# DELCO-REMY

# ELECTRICAL EQUIPMENT

OPERATION AND MAINTENANCE HANDBOOK

## DR-324

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DELCO-REMY DIVISION, GENERAL MOTORS CORPORATION, ANDERSON, INDIANA, U. S. A.

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# CONSTRUCTION, OPERATION, CARE AND MAINTENANCE OF

# DELCO BATTERIES

The lead-acid storage battery used on automotive applications is an electrochemical device for converting chemical energy into electrical energy. Active materials within the battery react chemically to produce a flow of direct current whenever an electrical device is connected to the battery terminal posts. The amount of electrical power the battery can produce is limited by the amount of active materials within the battery. When these substances have, in effect, been "used up," the battery is discharged. It can be recharged by being supplied with an opposite flow of direct current from an external source. This reverses the discharge reaction and restores the materials to active condition.

## FUNCTION OF BATTERY

On the automotive vehicle the battery has three major functions:

(1) It provides a source of current for starting the engine.

(2) It acts as a stabilizer to the voltage in the electrical system.

(3) It can for a limited time furnish current when the electrical demands of the vehicle exceed the output of the generator.

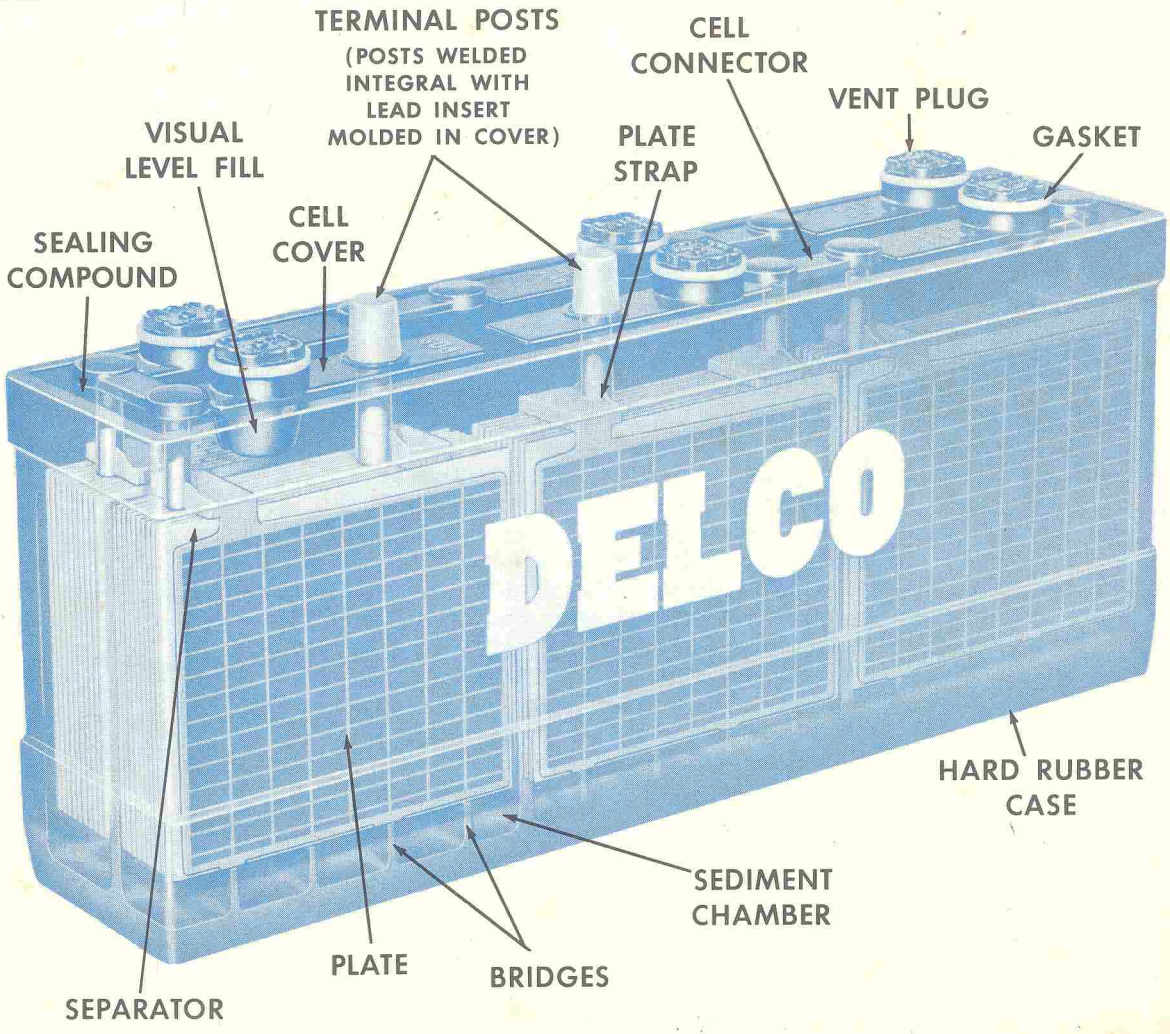


**Figure 1—Phantom view of 12-volt battery showing the internal construction.**



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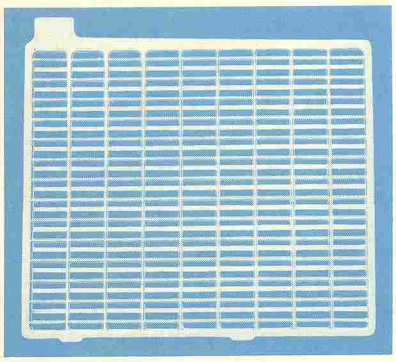

Figure 2—Battery plate grid.

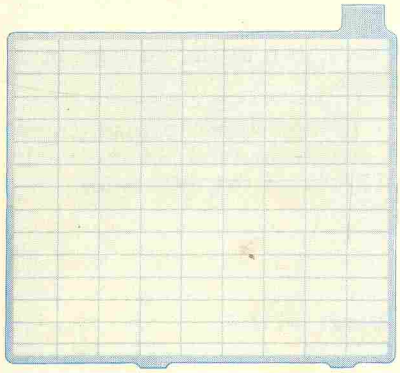

Figure 3—Battery plate.

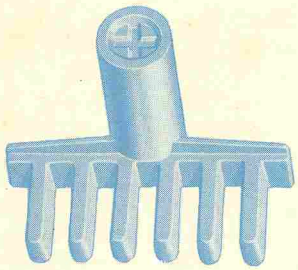

Figure 4—Battery plate strap.

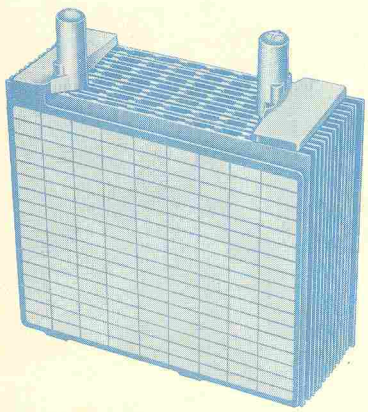

Figure 5—Battery element.

In order for the battery to continue to function it is necessary that current withdrawal from the battery be balanced by current input from an external source, such as a generator, so that the battery is maintained in a charged condition. If the outgo exceeds the input, the battery will become discharged so that it can no longer supply current.

## BATTERY CONSTRUCTION

Figure 1 illustrates a battery in phantom view so that the internal construction can be seen. In the 6-volt automotive battery there are three compartments or cells and in the 12-volt six cells. Each cell supplies approximately 2 volts. The cells are connected in series so that voltages add to provide a total of 6 or 12 volts (depending on the number of cells) at the battery terminal posts.

Each cell contains an "element" composed of negative plates, positive plates, separators (one on each side of each positive plate) and two plate straps. One strap connects all negative plates together and the other connects all positive plates. Plates are made by applying special lead oxide pastes to rectangular lattice-like grids (Fig. 2). The grids are cast from an alloy of lead and antimony and have a heavy outside border. Inside the border is a network of vertical and horizontal wires. These are spaced so as to lock the lead oxide pastes in place. The grid has the important additional function of distributing current uniformly over the plate during both charge and discharge. The pastes, after processing, are converted to active materials in the completed battery. A typical plate is shown in Figure 3.

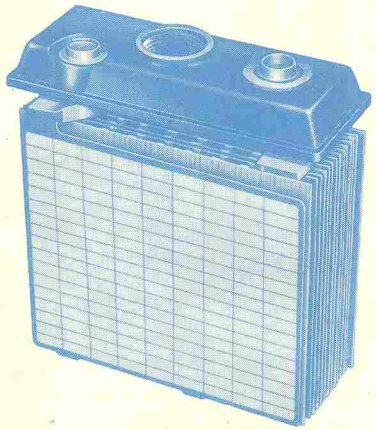

Figure 6—Battery element with cell cover in place.

To construct an element, automatic machines first gather or stack the proper number of positive plates, negative plates and separators in the proper order. After stacking, plate straps (Fig. 4) are added and welded into place to complete the element (Fig. 5). A cover is then placed on the element (Fig. 6) and the element placed in the proper compartment in the battery case. When all elements have been assembled into a case, the cells are connected in series by means of cell connector straps (Fig. 7) The covers are then sealed into place with acidproof sealing compound to provide a leakproof joint. The battery case is molded of hard rubber and contains a given number of cell compartments which are separated by heavy partitions. In the bottom of each, there are raised sections or "bridges" which support the battery elements and also provide chambers into which sediment can drop.

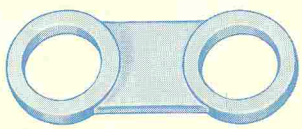

Figure 7—Connector strap.

After the covers are sealed in place, electrolyte (a solution of sulfuric acid in water) is added to each cell until filled to the proper level. The

battery plates are then "formed" by a flow of direct current which converts the lead oxide paste in the positive plates into lead peroxide ($PbO_2$) which is chocolate brown in color, and the lead oxide paste in the negative plates into sponge lead (Pb) which is gray in color. At the end of the formation process the electrolyte is dumped and a fresh solution added. The battery is now fully charged and for most models the specific gravity of the electrolyte is 1.270 plus or minus .010 at 80 F.

## VISUAL LEVEL FILL

All Delco batteries have cell covers with the "visual level fill" feature (Fig. 8). Guesswork is thus eliminated in filling the battery to the proper level, as it is simply filled to the point indicated by the device (Fig. 9).

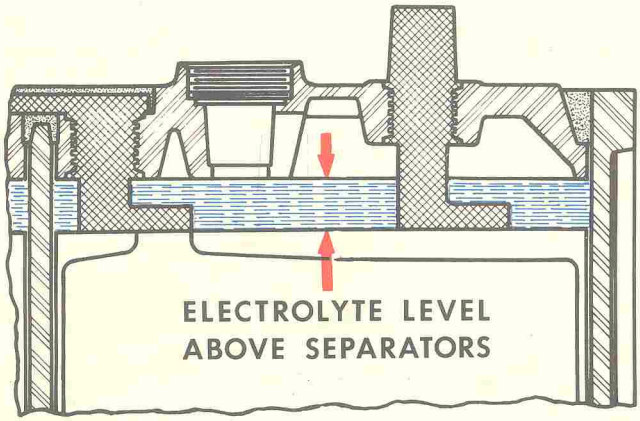


**Figure 8—Top of battery cell and cover cut away to show construction of "visual level fill" cell cover and electrolyte depth above separators.**

The "visual level" cell covers are molded with a long, circular, tapered vent well which extends below the upper inside surface of the cover to a

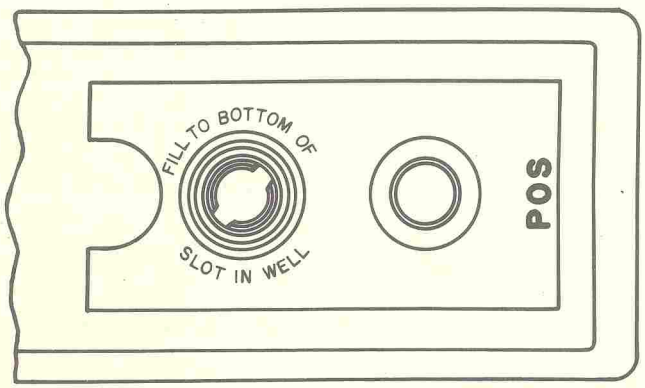


**Figure 9—Top view of Delco "visual level fill" cell cover showing slotted vent well.**

point even with or below the lower edge of the cover. A narrow vertical opening or slot is molded in the side wall of the vent well, extending from a point slightly below the upper inside surface of the cover to the end of the well. This slot serves as a vent for gas accumulating above the electrolyte level and helps to prevent electrolyte from being pushed out when the battery has been slightly overfilled. Viewed from above through the vent opening, the lower end of the vent well presents the appearance of a ring with a portion of the circumference missing (split ring). The lower end of the vent well in these covers serves as the reference point in determining the proper level of electrolyte. As water is added to the cell, the surface of the rising liquid contacts the slotted lower end of the vent well causing a distortion of the reflecting surface which is readily observable. If some overfilling occurs, the amount can be estimated quickly by the height of the liquid in the vent well itself. In the same way, a glance will disclose whether or not a cell requires the addition of water after a period of service.

It should be kept in mind that the "visual level fill" cannot prevent overfilling but is rather an aid to proper servicing. Overfilling should be avoided at all times since it contributes to premature battery failure by causing loss of electrolyte. Loss of electrolyte not only results in poor performance of the battery itself but also causes excessive corrosion of cables, connections, and other equipment.

## BATTERY SAFETY PRECAUTIONS

Several hazards exist in connection with battery service work. These should be kept in mind at all times and the following precautions observed:

1. Do not smoke near batteries which are on charge or which have been very recently charged. Do not break live circuits at the terminals of batteries on charge. (When batteries are charging an explosive gas mixture forms beneath the cover of each cell. Part of this gas escapes through the holes in the vent plugs and forms an explosive mixture around the battery itself. Sparks or flame can ignite this gas and cause an internal explosion which may shatter the battery (Fig. 10). A battery may carry an explosive mixture for several hours after completion of charge.)

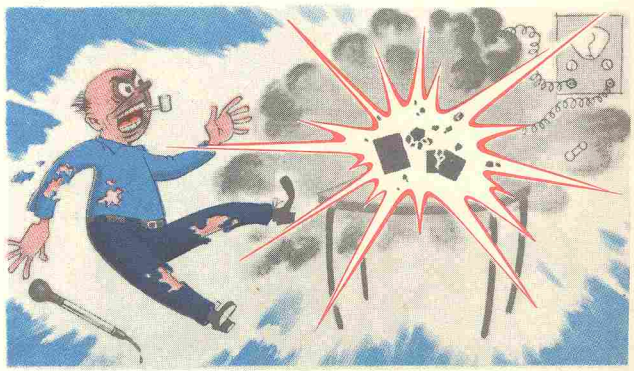

**Figure 10—Explosive gases are formed when a battery is charged. Sparks or flame near the battery may ignite these gases causing a dangerous explosion.**

2. Always remove vent caps and blow across vents (or use gentle air blast from filler syringe) to remove explosive gases before working with a freshly charged battery. If a torch is used near a battery, place a wet cloth over the open vent holes after blowing out gases.

3. Be sure patented filler devices or valves are working and in proper position before charging any battery.

4. Always wear safety glasses while testing batteries to protect the eyes from sulfuric acid spray or splash.

5. When installing a battery in a vehicle, connect the "grounded" lead last. This helps to prevent accidental short circuits caused by tools striking metal surfaces.

## BATTERY OPERATION

Figures 11 and 12 illustrate diagrammatically the chemical activities within the battery during discharge and charge. When the battery is in a fully charged condition, the positive plates contain essentially pure lead peroxide ($PbO_2$) which is chocolate brown in color and the negative plates contain essentially pure sponge lead which is gray in color. The electrolyte consists of a solution of sulfuric acid ($H_2SO_4$) in water; the specific gravity of the solution is approximately 1.270 at 80 F.

During discharge, as when the battery is connected to an electrical load, the active materials in the positive and negative plates ($PbO_2$ and Pb) react chemically with the sulfuric acid ($H_2SO_4$) as shown in Figure 11. In the reaction some sulfate ($SO_4$) from the acid enters the positive plate and replaces the oxygen ($O_2$) while other sulfate ($SO_4$) also combines with the sponge lead in the negative plate. The displaced oxygen leaves the positive plate and combines with the hydrogen ($H_2$) from the acid to form water ($H_2O$). Thus, in both plates, lead sulfate ($PbSO_4$) is formed while the sulfuric acid in the electrolyte is replaced with water ($H_2O$).

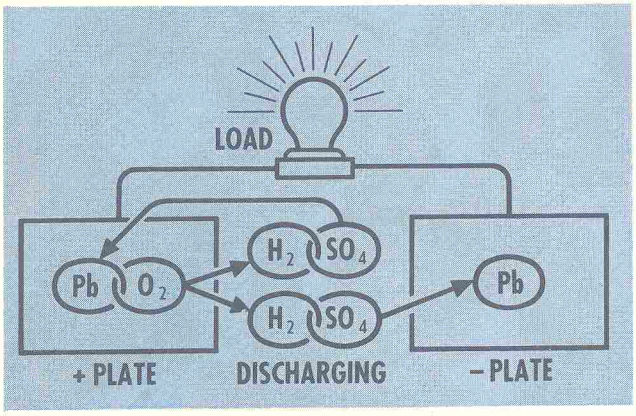


Figure 11—Chemical actions in battery during discharge.

As the discharge continues, more and more of the sulfuric acid combines in this manner with the materials in the positive and negative plates. Finally, most of the active materials will have been converted into lead sulfate while most of the sulfuric acid will have been used up in the discharging process. The battery is then said to be discharged and cannot deliver any appreciable additional current. It must be recharged by being supplied with a flow of direct current from some external source before it can function again.

During the charging process (Fig. 12), the chemical actions are reversed. The sulfate leaves both the negative and positive plates to recombine with the hydrogen in the water. The oxygen displaced by this process re-enters the positive plate where it combines with the lead to form, once again, lead peroxide ($PbO_2$). The material in the negative plate again becomes spongy metallic lead.

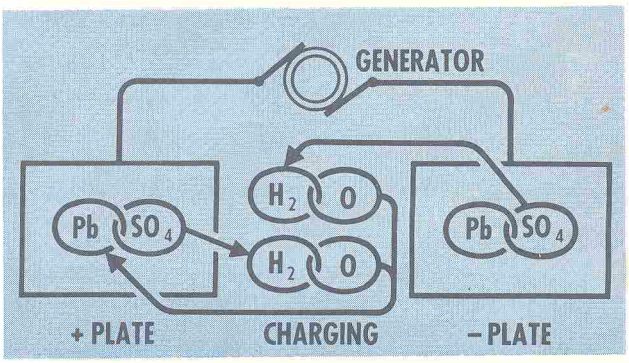


Figure 12—Chemical actions in battery during charge.

## BATTERY RATINGS

The amount of current that a battery can deliver (or the battery capacity) depends upon the total area and weight of active plate material and the quantity and strength of the electrolyte. Factors that influence battery capacity include the number of plates per cell, size and thickness of plates, cell size and quantity of electrolyte. The four specifications most commonly used in referring to battery performance are the 20-hour rating, the 15 or 25-ampere rating, the cold rating of 150 or 300 amperes, and the 5-second voltage rating.

1. The 20-hour rating represents the lasting power of a battery connected to a small electrical load. This rating is based on the following test conditions:

   a) A constant current output for 20 hours.

   b) A final limiting voltage of 1.75 volts per cell.

   c) A starting battery temperature of 80 F.

Bạn đang có trong tay thông tin cơ bản của một trong số những tài liệu có hàm lượng chất xám cao, với những thông tin vô cùng hữu ích cho quá trình học tập và nghiên cứu của bản thân bạn !

Bạn đã và đang trải qua những ưu tư, trăn trở của bản thân mình trước biển kiến thức mênh mông vô hạn và đang tìm hướng đi cho riêng mình bằng việc biến kiến thức thành tài sản tri thức của riêng bạn !

***Hãy để Thư viện trường Đại học Sư phạm Kỹ thuật Tp. HCM chia sẻ những khó khăn và trăn trở đó cùng bạn!***

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THƯ VIỆN

***Cùng với bạn, Thư viện ĐH Sư phạm Kỹ thuật Tp. HCM mong ước góp phần duy trì và phát triển văn hóa đọc !***

THƯ VIỆN

**Hãy đến với chúng tôi - Thư viện trường Đại học Sư phạm Kỹ thuật Tp. HCM** để cảm nhận, trải nghiệm và biến ước mơ khoa học của bạn thành hiện thực !

Hân hạnh được đón tiếp và phục vụ bạn tại
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***Thông tin tài trợ!***

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