BATTERY CHARGING

Expert explains voltage, specific gravity, hydrometry and other aspects of the golf car power unit

(First of Two Articles)

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In order to understand battery charging, the replacement or restoration of energy to the battery, we must first understand the basic characteristics of a battery.

The storage battery is rated in ampere hours. This means that a 120 AH battery can theoretically deliver one amp of current for 120 hours or any other combination of amperes and hours that, when multiplied together, gives 120.

The standard 6-volt golf car battery is essentially three 2-volt cells connected in series. In a standard 36 volt system, 18 cells. This means that we have 6 6-volt batteries connected in series. Each battery having three cells, multiplied by the number of batteries, gives the total number of cells in series. Six three-cell batteries multiplied by two volts per cell, is a 36-volt system.

Specific gravity is the relationship between the weight of electrolyte and the weight of water. If a battery has a specific gravity of 1.260, the electrolyte (acid solution) is 1.26 times as heavy as water.

In a fully charged battery the positive plates consist of grids containing lead peroxide.

Electrolyte Solution

The negative plates contain spongy lead. The electrolyte is a solution of sulfuric acid and water whose specific gravity will range from 1.260 to 1.280, depending upon the strength of acid used as finished acid strength when the battery is manufactured.

When a battery is discharged the lead peroxide of the positive plates turns to lead sulfate when it combines with the sulfuric acid. The lead of the negative plates also turns to lead sulfate.

On charge, the reaction is reversed. The acid is driven out of the negative and positive plates and they return to their original state of lead peroxide and spongy lead. When batteries are in a discharged condition, the specific gravity may have a low reading of approximately 1.140. In a charged condition they would read 1.260 to 1.280. This is relative strength or capacity of the battery.

Rectification is a method of changing alternating current to direct current. So, all battery chargers are rectifiers. Selenium rectifiers or silicon diode rectifiers have been used in golf car battery chargers. They restrict the flow of current to one direction, thereby giving direct current.

Automatic vs. Semi-Automatic

Battery chargers have been termed automatic (self-operating) and semi-automatic. There are several methods of charging. The most popular are the two-rate and the taper charge type.

In golf car battery charging, an automatic charger is one that does not require a specific gravity reading prior to placing the batteries on charge.

The automatic two-rate charger operates with a terminal voltage relay which gives the batteries a finish charge when they reach their gassing point, or when they are approximately 80 per cent charged.

The semi-automatic charger is basically the same type of charger. However, instead of a (TVR) terminal voltage relay, the amount of charge must be determined through use of a hydrometer, or a percentage of charge meter and a timer pre-set to give the batteries the correct

amount of charge.

Differential Operation

The taper type of chargers is automatic but operates on a different principle. The taper type charger operates from the difference between the battery voltage and voltage output of the charger.

Thus, when the terminal voltage of the batteries is low, a higher current is required. As the voltage of the batteries on charge builds up, the voltage difference between the charger and batteries decreases and the current tapers or decreases proportionately. At the end of charge the rate will be quite low.

Most battery chargers are equipped with timers. The timers, in addition to being on-off switches, are in reality a safety feature and should be used with this in mind. Whether you use the two-rate or taper-type chargers, if all the cells in the batteries are not in good condition the batteries will never reach the proper terminal voltage. Consequently, the charger won't know when to reduce the charging current. If you did not have a timer or some sort of turning-off device, batteries could remain in a higher-than-normal charge rate and could cause damage to the good batteries.

Take Occasional Reading

It is advisable to take an occasional reading to determine just what state the batteries are in. Good maintenance will reveal defective or low cells and these can be corrected immediately.

Open circuit voltage in relation to specific gravity and percentage of charge is as follows:

Specific Gravity	Open Circuit	Per Cent Charge
1.260	2.10	100
1.220	2.06	75
1.180	2.03	50
1.140	1.99	25
1.100	1.95	0

Theoretically, there is only one-tenth of a volt difference per cell between a charged and a discharged battery.

When the batteries are connected to a charger, voltage readings will be approximately as follows:

Bing Crosby holds plaque which has been installed in his name at the third hole at Green Tree G & CC, Victorville, Calif. He is shown with Barney McCoy (l), club pro, and Robert Tatum, owner. Hole is 610 yards long.

	Specific Gravity	Total Volts
At start charge 2.13 volts per cell	1.140	38.4
At gassing 2.37 volts per cell	1.220	42.7
At finish 2.4 to 2.5 volts per cell	1.260	43.2 - 45.0

Consider Replacement

When taking monthly specific gravity readings, you should find a battery with a 40 point difference between the cells. This indicates a faulty cell or a potential problem. The battery should be watched for performance, or should be replaced. Proper charging procedures are important in charging batteries so that they give maximum service. Chronic overcharging and undercharging have a harmful effect on batteries and will shorten battery life.

A little experimentation with a hydrometer will show what charge is sufficient to bring your batteries to capacity. Observation of the hydrometer and different charging times will indicate the amount of charge needed for a car that has been out for 9, 18, or 36 holes. The most neglected tool is the hydrometer. When used properly it can save hundreds of dollars in battery replacements due to premature battery life.

The second part of this article will appear in the April issue of Golfdom.