HOW THINGS WORK
BATTERY

Inside a battery, sulfuric acid changes lead peroxide and spongy lead into electrical power, then back again, in one of the neatest tricks since Houdini, and all it asks of you is a little understanding care, steady employment, and from time to time a few ounces of distilled water.

By Gordon Jennings

● Like the rich man's butler, a battery gets almost no attention unless it drops dead instead of continuing in the silent performance of its duties. Sure, family retainers are given an occasional fleeting smile to encourage further devotion, and if your bike's battery is lucky you will sometimes think to dribble a few ounces of water into its parched cells. Otherwise, for batteries and butlers life is mostly out of sight, out of mind, and kindly do not intrude in the festivities.

This policy of neglect may work well in dealing with servants (Uriah Heep himself couldn't take many of Nelson Rockefeller's "Hiya, fellah"s) but it's a bad plan for batteries. If you ignore a battery's persistent thirst or let it languish in disuse its health will suffer, sometimes terminally. And even when a neglected battery survives it is likely to be with a diminished vitality, which causes not only the familiar starting difficulties but may also be the source of seemingly unrelated ailments, such as the rapid pitting of ignition contact breaker points.

There's little point in simply repeating here the advice about electrolyte levels, etc., printed in every motorcycle owners manual; you already have that information at hand. We do think that you (like ourselves) will be more strongly motivated to give your bike's battery decent care if you know what's inside its plastic case, know how it stores and returns electrical energy, and understand why the process all too frequently fails.

Most people old enough to be involved in motorcycling have at some time seen what's inside a battery and know that its interior is divided into compartments, each containing a number of nasty looking plates. Most of us also know that the fluid contained in these compartments is an acid, and that periodic topping with water is required—for some reason or other. How much more is there to know? A lot, as you shall see.

Those compartments are called "cells," and each—whatever its size—will deliver an electrical pressure of almost exactly two volts. Thus, a six-volt battery will have three cells; a 12-volt battery will have six. Inside each cell there are two kinds of plates, each a cast lead grid that supports an active material: the positive plate a lead peroxide; the negative, spongy lead. A lead-on-lead negative plate may seem redundant, but the battery's active materials have to be porous to permit good penetration by the electrolyte and would crumble if left unsupported. Hence, the matrix of solid metal.

Increasing the size or number of plates in a battery's cells has almost no effect on voltage; it does improve the energy capacity, which is rated in ampere-hours (Ah). A 30-Ah battery will deliver a one-ampere current for 30 hours. The same battery can not give you a 30-ampere current for an hour, as the chemical processes that produce the current don't work that fast. The rating system does require that a battery be able to maintain its terminal voltage against a discharge rate, in amperes, equal to 5-percent of its stated capacity.

The electrolyte used in lead-acid batteries is a dilute sulfuric acid, which combines with the plates' lead peroxide and spongy lead to form lead sulfate and water. In this chemical process the positive plate acquires a surplus of free electrons; the negative plate develops a shortage. It is this unbalanced condition that creates the battery's electrical pressure, or voltage. The process occurs only very slowly unless the terminals are bridged with a conductor, as when you switch on your bike's headlights, which sends a flood of electrons from the positive to the negative plates, shifts the electron balance, and allows the lead-acid reaction to work more rapidly.

Because water is a by-product of the reaction, a battery's electrolyte becomes diluted as its cells are discharged, and the degree of dilution is an excellent indicator of its condition. Electrolyte in a fully charged battery should have a specific gravity (density, compared with water) of between 1.275 and 1.30. At half charge it will be 1.21–1.275; at the operative but depleted level, 1.15–1.21; and anything below 1.15 may be considered evidence of a fully discharged battery. These specific gravities are for batteries at 80°F. and an adjustment of four gravity points (.004) must be added for each 10° above that temperature, or subtracted if the battery is colder. Specific gravity is checked with a hydrometer, which is a glass tube fitted with a squeeze bulb and containing either a float or a set of colored beads.

A wonderfully useful characteristic of the lead-acid battery is that its electrochemical reaction can be reversed. When an over-riding voltage is applied at its terminals—say, 14 volts on a 12-volt battery—the positive plates get an inflow of electrons, some are drawn from the negative plates, the lead sulfates turn back into spongy lead and lead peroxide, and their sulfuric component is returned to the electrolyte—which becomes less dilute. This is what happens in a battery being charged. Unfortunately, you also get some heat and an electrolytic breakdown of the water into gaseous hydrogen and oxygen. These gases, and small amounts of water vapor, escape out the battery vent. The loss must be compensated by the frequent addition of distilled water. Ordinary tap water contains minerals injurious to a battery's health. Overfilling also does harm, by diluting the electrolyte to a density below the prescribed levels.

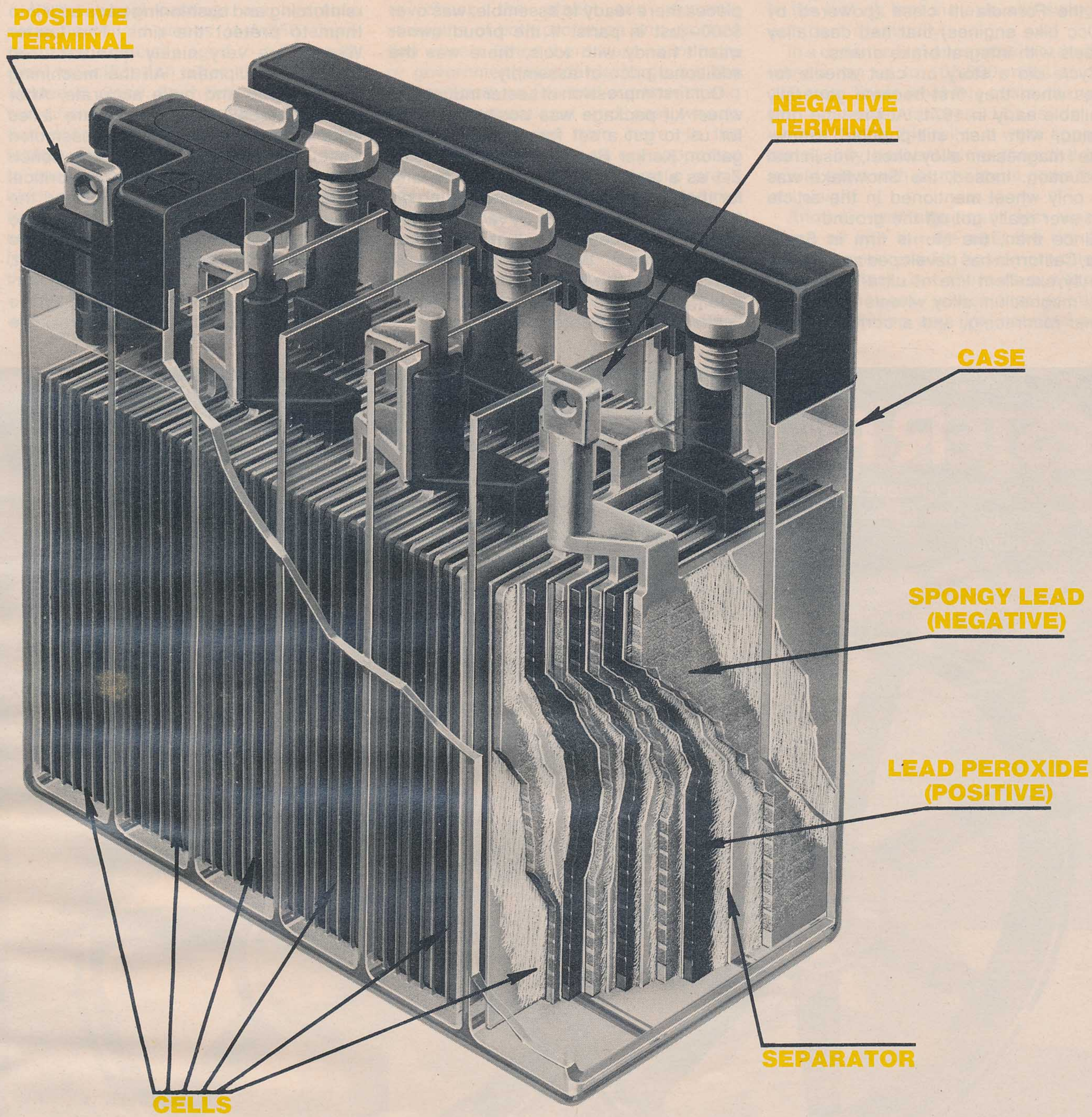
Let a battery's electrolyte level get too low and its cells are exposed to two kinds of damage: first, there is the concentration of electrical activity, and a highly concentrated form of sulfuric acid, working on the plate areas still immersed; second, the exposed plate areas dry out. Both of these tend to loosen the active material; in a motorcycle the damage is compounded by engine vibration—and in many cases, by rather primitive voltage regulation. The loosened material usually comes to rest in the bottoms of the cells, where it forms a useless sludge. If the sludge gets deep enough it will create a short-circuit between the plates, and a cell in that condition is depressingly dead.

A measure of short-circuiting between cells also may be created by dirt collecting on a battery's case, and we've all had experiences with the insulating properties of the lead salts that can form between terminals and battery cables. So keeping the battery case clean is good practice, as is smearing the terminal/cable junctions with petroleum jelly, which is very effective in preventing corrosion.

Among all the misfortunes that may befall a battery, the worst (at least equalling the horrors of dehydration) is simple disuse. Leave a battery unused, and it will slowly discharge, which isn't a disaster in itself but eventually leads to one: in time the battery's lead sulfates will group into large crystals, forming a white fuzz on the plates. This fuzz will remain stubbornly inactive and, worse, block the activity of the material behind it. A partially "sulfated" battery may be restored to a measure of health by thumping its base on the floor to shake the fuzz of the plates, then pouring off the electrolyte, flushing the fuzz out of the case with distilled water, and refilling with electrolyte. Still, it's best if the fuzz isn't allowed to form, and it won't if you keep your bike's battery on a trickle charger while you're waiting for spring and good riding weather.

Should you have to deal with a sulfation problem, don't thump the battery too vigorously. Its plates are kept from touching, and short-circuiting, by separators—which can be made of treated paper, porous rubber or fiberglass mat—but the whole collection is held in fairly precarious suspension by soft lead bars bridging between the upper corners of plates, and the bars supported only by the between-cells connectors. Batteries made specifically for severe vibration conditions may have their plates supported from below, on ridges rising from the cell floors, but this (like the more expensive through-wall form of cell connector) is not a feature common to motorcycle batteries. Manufacturers prefer to use a cheap, simple battery and cope with vibration by means of rubber mounting pads.

Batteries in bikes ridden every day are, assuming good condition in the rest of the electrical system, almost constantly at full charge. The needs of ignition, lights, etc. will be met by generator output. That doesn't mean the battery's sole function is to power a bike's electric starter. In fact, it serves a very useful purpose in stabilizing electrical system voltage, supporting it when you're riding slowly with lights on and absorbing the peaks produced by high engine (and alternator) speeds. It can't provide that function if one or more of its cells are half dry, and that's why low electrolyte levels lead to melted light-bulb filaments and pitted ignition points. And that's why, even if you don't mind buying a new battery each spring, you should try to keep the one you're using in healthy condition during the riding season. ◉



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