Signal Training Bulletin

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

B-4 Secondary Battery Nickel-Iron-Alkaline Storage-Type

Approved October 1973

Definition: (a) Secondary Battery: A combination of two metals or metalloids immersed in an electrolyte which in itself will not produce electrical energy without first having the metallic portion of the element decomposed by the passage of electric current.

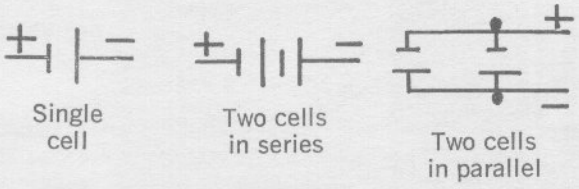
(b) Storage Cell: A secondary cell for storing electrical energy at one time for use at another time.

(c) Charging: The process of putting energy into a battery.

(d) Discharging: The process of taking energy out of a battery.

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

Symbol:



Description: The nickel iron battery consists of three essential components: positive active material which is nickel oxyhydrate, negative active material which is metallic iron sponge and the electrolyte which is potassium hydroxide and water with lithium hydroxide added.

The positive material is encased in perforated nickel plated steel tubes. The negative material is encased in flat, perforated nickel plated steel pockets. The plate is formed by grouping the desired number of tubes or pockets and crimping or welding them to a nickel plated sheet steel frame. The cell container is of nickel-plated sheet steel insulated from the elements by hard rubber or plastic. See Figure 1.

Note: The last U.S. manufacturer of the nickel-iron battery will discontinue production of this battery early in 1975. Although this line of batteries will be discontinued, some railroads will continue to put nickel-iron batteries in service until existing stocks are exhausted. The manufacturer advises that parts and electrolytes will be available for at least 5 years.

Purpose and Application: The nickel-iron storage battery is used as a dc power source at locations where an ac charging source is available. It can be used for track circuits, signals, highway crossing protection or for any railway signal appliance or circuit that requires direct current.

General Information: The nickel-iron battery is especially adaptable under conditions of dirt and corrosion and where rough handling may be encountered. The rugged construction of the cells contributes substantially to their long life, thus shedding of active materials from the plates is virtually impossible.

One important advantage of the nickel-iron battery is that it can be stored almost indefinitely without attention.

The cell containers are metal and must be insulated from adjacent ones and other conductive materials.

The nominal voltage of a nickel-iron cell under load is 1.20 volts. The actual voltage depends on whether the cell is on open-circuit, charge or discharge. Open-circuit voltage may vary from 1.25 to 1.35 volts. When the cell is connected to an external load, its voltage will fall to a value dependent on discharge rate and state of charge. If the rate is held constant, the voltage decreases until it reaches a point where the cell is considered normally discharged. This is termed "final voltage", and it varies with the rate of discharge. A commonly used final voltage is 1.14 volts per cell.

Some general rules for storage battery installation and maintenance:

(a) Check polarity and connections when installing.

(b) Maintain proper charge.

(c) Maintain proper electrolyte by adding water but do not overfill.

(d) Keep battery dry and clean.

(e) Avoid flames or sparks around battery since discharged gases might explode.

(f) Keep vent plugs in place and tight.

(g) Check terminal nuts at regular intervals and tighten if necessary.

(h) Keep terminals coated with grease as specified by railroad maintenance instructions.

(i) The electrolyte is alkaline and is injurious to skin and clothing. If contact occurs, wash immediately with water.

Detailed Operation: The nickel-iron battery has a nickel oxyhydrate positive plate, iron sponge negative plate and potassium hydroxide electrolyte. When the battery is discharged, the positive plate is reduced to a lower oxide and the iron negative plate is oxidized. The reaction is mainly an oxygen iron transfer between plates. The specific gravity of a new cell is 1.160 to 1.190 at 25C (77F) and at normal solution level. As no constituents of the electrolyte combine with the active material of the plates, the specific gravity does not change appreciably during charge or discharge, and therefore it does not indicate the state of charge or discharge.

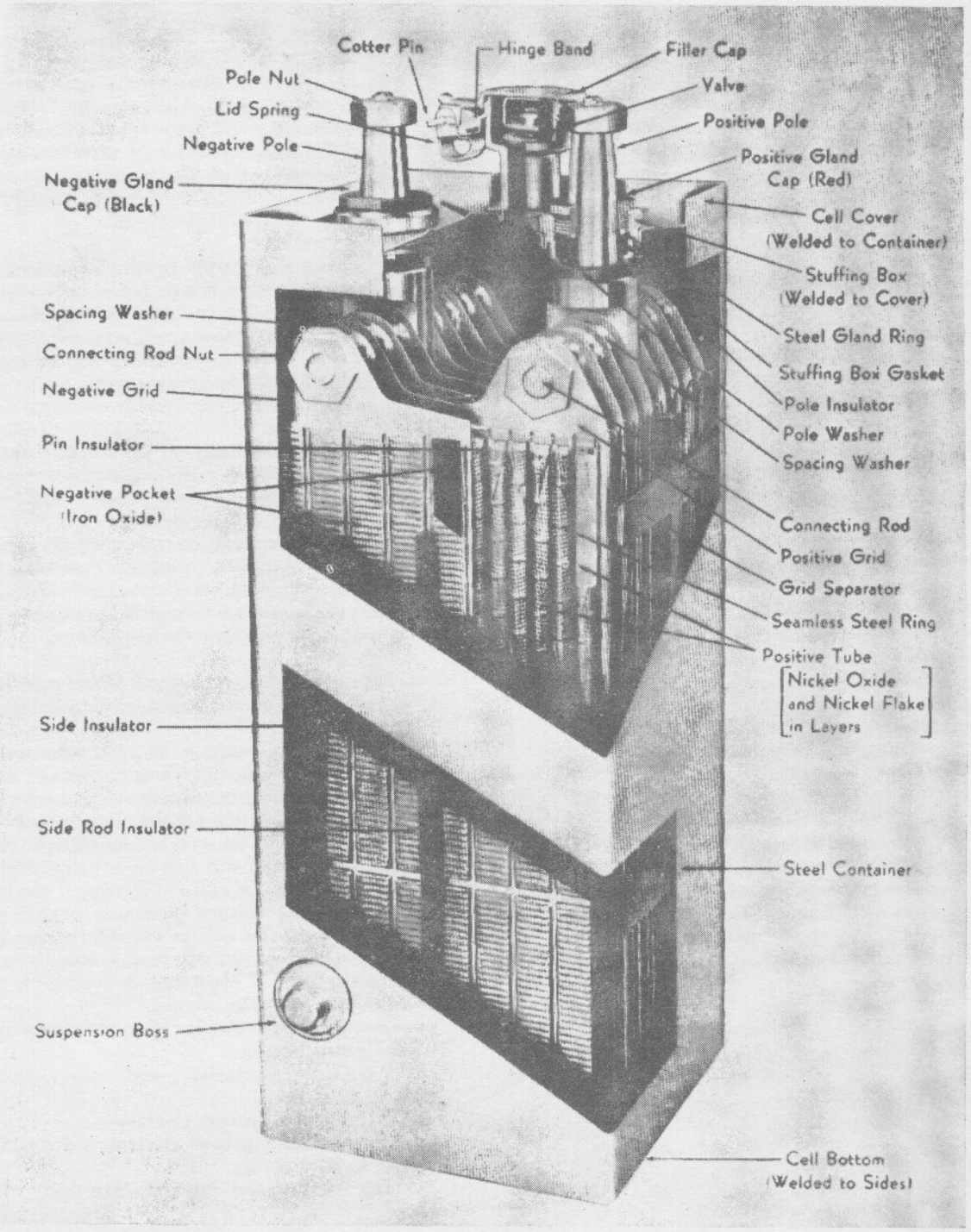


Figure 1 is a Nickel-Iron-Alkaline Storage Cell