BATTERY MONITORING AND INTEGRITY TESTING OF LARGE LEAD–ACID STORAGE BATTERIES

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Traditional maintenance programs

In the past, most battery users have relied on battery manufacturers and industry standards for recommendations on how to maintain their batteries. Unfortunately, these recommendations have been very slow in recognizing the major cause of battery systems failures.

Most battery user's maintenance programs consist of monthly, quarterly, and annual inspections calling for:

(i) visual inspection of batteries and battery racks;

(ii) static measurements of overall battery voltage, individual cell voltage, electrolyte temperature, and specific gravity.

If any load testing is done at all, it is typically a capacity test performed at five-year intervals.

Shortcomings of present programs

We have found from experience gathered over the past ten years in helping our customers to test batteries, that 80% of battery system problems are conduction-path related. Of these problems, the majority occurs in the external conduction path and can easily be detected and corrected.

Until very recently, none of the standards or battery manufacturer's recommended practices emphasized testing for conduction path problems. Strap resistance measurements have been included within the last few years but, in general, the conduction path problem has not been addressed strongly enough.

In addition to not detecting conduction path problems, many battery users do not obtain more than 75% of the rated life of the battery, while spending a considerable number of man hours on their maintenance program.

New concept

I would like to introduce the concept of continuous battery monitoring. Such a concept will increase battery system's reliability, extend battery life, and reduce maintenance man hours.

A permanently-installed, constant scanning battery-monitoring device can detect and alarm on battery and charger out-of-tolerance conditions such as individual cell voltage over and under charging, cell equalization, incipient conduction path problems, and temperature extremes.

The monitor I am describing is essentially an intelligent scanning digital voltmeter that reads all individual cell voltages, overall battery voltage, current and pilot cell electrolyte temperature (Fig. 1). The readings acquired by the monitor are compared with user-programmed levels, and an alarm is energized when an out-of-tolerance condition is detected.

In addition to monitoring the float charge condition of the battery, the monitor can also support a battery load test. The load applied to the battery is either the natural system load or an external resistive load module. Either one can be activated by the monitor for a programmed period of time or until a critical battery alarm level has been reached.

In order to minimize the monitoring cost per installation, a portable Programming/Display/Printer (PDP) unit that can service many permanently-installed monitors is used. As an alternative to the portable PDP, the monitor can be interfaced to a remote data terminal via telephone modems.

Float charge monitoring

The alarm conditions monitored during the float charging of the battery are primarily conditions that affect the life of the battery. Over and undercharging and temperature extremes can easily be detected. It is also easy to detect when a battery needs to be equalized by using the individual cell measurements as a trigger.

Load test monitoring

The conditions monitored during a load test are conditions that determine if the battery is able to meet its minimum functional requirements.

The following two types of load tests are considered essential in any battery maintenance program:

Capacity test

A complete discharge test performed every three to five years to measure the capacity of the system. The capacity measurement will determine if the battery can supply the system's minimum required energy, and it is also used as one of the most important parameters for determining whether or not the battery should be replaced.

Integrity test

A momentary-high-current test to detect any weak cells or conduction path problems. The load current should be close to the highest current normally drawn by the natural load and should be at least 100 A.

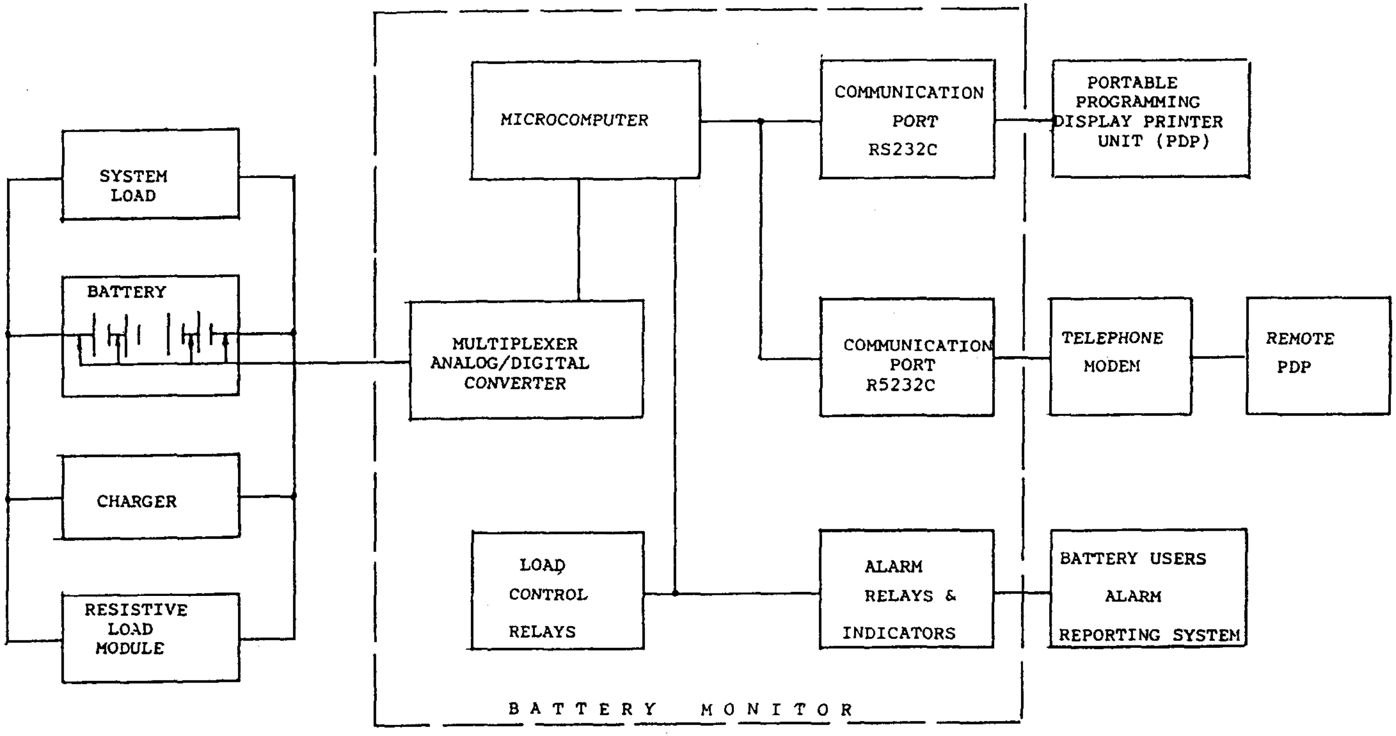

Fig. 1. Schematic diagram of constant scanning battery-monitoring device.

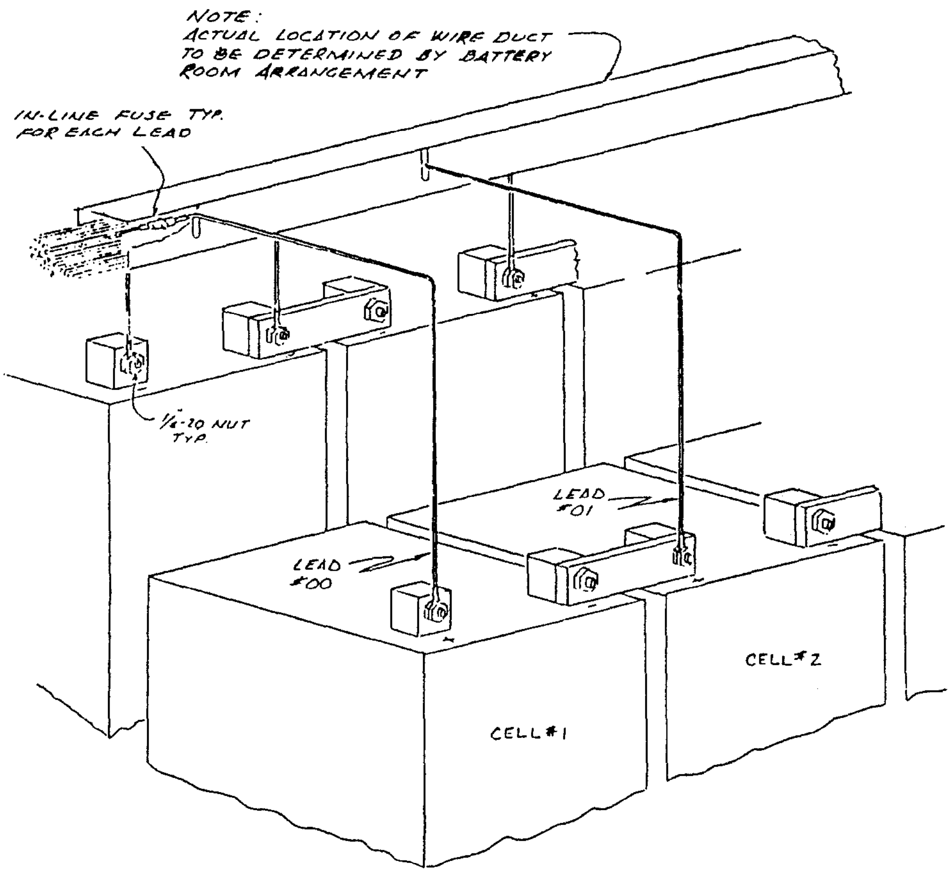

Fig. 2. Diagram showing connection of individual cell sense leads.

Integrity testing, when performed periodically (at least once every six months), will detect deteriorating conditions before they get severe enough to cause a system failure.

Figure 2 shows how individual cell sense leads are connected to the battery. Note that there is only one lead per cell which minimizes the number of leads used and also forces the voltage drops in the intercell connectors to be included in the measurement.

Conclusion

A permanently-installed monitor will:

(i) Protect the battery from conditions that are harmful to the life of the battery;

(ii) increase system reliability by detecting incipient problems before they cause system failure;

(iii) reduce maintenance man hours by extending maintenance intervals. For example, lead–calcium batteries need only be inspected for electrolyte level, specific gravity, and general visual once every six months.