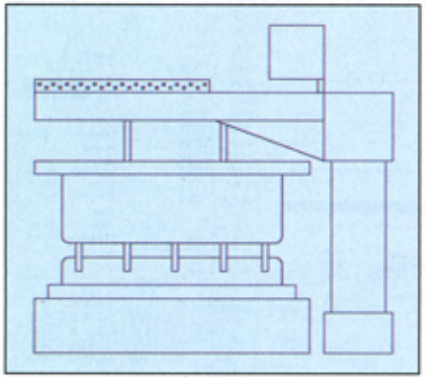
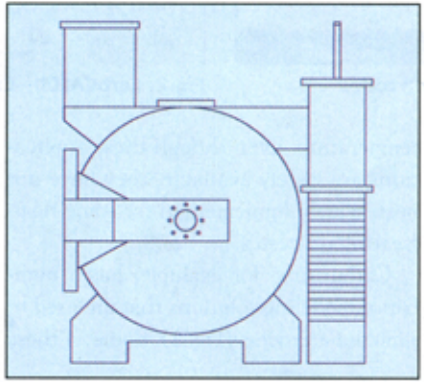


Nitriding Control

Nitriding has followed a similar control-evolution path and is a little further behind in control acceptance. This is probably based on the amount of nitriding being performed as compared with other heat-treating applications like carburizing. With that said, there has been much recent interest in automating nitriding applications. Historically, gas nitriding used a periodic sampling method with manual inspection of an ammonia-dissociation burette. Operators would adjust flow rates based on this subjective measurement.

Sophisticated systems are available that continuously measure atmosphere along with all the safeties and multiphase processes. To achieve this, multivariable control systems monitor temperature, atmosphere, nitriding potential, flow rates, pressure, etc. to provide a safe environment with precise control of case and compound-layer variations.



Vacuum Control

Vacuum heat treating has certainly benefited from automation. Traditionally, vacuum applications have higher quality demands and require extensive traceability. As with all the other areas of heat treating, control-sensor technology and sophistication are providing the ability to control a process with more precision, resulting in higher-quality products. Vacuum control has traditionally used either hard-wired relay technology or programmable logic controllers for sequencing and safeties. Vacuum heat treating has used process controllers, or PLCs, to run complete cycles using digital I/O, pressure sensors and thermocouples (Fig.3).

In vacuum heat treating, precision processing is always required. The phases of the process are typically the safety interlocks, pumping sequence, heating and cooling. From an automated-processing standpoint, the process controller is used to manage these steps. Either communication or discrete I/O is used to verify