

DESIGN AND CONSTRUCTION
ENCLOSED-TYPE, LEAD-ACID BATTERIES

1. GENERAL

1.01 This section describes the design and construction of the lead-acid storage batteries of the enclosed type used in telephone and telegraph power plants. Additional educational information covering the theory of operation of cells of this type is covered in Section A801.002.

1.02 This section is reissued to bring it up to date generally.

2. CONSTRUCTION

2.01 A storage cell includes the active material in a suitable container, with necessary accessories and arranged for connection to charge and discharge circuits. Details of construction and principal accessories are described below. The capacity of a cell, in amperes, depends primarily on the size and number of plates in parallel. The voltage of a battery depends on the number of cells in series.

2.02 The active materials of a storage cell are the electrolyte and the materials of the plates which react chemically to produce electric energy when the cell discharges and which are restored to their original composition, in the charged condition, by oxidation and reduction processes produced by the charging current.

2.03 A grid is a metallic framework employed in a storage cell for supporting the active materials of the plate and conducting the electric current. The grids are of lead-antimony or lead-calcium alloy. The ribs of the grid are usually horizontal and vertical, see Fig. 1, but may be at an angle, see Fig. 4.

2.04 A positive plate consists of the grid and active material from which current flows to the external circuit when the cell is discharging. Designations such as + or POS appear on or near the terminal associated with the positive plates and in addition, the positive terminal is often marked with red. The original paste of the positive plate is lead oxide (red lead). After it has dried and hardened, the plates are immersed in dilute sulphuric acid solution and given the factory charge. During this charge, the lead oxide is converted to lead dioxide which is dark brown in color.

2.05 A negative plate consists of the grid and active material to which current flows from the external circuit when the

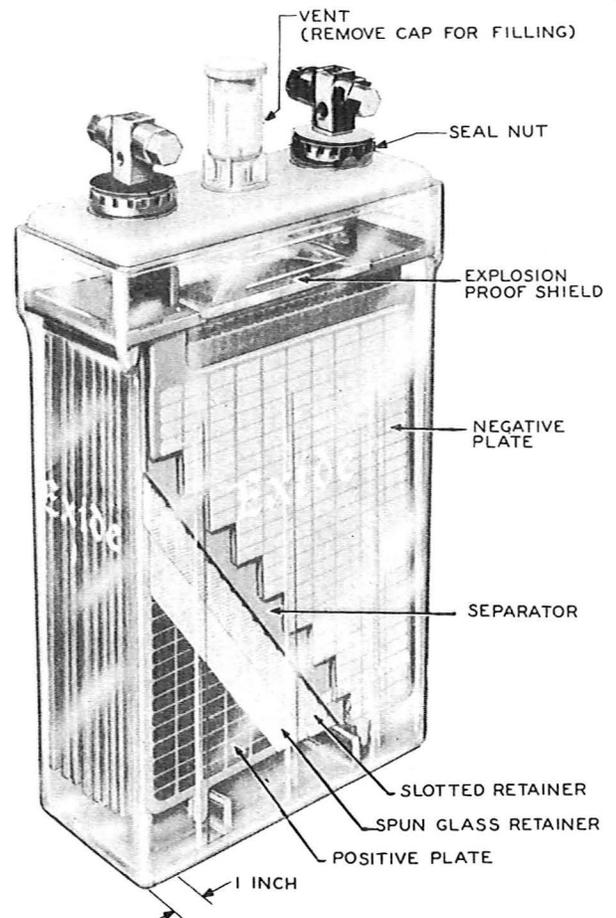


Fig. 1 - 240-ampere-hour Cell
With Slotted Retainers

cell is discharging. The terminal associated with the negative plates is usually unmarked but sometimes carries a designation such as - or NEG. The original paste of the negative plate is lead oxide (yellow lead or litharge). It is reduced during the factory charge to sponge lead which is light gray in color.

2.06 A strap is a casting to which a plate or group of plates are burned. The terminal post of this part is the point to which electrical connection is made to the external circuit. For terminal markings, see 2.04 and 2.05. See Fig. 4.

2.07 A group is an assembly of plates of the same polarity, burned to connecting strap. See Fig. 4.

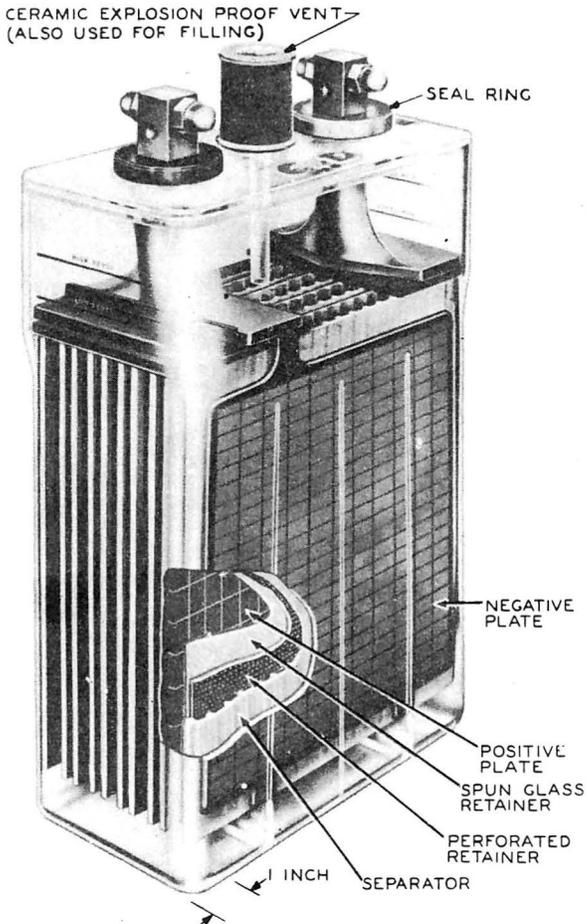


Fig. 2 - 240-ampere-hour Cell With Perforated Retainers

2.08 A separator is a spacer employed to prevent metallic contact between plates of opposite polarity within the cell. See Figs. 1 and 2. Separators are of wood, microporous rubber, or plastic.

2.09 A retainer is a perforated or slotted sheet of hard rubber, a slotted sheet of plastic, a sheet of matted fine glass fibers, or similar material held in intimate contact with the surface of the pasted positive plate to prevent the loss of active material on cycle operation. Its principal function on batteries in full-float service is to prevent oxidation of the separator material. See Figs. 1 and 2.

2.10 A separator protector (see Fig. 8) is a perforated or porous sheet, sometimes located below the vent well, to shield and prevent possible damage to the separators by a hydrometer syringe or thermometer.

2.11 An element consists of the positive and negative groups with separators or separators and retainers assembled for one cell. In the multiplate cells, the number of

negative plates usually exceeds the number of positive plates by one so that the extreme end plates are negative plates. This is done so that both sides of each positive plate may be faced by a negative plate surface which contributes toward even working of the positive plate so it will not buckle.

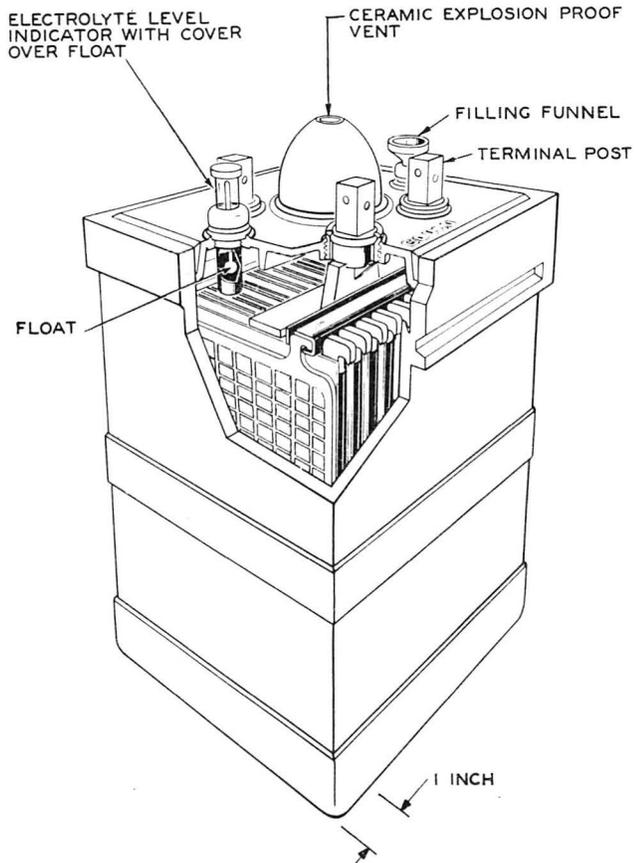


Fig. 3 - 1680-ampere-hour Cell Rubber Container

2.12 The electrolyte is an aqueous solution of sulfuric acid.

2.13 A jar is a glass, rubber, plastic, or composition container for the element and electrolyte of a single cell. The present trend is toward plastic.

2.14 A case is a multicompartiment container for the elements and electrolyte of two or more cells. See Figs. 7 to 9.

2.15 A tank is a lead-lined wooden container for the element and electrolyte. The term "tank" has also been used in the past for large floor-mounted jars (see Fig. 6), but this practice is being discontinued to agree with terminology now used in the battery industry.

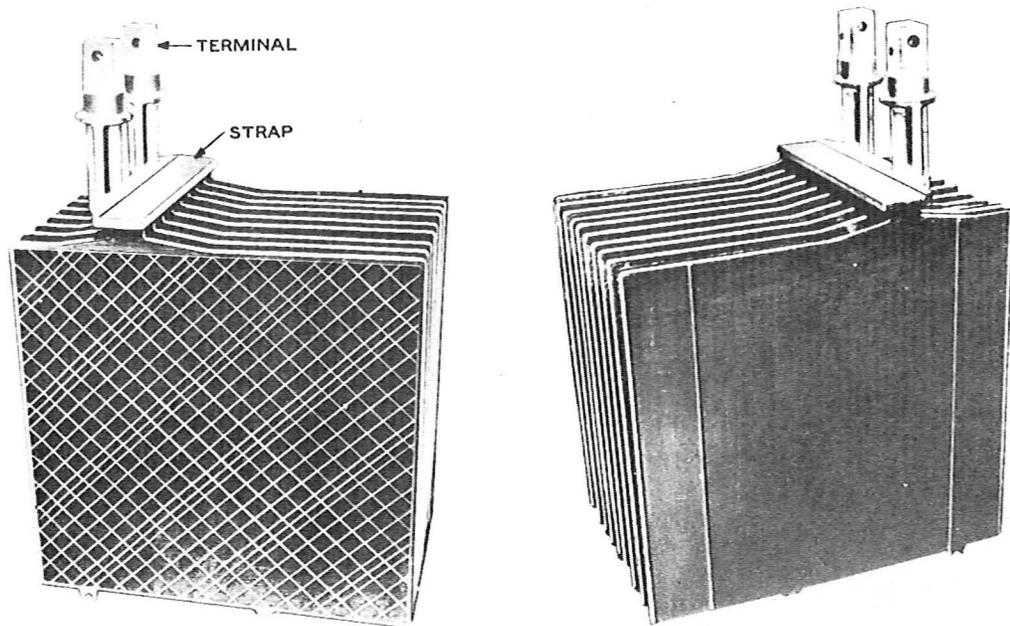


Fig. 4 - Groups of Plates

2.16 A tray is a support or holder for one or more cells. See Fig. 5. In the past, trays have sometimes been called "crates" or "cases." The term "tray" has also been applied in the past to the rubber or lead pan set under a glass jar battery, particularly in rented quarters.

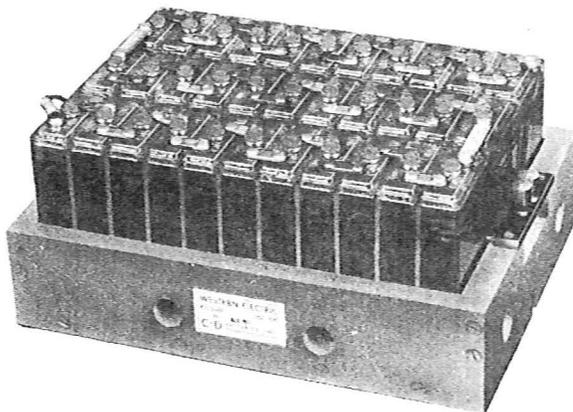


Fig. 5 - Tray of Four Ampere-hour Cells

2.17 Terminals are the parts of a battery to which the external circuit is connected. They are frequently called "terminal posts." See 2.06 and Figs. 3 and 4.

2.18 A terminal connector is the electric conductor for carrying current between the battery terminal and a second terminal to which the external circuit is connected. Its use is on cells whose terminals are not

of desired size or location for convenient connection to the external circuit direct or where more than one external lead is to be connected to the same post.

2.19 A cell connector is an electric conductor used for carrying current between cells.

2.20 Explosion-proof cover design is usually employed with larger cells. For smaller cells, see 3.05. Explosion-proof covers now being furnished are of the following types.

(a) One is a shield, Fig. 1, located over the top of the plates but below the electrolyte level, which clears the sides of the jar by only a small amount to permit electrolyte to flow past the edges. The lower face of the shield is slightly concave with an opening at the center. The vent tube extends down to the opening in the top of the shield. The gas rising from the plates comes in contact with the concave surfaces, flows toward the center and out through the vent tube. The maximum gas accumulation is limited, therefore, to the space within the tube between the top of the electrolyte and the top of the tube. The space between the top of the shield and the cover is vented through a clearance space between the filling tube and the cover. Very little gas can enter this space as the shield is quite efficient.

(b) Another is a porous ceramic dome, see Figs. 6 and 8, mounted on top of the cover. It permits the gas to escape from the cell but prevents the possibility of a flash back into the cell. This is entirely separate from the filling tube which extends below the electrolyte level.

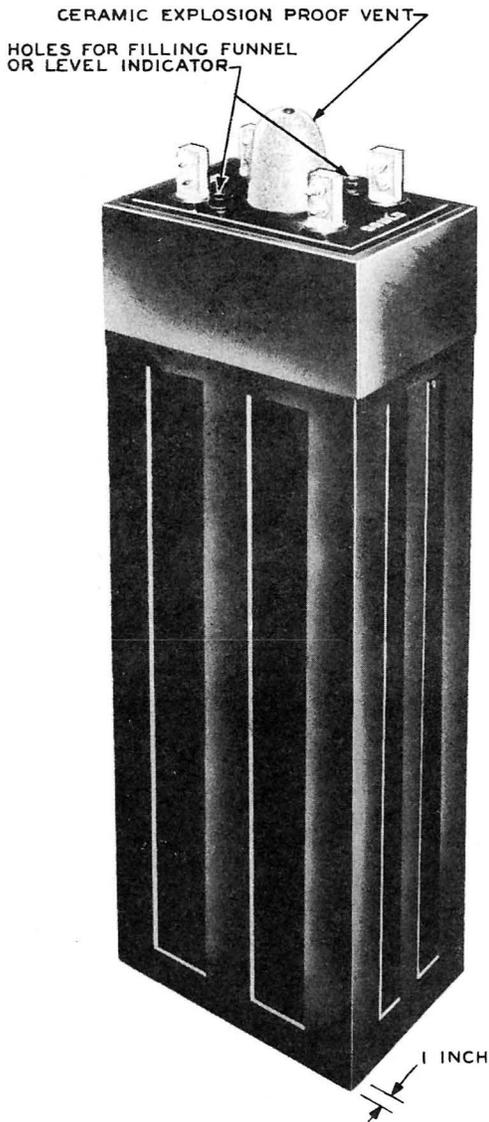


Fig. 6 - 5000-ampere-hour, Floor-mounted Cell

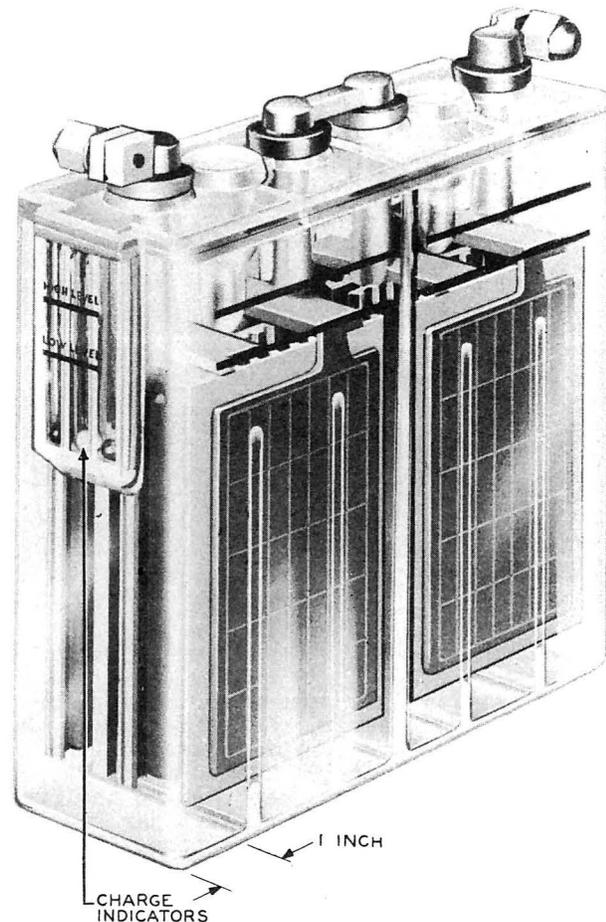


Fig. 7 - 15-ampere-hour, 2-cell Case

3. ACCESSORIES

3.01 A hydrometer is an instrument for measuring the specific gravity of the electrolyte. The syringe type used with enclosed cells consists of a glass float properly weighted and provided with a scale graduated in terms of specific gravity. This is enclosed in a syringe, consisting of a plastic or glass tube with rubber bulb at one end and a tip at the other, arranged so that electrolyte can be drawn out of the cell into the tube to float the hydrometer. Hydrometer holders mounting on wall or framework are available.

3.02 The nonfloating thermometer is graduated in degrees Fahrenheit and may be inserted through a filling hole in the cover of an enclosed cell for indicating the electrolyte temperature. Most nonfloating thermometers also have a scale indicating the correction to be made in the observed hydrometer reading to correct it to the established

2.21 Charge indicators are furnished on some smaller cells. They have wax balls of selected specific gravity so that whether one or all of the balls are floating gives a rough check of the specific gravity of the electrolyte. See Figs. 7 and 8. For accurate check of specific gravity, a hydrometer is used. See 3.01.

base temperature. The older thick barrel thermometers are being replaced by a new thin barrel, laboratory-type thermometer which is expected to be less prone to breakage.

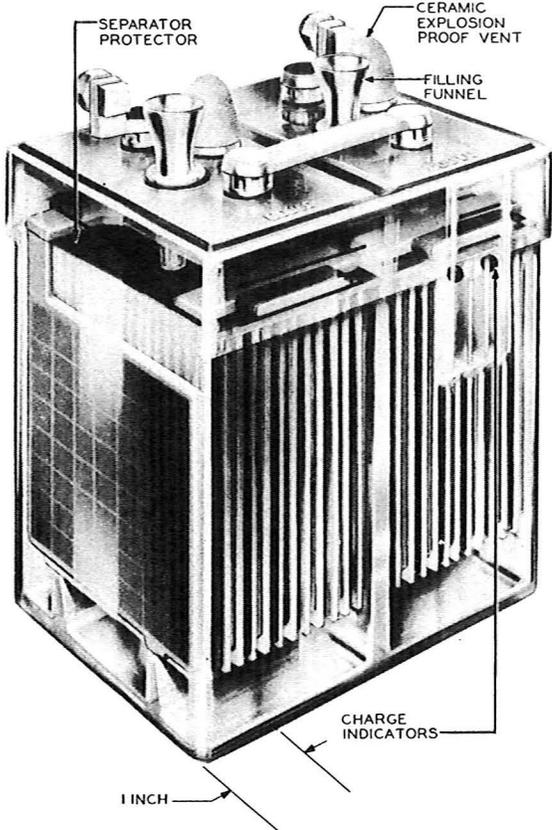


Fig. 8 - 50-ampere-hour, 2-cell Case

3.03 Electrolyte level indicators are provided in cells when the level cannot be observed through the container such as rubber or porcelain jars. The indicator float extends through a hole in the cover. The stem of the indicator is colored part way so that a change in color indicates the electrolyte is at the maximum level as soon as it appears. The minimum level occurs when the top of the stem is flush or level with the top of the hole in the cover. Some of the older indicator stems were enclosed in a glass tube above the cover as in Fig. 3. In this case, a line on the stem of the indicator is used in connection with two lines on the covering tube to determine the maximum and minimum level of the electrolyte.

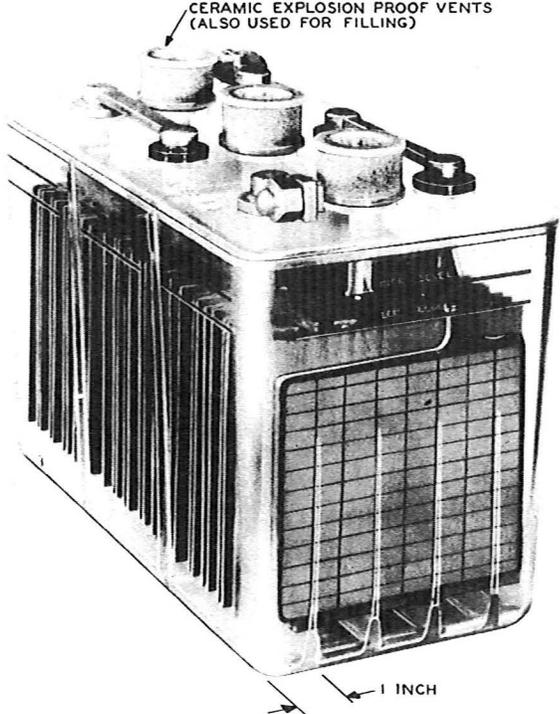


Fig. 9 - 50-ampere-hour, 3-cell Case

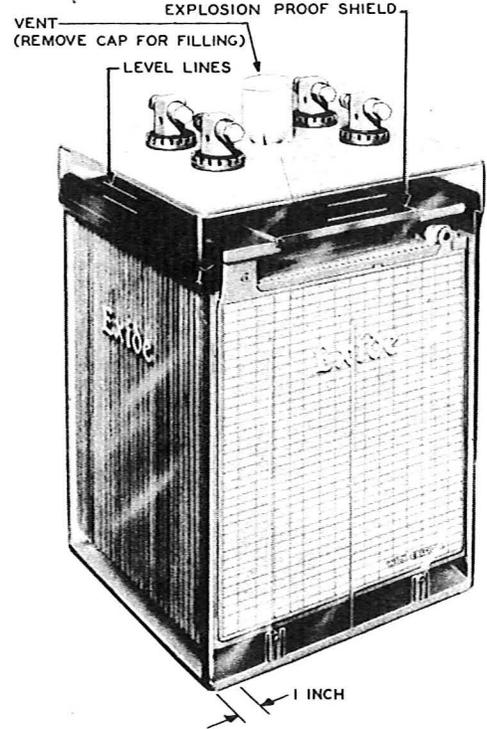


Fig. 10 - 1680-ampere-hour Cell-Plastic Container

3.04 A syringe-type cell filler is used to fill smaller cells, particularly where clearances make other methods of filling awkward. Older fillers had a hole in the snout to assist in obtaining an exact level, but this is no longer considered necessary.

3.05 Vent plugs vary from a simple plug with breather hole, such as used on most

automobile batteries, to explosion-proof vents such as shown in Figs. 2 and 9. Some of the smaller cells have no vent plugs.

3.06 A filler funnel, separate from the vent, is furnished on some cells. See Figs. 3 and 8.