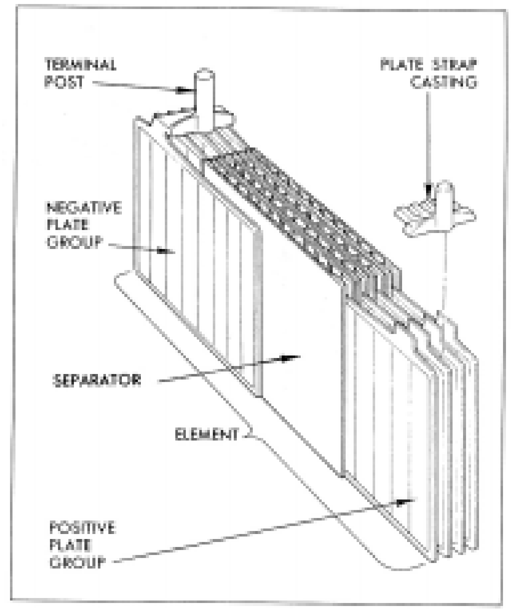
It All Started With A Pine Tar Box.....BATTERIES
It All Started With A Pine Tar Box

The automotive storage battery is something we pretty much take for granted. And why not, it has been around since the Mid-1800’s and for the most part looks similar in design to the batteries sold in the 1920’s. You would think that after that length of time with no significant changes, that the engineers of the day pretty much got it right the first time. And they did. But first a simple review.



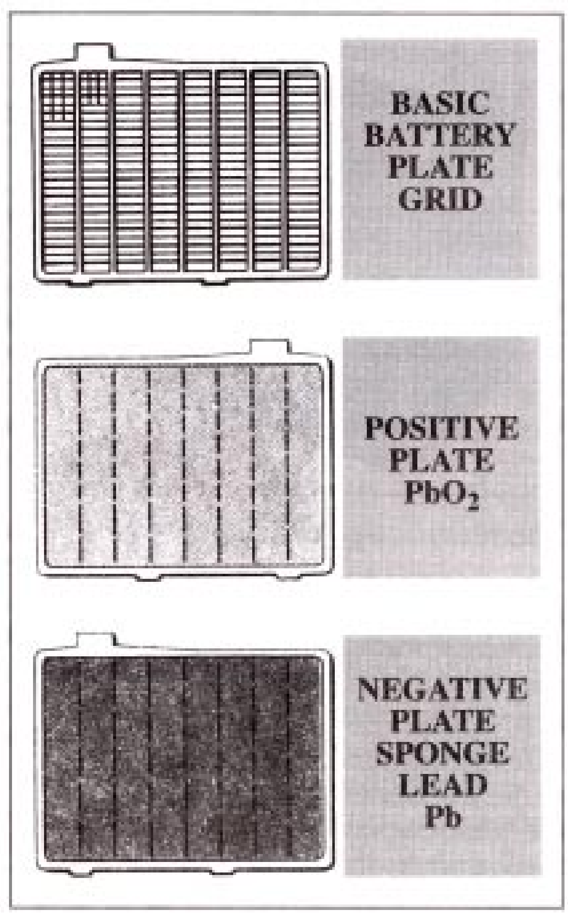
Let’s look at the job the battery has been doing all of these years. The battery has the official title of the “electro-chemical” device that changes chemical energy into electrical energy. In other words, it stores the chemicals and provides the place for the chemical change to happen, which creates the electricity. And that is the exact same job it had in 1920.

OK, SO IT CONVERTS CHEMICAL ENERGY INTO ELECTRICAL ENERGY.
EXACTLY HOW DOES THAT HAPPEN?

The inside of a battery is made up the three active parts. It is these three parts, which cause the chemical reaction that produces the electricity.

Two of those parts consist of “positive” and “negative” plates. A plate is made up of a series of grids. In turn, a grid is simply a framework of cast lead and alloys to which an active chemical is attached. It is this active chemical attached to the grid that is involved in the chemical reaction.

Grid construction is important and is used to determine both the life and the output of a battery. As you might guess, the more area or grid space available, the more chemical that will be exposed to the electrolyte, (the third active ingredient on the inside of our battery), the more powerful the battery will be.



However, thin grid plates will flex more, and are easily damaged by vibration. Also, excessive heat will cause the plates to flex and warp, which makes the chemical attached to the grid flake off, causing the battery to fail.

Grid plate thickness is for the most part determined by the application of the battery, and the environment in which it will be used. Grid plates will usually range in thickness from 3/32nd to 3/16th of an inch.

Ideally, pure lead would be the best grid material. However, because lead is soft, a material call “antimony” is often missed with the lead to harden and stiffen the grid structure. Only a small amount, just two to eight percent, is needed.

An excess of antimony will cause brittleness, and high electrical resistance that will “block” the electrolyte from reaching the chemical on the grid material. Excess antimony will also cause the battery itself to self-discharge more rapidly.

In recent years, battery engineers have learned that it is also possible to harden the lead grid using a small amount of calcium. Calcium promotes less self-discharge along with low water loss. Using calcium has been a part of the recent technology used to develop the maintenance-free batteries.

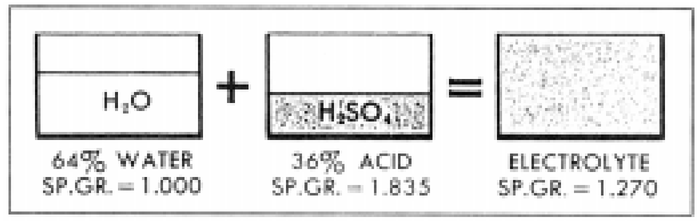
BUILDING A BATTERY

After a series of grids is assembled it becomes a "plate". Once becoming plates, the grids are coated with the chemicals that will be necessary to product electricity.

The positive plates are coated with peroxide of lead or PbO2, and will be chocolate brown in color.

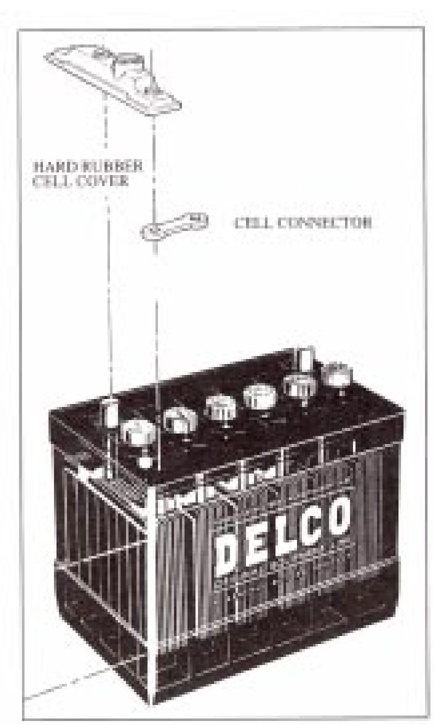
The negative plates are coated with sponge lead or Pb, and will be gray in color.

The **electrolyte** is the solution that mixes with these chemicals and produces the electricity. The electrolyte is commonly called **sulfuric acid** or H2SO4. The water in the battery is simply the carrier of the sulfuric acid.



Formula for electrolyte

A collection of treated plates or grids inside of a battery is called a **plate group**. Because the positive plate group and the negative plate group are exact opposites, they do not make good neighbors. This makes it necessary to have separators between the plate groups that separate the positive plates from the negative plates.

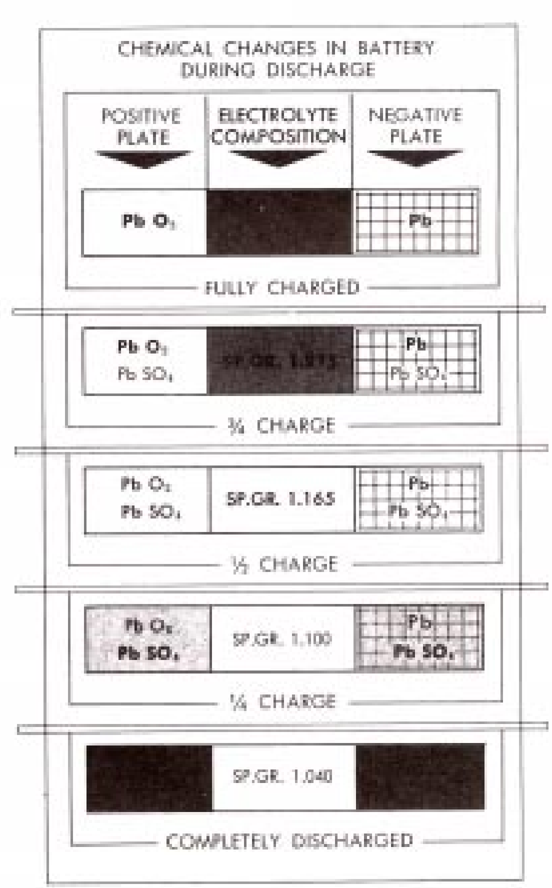


1960s battery technology

In the old days, separators were made of hardwood lumber pieces. In later years they were made of hard rubber. Because of modern technology, plastic is commonly used today. Regardless of what they are made of, separators still have the same functions as in the old days.

When the chemical reaction takes place inside of the battery, the electrical energy produced will exit the battery by traveling from the positive plates inside of the battery, to the outside of the battery through the positive post, and on to the wiring harness and various accessories.

After the electricity has traveled through the wiring harness and to all of the accessories, it will be returned to



Chemical changes in battery during discharge.

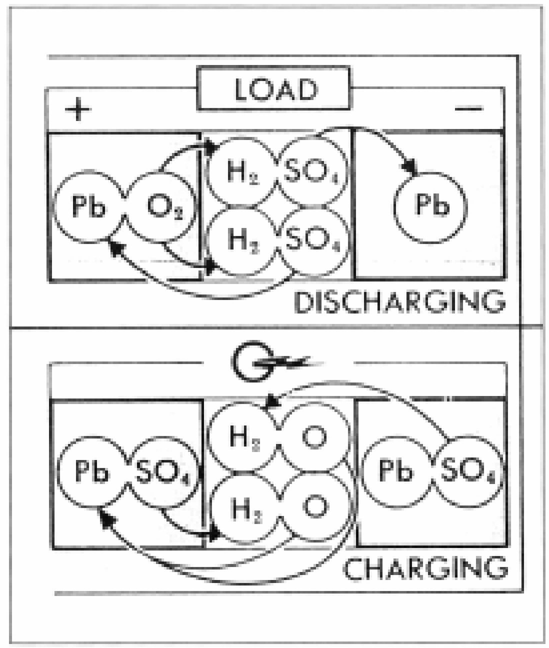
the battery at the negative post. From there it enters the inside of the battery and is collected by the negative plates. The electrolyte chemical then begins to break up and the solution becomes sulfur and oxygen.

This leftover sulfur and oxygen solution join up with the chemicals that were originally a part of the positive plates. When the separated electrolyte chemicals mix with the chemicals from the positive plates, the leftover chemical solution is water (H_2O). This weakens the battery and it becomes **discharged**.

Overtime, as the "cycling" of the battery takes place over and over, the sulfation that is produced as a result of this charging/discharging process will collect on the bottom of the inside of the battery case. Eventually enough will accumulate to reach the bottom of the plates and short out the battery, causing it to fail.

An inactive, partially discharged battery will speed up this process. Also, a battery low on water will expose the top of the plates to the outside air and will allow sulfation to grow on top of the plates themselves.

The sulfation will also act as an insulator and prevent the electrolyte from reaching the chemical on the grid. This reduces the surface area left for the chemical reaction to take place, and will in turn reduce the output of the battery.



Chemical reactions occurring in the battery cell during charge are basically the reverse of those which occur during discharge.

OK, NOW WE HAVE "DISCHARGED" THE BATTERY. HOW DO WE RECHARGE IT?

In order to recharge the battery, the current flowing through the battery must be reversed. This is where the charging circuit comes into play. The generator or alternator produces current mechanically, and sends that current into the battery through the positive post. This is exactly the **opposite way** that the battery released the current it originally produced.

When this electrical current from the generator enters the battery, this starts a chemical reaction that causes the sulfur and oxygen to leave the negative plates and reunite on the positive plates, to form electrolyte once again. When the battery is completely recharged, the electrolyte will again be back to its original solution.

**NOW THAT WE KNOW HOW ALL OF THIS WORKS,
HOW DO WE FIGURE OUT WHAT CONDITION THE BATTERY ELECTROLYTE IS IN?**

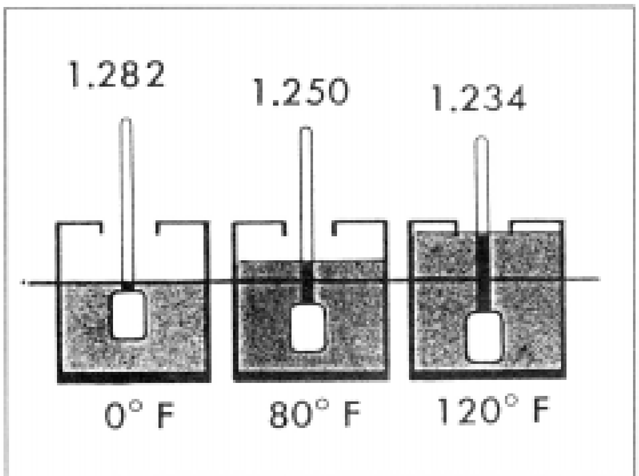
The tool most often used to check the condition of a battery is called a "hydrometer." As you might suspect, all that a hydrometer does is measure the acid strength of the electrolyte, or what concentration of acid is present in the water.

A hydrometer does this by measuring the specific gravity or the weight of the solution. Water has been assigned a value of 1 to make it easy to figure the acid-to-water ratio.

Pure sulfuric acid, the active ingredient in electrolyte, weights 1,835 times more than pure water. This means that if a **gallon of water weighs eight pounds, then a gallon of pure sulfuric acid will weight 14.68 pounds**.

Example: $8 \times 1.835 = 14.68$

The weight of electrolyte will change with the amount of acid present in the water. Using a hydrometer, a fully charged battery will show a specific gravity reading of 1.275 or 1.300. A partially discharged battery could give a reading of 1.150.



Compensation for specific gravity variations caused by temperature changes.

One more thing, as you might suspect, the outside temperature will affect the readings of the hydrometer. Eighty degrees Fahrenheit is considered the ideal temperature for specific gravity readings.

So to correct for a warmer outside temperature, simply **add four points** to the reading for every 10 degrees above 80 degrees Fahrenheit.

For every degree colder than 80 degrees Fahrenheit, **subtract four points** from the reading.

If you are still wondering why you have to do that, it is because warmer temperatures will cause expansion of the electrolyte, while the colder temps will cause the electrolyte to contract.

OK, WE NOW KNOW HOW A BATTERY WORKS, AND HOW TO CHECK ITS CONDITION. NOW LET'S LOOK INTO WHAT AFFECTS THE FINAL OUTPUT.

The total capacity of a battery is greatly determined by the total amount and size of grid material in the plates. The overall size or thickness is not as important as the total amount of surface area.

The useful capacity of a battery can be increased greatly by placing a large number of thin plates inside the battery as opposed to a smaller quantity of thicker plates. By using thin plates there is more grid surface exposed, which will make the chemical action happen more quickly.

But as with most things there is a compromise. The thin plates do not have the heavy coating of chemical that the thick plates do. As a result, the thin plates will deteriorate faster, and be more likely to be damaged by vibration and excess heat. This will give the battery a shorter life span.

An example of this is heavy construction equipment. These batteries must have thicker plates to be able to stand the rough environment and all of the vibration. As a result, the case will fill faster with these fat grids. This is why you will see construction vehicles have a series of big batteries. Inside of those batteries will be few, but thick, plates. It will take a series of these batteries to get enough grid surface to provide the electrical energy needed to do the job.

HOW DO THEY RATE THE OUTPUT OF A BATTERY?

There have been a number of different rating systems for battery output over the years. The one most common in the early years up through the late 1950's was called **ampere-hour rating**. This rating system was used mainly during the 6-volt battery era. An ampere-hour rating was actually the storage capacity of a battery. This was figured out by **multiplying the current in amps by the time of discharge**.

Example: A battery that will deliver a minimum of 5 amps for a 20-hour period is said to have a 100 ampere-hour capacity (5 x 20 = 100).

The 12-Volt Era….

When 12-volt systems were introduced, a new rating system was needed to reflect the change that voltage had in rating batteries, since ampere-hour ratings were based mainly on total weight of grid material.

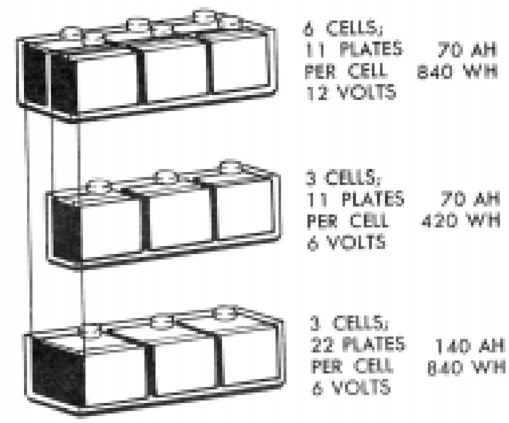
It All Started With A Pine Tar Box.....BATTERIES

We know that 11 thick plates such as those found in a 6-volt battery cell could weigh the same as 22 thin plates found in the cell of a 12-volt battery.

While they could have the same ampere-hour rating based on the weight of the material, we know that the 66 thin plates found in the 12-volt battery will have more grid surface area and would be a higher output battery than the 6-volt battery it is being compared to by weight. The 6-volt battery will have only 33 plates total.

In addition to the extra grid surface area, the extra voltage will have a noticeable affect on the battery's total output. None of this would be reflected in the ampere-hour ratings used during the 6-volt era.

As a result, the Society of Automotive Engineers developed and adopted the following updated battery ratings.



A comparison of ampere-hour capacities of 6- and 12-volt batteries.

1. **Reserve Capacity –** This test measures the time in minutes that a battery can be discharged at the rate of 26 amps and still keep a minimum voltage of 7.5 volts at 80 degrees Fahrenheit. Reverse capacity is measured in minutes. An example would be a 120-minute reserve capacity.
2. **Cold Cranking Amps or (CCA) –** The most difficult job a battery has is to provide electrical energy to the starter to crank over the engine. Since turning over the engine becomes more difficult as the temperature drops, the best way to measure a battery's true cranking energy is to measure the cranking power available at zero degrees Fahrenheit for 30 seconds while staying above 7.5 volts. An example of a rating would be 800 CCA.
3. **Cranking Amps (CA) –** CA is sometimes referred to as Marine Cranking Amps. MCA measure how much current can be delivered for 30 seconds at 32 degrees Fahrenheit while staying above 7.2 volts.

In the old days, batteries were judged by how many plates they contained. The old rule was "the more plates, the better." As we have just learned, that was not always the best advice.

**OK, NOW WE KNOW HOW A BATTERY IS MADE AND
HOW THE OUTPUT IS RATED.
NOW WHAT ARE THE DO'S AND DON'T OF BATTERY CARE,
AND WHAT MAKES A BATTER FAIL COMPLETELY?**

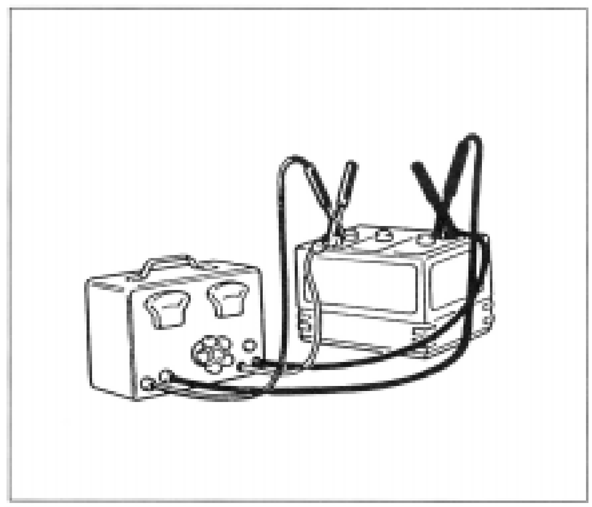
- Having a **low electrolyte** level is one of the main causes of battery failure. When the level of electrolyte drops below the plates, the result will be excessive sulfation and buckling of the plates, caused by excess heat.
- The next most common mistake is **overfilling** the battery, which will cause the electrolyte to "boil out" or "gas " excessively when the battery is being charged. This will cause a loss of the electrolyte solution.

Also remember when the electrolyte boils out on top of the battery, it forms the green and white corrosion on the battery posts and wiring connections. This corrosion will act as an insulator and stop the flow of current from the battery posts to the battery cables, as well as to the wiring harness and accessories.

It All Started With A Pine Tar Box.....BATTERIES

A hot shower will put your old car's battery into top condition for summertime driving. (Illustration courtesy of John Gunnell)

- **Impurities** are another common battery problem. It is always best to use distilled water when adding water to your battery. Any dirt or foreign matter will lessen the effectiveness of the electrolyte solution in the battery.
- **Freezing** happens quite often to a partially discharged battery. The examples below are the temperatures at which the electrolyte inside a battery will begin to freeze, causing damage to the battery. Keep in mind a fully charged battery will not freeze until the temperature reaches –90 degrees Fahrenheit. (Brrrrrr)
- A half-charged battery with a specific gravity of 1.150 will freeze at just 9 degrees Fahrenheit.
- A battery showing a specific gravity of 1.025, an almost totally discharged battery, will freeze at just 30 degrees Fahrenheit.



Believe it or not, cold temperatures will not harm a battery if the battery is kept charged up so the electrolyte does not freeze.

Most frozen batteries cannot be repaired. NEVER TRY TO JUMP-START A FROZEN BATTERY. The battery will explode, causing serous damage to you and your car.

- **Overcharging** of the battery is another common cause of early battery failure. Overcharging is most commonly caused by burnt points in the voltage regulator or cutout, allowing the generator to overcharge, or from overcharging caused by too high an amp setting while being recharged on a battery charger.

The results of overcharging are warping or buckling of the battery plates, followed by internal shorting of the battery. In addition, a good portion of the electrolyte will be “cooked” away. This will cause most of the chemical attached to the grids to flake and fall off, causing the battery to be useless.

Remember, a long, slow charge from a battery charger is much better for a battery than a fast high-amp “booster” charge. Always **be sure you have the cables connected correctly** before you turn on your battery charger.

It goes without saying, when jump-starting a vehicle, be sure to match negative (black) to negative (black) posts, and positive (red) to positive (red) posts.

Also, when jump-starting a vehicle, hook up your jumper cables to the fully charged battery first. NEVER STAND DIRECTLY OVER THE BATTERY YOU ARE TRYING TO JUMP-START.

Always stand off to one side in case the battery would explode. Remember, the gas that is vented from the battery as it charges is explosive. You should not be smoking or near open flames when jump-starting your car. You do not want to risk damaging your pretty profile as well as that of your cars.

Make your connections to the charged battery first. Then connect the positive jumper cable to the positive post of the dead battery. The last connection should be ground. **It is also suggested that you connect the ground to a metal surface away from the battery anyplace along the frame is good.**

The idea here is to keep the sparks away from the battery. When you connect the cables to the disabled car, sometimes sparks will occur. If the battery has been “gassing” and explosion could result.

After the car starts, remove the ground cable first, then the positive. After you remove them be sure you do not touch them together. **REMEMBER**, your cables are still attached to the other battery.

Observe all safety rules, and be sure the brake is set on both vehicles BEFORE you start this process. It is kind of embarrassing if you are run over by your own car.

CAN I JUMP-START MY 6-VOLT VEHICLE USING A 12-VOLT BATTERY?

While this is risky, it can be done, IF YOU ARE CAREFUL! If you are going to do it (and some of your will anyway), here is the safest way. Be sure all of your lights and accessories are turned off. Start by connecting to the 12-volt battery first. Then connect the negative to the 6-volt vehicle. Last of all; briefly touch the positive cable directly to the STARTER BATTERY CABLE POST. DO NOT CONNECT DIRECTLY TO THE BATTERY!


The joys of winter

It is a good idea to have someone ready to try to start the car when the 12-volt cable touches the starter. **You want to have the 12 volts connected to the 6-volt car for the least amount of time possible!**

Remove the cable as soon as the car is started. If the car fails to start, DO NOT leave the cable connected to the starter. AGAIN, DO NOT connect directly to the 6-volt battery! The same safety rules apply. Do not get run over by your car.

Rundle’s Rules:
If your car is positive ground, and some were (the positive post of the battery is ground), be sure that you match up the jumper cables to the correct terminals. Always positive-to-positive and negative-to-negative. NO EXCEPTIONS! Or you may end up like Alice Kramden and go straight to the moon.

REMEMBER THIS HAPPENING?

Here is a battery problem straight from the archives:

IS IT POSSIBLE TO INTERNALLY REVERSE THE POLARITY OF A BATTERY?

It was possible in the old days, as a result of a heavy discharged battery, to actually “reverse” the polarity of the battery internally.

This was due to overheating from a high charging rate. Sometimes it would occur in just one or two cells, and in severe cases all of the cells will be reversed. In a reversed polarity battery, the grid plates take on each other's chemicals.

A battery with reversed polarity will tend to overheat easily, contain a large amount of sulfation on the plates, and will not take a charge, or will only hold a charge for a short time.

The cure for reversed polarity was a long, slow charge in the correct direction of charge. Sometimes up to two weeks was required. It also may be necessary to "cycle" the battery: Charge it for a few days then install a load on the battery to discharge it completely. Then start the charging process over again.

With some time and patience and lots of good luck, a few of the batteries with reversed polarity were saved. However, no many, and the odds are not in your favor.

CAN A HYDROMTER TELL ME ANYTHING ELSE ABOUT THE CONDITION OF A BATTERY BESIDES THE CONDITION OF THE ELECTROLYTE?

Besides the overall condition of the electrolyte, you can also check the specific gravity in each cell of the battery. The specific gravity readings of all of the cells should not vary more than half a point (.5). If there is more than a .5 difference between the highest and the lowest cell reading, that is a sign that you have a defective cell in the battery, and the battery itself may need replacing.

TIME-SAVING TIPS: There is an easy way to check to see how good your battery connections are between the battery and the starter. Simply turn on your headlights before you crank over your engine. If the headlights go completely out when the engine is cranking, you have high resistance in the starting circuit. This can be caused by dirty cables, or a loose cable or wiring connection. If the headlights dim but the engine cranks over and start right away, you're in good shape.

IS THERE ANYTHING NEW IN BATTERY TECHNOLOGY AFTER ALL OF THESE YEARS?

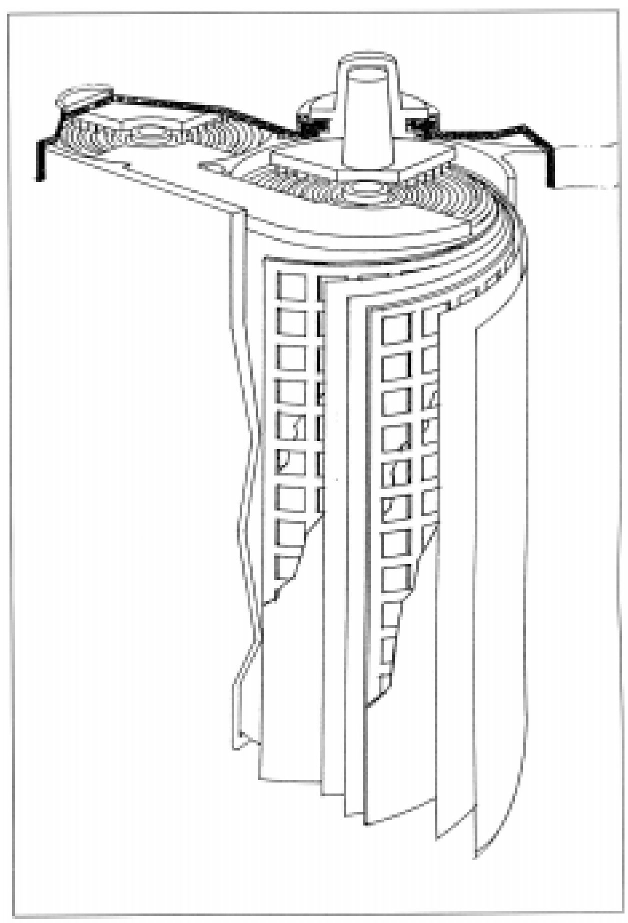
The latest technology in automotive batteries belongs to OPTIMA Batteries, Inc. of Denver, Colorado. By combining traditional lead acid chemistry with innovative construction techniques, OPTIMA Batteries, Inc. has developed what they call a "SprialCell" design. It is a sealed, maintenance-free battery with outstanding performance characteristics.

The OPTIMA Battery Co., once a division of Gates Rubber Co. of Denver, Colorado, invested twenty years of research and development into these batteries, resulting in the issuance of 20 patents to OPTIMA Batteries, Inc.

OPTIMA BATTERIES

First a little history about OPTIMA Batteries, Inc., then we will compare an OPTIMA battery to a conventional automotive batter and identify the similarities and differences.

In 1973, Gates Rubber Co. of Denver, Colorado, the same company known for the manufacture of automotive belts and hoses, develops a spiral cell battery design to be used for batteries that power portable power tools and small appliances. The



The OPTIMA SpiralCell.

batteries are a big success.

In 1984, after 10 years of production of the single spiral cell design batteries, a project team is established by Gates to look into apply the SprialCell technology to automotive-type batteries.

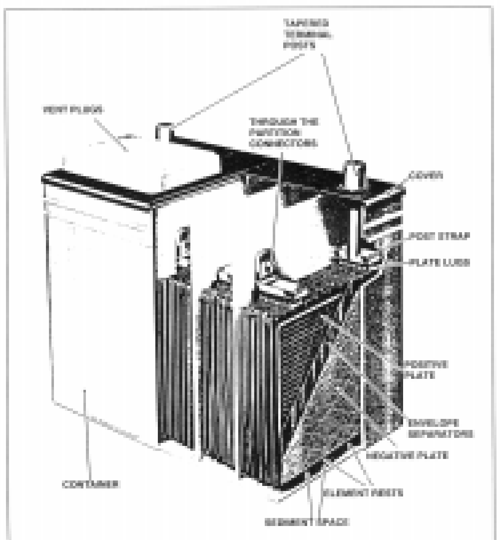
In 1987, limited production begins of a new type of automotive battery. Although further testing is still going on, the SprialCell technology has successfully been incorporated for use in an automotive-type battery.

In 1990, the project is declared a success and Gates incorporates the new division as OPTIMA Batteries, Inc.

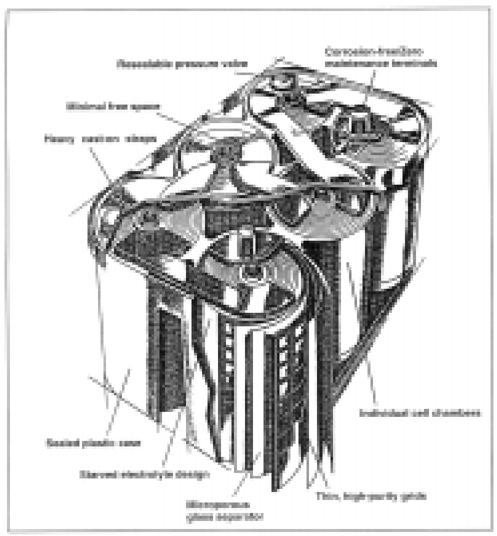
In 1992, The Gylling Group of Scandinavia, one of the largest importers of the new OPTIMA battery, purchases the company from the Gates Rubber Co.

In 1993, public demand rapidly increases for the new OPTIMA battery. Ground is broken for a new modern OPTIMA Battery manufacturing plant in Denver, Colorado, to meet the growing demands for the new battery.

To have 20 patents issued during the development of a battery, a product that has remained unchanged for 75 plus years is quite unusual. Let's take a look at a new OPTIMA battery and compare it to a regular automotive battery.



Conventional Flat Plate Battery.



OPTIMA SpiralCell Battery Design.

OPTIMA VERSUS CONVENTIONAL BATTERIES

Plate/Grid Construction-OPTIMA

Pure lead plates are used to make grid for the cells of the OPTIMA battery. Two long bands of grid are wound into a tight spiral configuration, and then pressure-inserted into an individual cylinder within the case. This design provides the mechanical strength for the cell, eliminating the need for alloys in the lead.

Using lead without alloys extends the life of the OPTIMA battery by reducing grid corrosion. Alloys added to the grid of conventional flat plate batteries accelerate corrosion of the plates and, ultimately, shorten the life of the battery. Heat will further accelerate corrosion of the alloys in conventional batteries. The OPTIMA, however, with pure lead grid, will resist corrosion and last longer in high temperature environments.

The use of pure lead also enhances the electrical conductivity in the cell, contributing to the low internal resistance of the OPTIMA. This low resistance allows the OPTIMA to deliver high amounts of power quickly to meet the demands of vehicle electrical systems and on-board electronic components.

Another advantage of the pure lead used in the OPTIMA is a low self-discharge rate. The alloys in conventional batteries act to chemically accelerate the reaction between the active material and the grid, causing a loss of electrical charge.

Also, when a conventional battery is stored for a long period of time without recharging, corrosion of the alloys in the grid accelerates. This corrosion forms a boundary layer of nonconductive material between the active lead paste and the grid. This results in a loss of capacity in the battery.

Plate/Grid Construction-Conventional Battery Design

In conventional batteries, a series of flat grids are used in each cell. To improve strength and stiffness (needed for manufacturing, handling, and operation) flat grids have additional material added, such as antimony and calcium. These alloys in the lead increase corrosion, self-discharge, internal resistance, and promote shedding of the active material (lead paste applied to grid). Additional alloys such as tin, cadmium, and selenium are added to counteract these effects.

When a conventional battery is used in extreme high temperature condition, corrosion of the grid is accelerated. When the grid of a conventional battery corrodes it loses conductivity. The corroded grid also begins to shed the active material (lead paste) more rapidly. This reduction in conductivity and loss of active material results in a loss of power in the battery. This power loss is not immediately apparent but becomes noticeable when demand is highest on a battery, such as starting a car in very cold weather. The loss of active material also shortens the lifespan of the battery. While conventional batteries are adversely affected by heat, the effects of heat on a pure lead OPTIMA battery are minimal.

Use of alloys in the grid causes trade-offs in terms of performance versus construction benefits. For example, antimony improves castability and paste adherence, but it lowers electrical conductivity and increases the rate of self-discharge.

Cell Design-OPTIMA

Individual cells of the OPTIMA contain only two plates, one positive and one negative. These thin pure lead plates are wound into a tight spiral, separated by an absorbent glass material. The separator is very thin, allowing for very close plate spacing. The close proximity of the plates enhances the flow of current and lowers the internal resistance. The porous separator material retains the electrolyte like a sponge, preventing the active material on the plates from drying out.

The tightly wound spiral provides the lead plate with mechanical strength to enable the use of a very thin pure lead grid. Using thinner plates allows more winds in the spiral. This increases the amount of surface area in the cell, which in turn increases the amount of power, which can be generated from a battery. The plate surface area of an OPTIMA cell is much larger than a similar size conventional battery.

After the cell is wound, it is pressure-inserted into an individual chamber with a tight interference fit. This design increases the structural strength of the cell and retains all of the active material on the grid, preventing it from falling off or shedding from the grid.

Since the OPTIMA does not shed active material, it does not need extra space between the plates and below the cell as required in a conventional battery. The OPTIMA can take advantage of all of the available space inside the case to maximize the plate size and increase the power of the battery.

Another feature of the tightly wound cell is its resistance to vibration. There is no free space between the plates and separator material. This prevents movement of the plates, which causes plate-to-plate shorting, and shedding of active material.

Cell Design-Conventional Battery Design

The cell of a conventional battery contains several plates connected together and suspended in a pool of electrolyte. Alloys are added to the lead grid to increase its strength and stiffness. Stiffness and strength are required for the plates to retain the active material during operation and to make the plates easier to work with during manufacturing.

While the alloys do add strength to the grid, they also contribute to corrosion, higher internal resistance, and shedding of active grid material.

Sufficient space between the plates in the cell is required for shedding of the active material to prevent electrical shorts. This material falls from the plates and accumulates at the bottom of the case.

This spacing requirement results in a battery that is larger in size, with a lower energy density (energy per pound) and a higher internal resistance then the OPTIMA.

For the cells to remain operational they must not dry out. The electrolyte must always completely cover the grids in the cell. For this reason, the electrolyte in the conventional battery is filled well above the top of the cell.

The flat, suspended grids do not have sufficient means to retain the active lead material throughout the life of the battery. When a conventional battery is used in harsh conditions such as high temperatures or high vibration, shedding of the active material increases. This leads to premature battery failure. Typically, the battery fails due to loss of active material or plate-to-plate shorting.

Electrolyte-OPTIMA

The OPTIMA battery is designed as an absorbed electrolyte, recombinant battery. All of the electrolyte is absorbed (like a sponge) within the separator material between the plates in the SpiralCell.

The electrolyte consumes approximately 95% of the voids in the separator material. The remaining 5% is left as open space, for gas passages. Unlike a conventional battery, gas does not collect above the cell in an OPTIMA to create an explosion hazard. During the charging procedure, oxygen is emitted by the positive plate and hydrogen is emitted by the negative plate. Thee two gases combine to form water, which then recombines back into the electrolyte solution. A result of this absorbed recombinant system is that the battery can be totally sealed. Since the electrolyte is contained in the separator, it does not leak, even if the case is rupture or broken in an accident.

Since the electrolyte cannot escape via leakage or gassing, the plates will not dry out and cause loss of capacity.

The OPTIMA never needs water and does not gas. Therefore, it can be mounted anywhere in the vehicle. However, good engineering practices make it appropriate to not install the OPTIMA in an airtight space, but to provide some means of ventilation in the event that the vehicle’s charging system fails, causing an abusive overcharge. This overcharge could cause the internal safety valves to release some of the pressure within the battery case, resulting in the escape of some of the gas (primarily oxygen and hydrogen).

Another benefit of the sealed, no-gassing design is the elimination of corrosion to battery cables, connectors, and vehicle components.

Electrolyte-Conventional Battery Design

A conventional battery is described as a flooded system. Flooded means that there is an excess of electrolyte in the battery above the level of the plates. This excess electrolyte is required to prevent the plates from drying out (causing sulfation of the active material and leading to a failure of the sulfated part of the plate, which reduces the capacity of the battery).

Unlike the OPTIMA, which recombines the gases back into the electrolyte, gases in a conventional battery collect in the free space above the plates; these gases are ultimately vented out of the battery. When a battery is overcharged, gassing increases. The gas being vented (hydrogen and oxygen) is very combustible. If it is ignited by a flame or spark, it can lead to a rapid combustion of the gases. The result is a battery explosion, which can be extremely hazardous.

A portion of the gas, which is vented causes corrosion to the battery cables and connectors. This corrosion is often noticeable by the appearance of a white powder or blue fuzz on the terminals.

The conventional battery case must allow for venting of gases. These vents also provide passages for the electrolyte to escape if the battery is tipped over or tilted. If the battery case of a conventional battery is cracked or ruptured, the acid within the battery will escape. Loss of the acid will cause the conventional battery to fail. The escaped acid also poses a risk to people, equipment, and the environment.

Spiral Cell Design:

Function	Benefit
Great plate surface area	-Increases starting power (CCA-cold cranking amps) -Faster Recharging
Stronger mechanical design	-Withstands vibration, increasing life. -Eliminates shedding of active material -Reduces internal shorting
Pure lead grid	-Reduces corrosion for longer life -Lower internal resistance, which increases conductivity for more starting power and quicker recharging
Thinner plates/grid	-Higher CCA, for better starting -Faster recharging
Closer, consistent plate spacing	-More effective chemical reaction, proving increased starting power -Faster recharging
Reduced battery size	-Higher power-to-weight ratio. -Produces power equivalent to conventional batteries several times its size -Allows it to fit in more vehicles.

ADDITIONAL FEATURES AND BENEFITS

Unique to OPTIMA batteries is the 72-month warranty and a two-year Free replacement warranty. They can be shipped by UPS or other carriers (including the airlines) without a hazmat (hazardous materials) permit required.

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