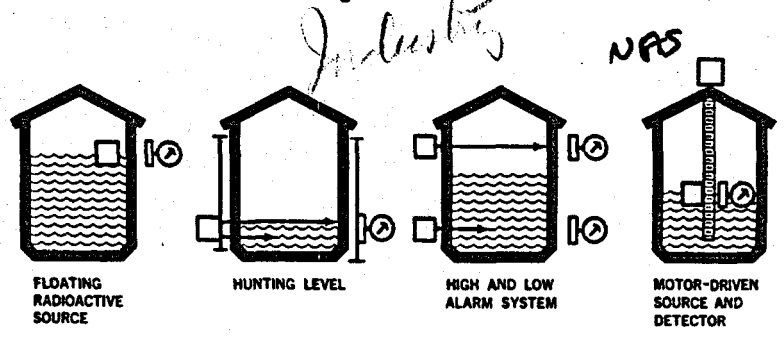

Figure 4. Principle of various types of level gauges.