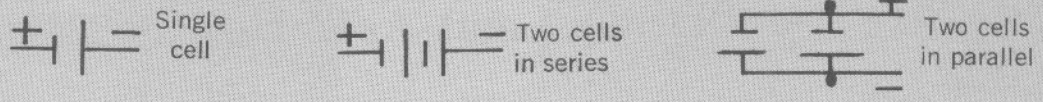
Communication & Signal Section, AAR
COMMITTEE G: Education & Training

Signal Training Bulletin

B-1 Primary Battery Carbon Cell

Approved October 1973

Symbol: 

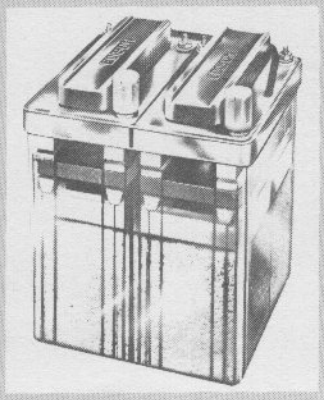


Figure 1

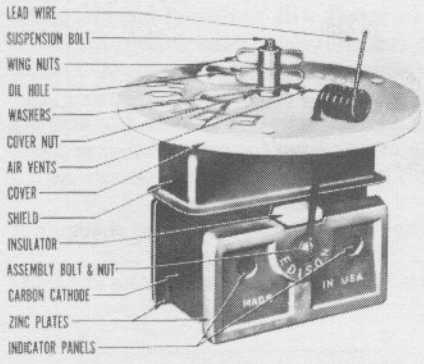


Figure 2(a)

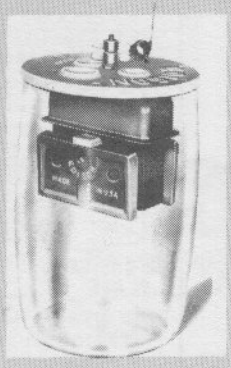


Figure 2(b)

Definition: (a) Primary Battery: A device for the direct transformation of chemical energy into electrical energy.

(b) Electrolyte: The fluid surrounding the elements of the battery.

Description: The carbon cell consists of one carbon electrode and two zinc plates in a solution of caustic potash (potassium hydroxide). There are two basic types of carbon cells, renewable and non-renewable. The non-renewable carbon battery consists of one or more cells sealed in a molded case and is activated by the addition of the prescribed amount of water. See Figure 1.

The renewable carbon cell consists of an element of two zinc plates and one carbon block, glass container, electrolyte and porcelain cover with air vents. See Figures 2(a) and 2(b).

Note: The last U.S. manufacturer of the renewable carbon cell battery will discontinue production of this battery as of August 1, 1974. Although this line of batteries will be discontinued, some railroads will continue to put renewable carbon cell batteries in service until existing stocks are exhausted.

Purpose and Application: A primary battery is used as a power source to supply direct current for railway signal system circuits and appliances.

It can be used as a source of energy for track circuits, signals and highway crossing protection, particularly at remote locations where an ac charging source of power is not available.

General Information: (a) The carbon cell gives best results where plenty of fresh air is available. When battery housings are provided, a slight amount of ventilation is necessary to permit air circulation and to dissipate dampness. It is important that carbon elements be kept dry.

(b) Primary batteries cannot be recharged. When carbon cells are used with a rectifier, adjustment of the rectifier output should always be made so that the battery does not receive a charge.

(c) It is not recommended that carbon cells be used in any installation where the battery service life is expected to exceed two years.

(d) The nominal voltage of a carbon cell is 1.2 to 1.6 volts depending upon temperature, discharge current rate and state of exhaustion. Battery capacities range from 500 to 3000 ampere-hours.

Detailed Operation: In operation, carbon cells are depolarized by oxygen extracted from the air which reaches the depolarization area through a porous carbon electrode. The carbon (positive) electrode takes oxygen from the air. The zinc (negative) plates gain oxgen to form zinc-oxide, which is immediately dissolved in the electrolyte.

When a non-renewable carbon battery is exhausted, it is discarded and replaced with a new battery. If indicator panels are not provided, battery life can be calculated on a calendar basis, or by use of a shunt meter in accordance with manufacturer's instructions.

When a renewable carbon cell is exhausted, it can be renewed by replacing the element and the solution. A maintainer can determine if the battery is ready for renewal by making a visual check of the amount of zinc remaining in the battery. Indicator panels are molded into the outside surface of the zinc plates. The panels gradually perforate as the capacity of the cell is consumed. When they are completely eroded the cell is ready for renewal.