The ABC of RADIO BATTERY LIFE

HOW LONG WILL BATTERIES LAST?

FOREWORD

THIS BOOKLET has been prepared to provide complete information for radio dealers and servicemen on the subject of radio batteries in general. Since National Carbon Company makes all types of batteries, we have "no axe to grind." Our interest is merely to help dealers avoid the annoyance and trouble that always result when radio batteries are misapplied and given work to do for which they are not suited.

NATIONAL CARBON COMPANY, INC.

HOW LONG WILL A DRY CELL "A" BATTERY LAST?

TURNED ON
8 HOURS PER DAY

"EVEREADY" No. X-125 OR
EQUIVALENT OF OTHER MAKES
Based on ½ ampere drain

200 HOURS

200 HOURS CONSUMED AT A RATE
OF 8 HOURS PER DAY WILL LAST
APPROXIMATELY 25 DAYS

OR ABOUT 3½ WEEKS

TURNED ON
3 HOURS PER DAY

"EVEREADY" No. X-125 OR
EQUIVALENT OF OTHER MAKES
Based on ½ ampere drain

400 HOURS

400 HOURS CONSUMED AT A RATE
OF 3 HOURS PER DAY WILL LAST
APPROXIMATELY 133 DAYS

OR ABOUT 4 MONTHS

NOBODY can predict how long a dry battery will last when used as a Radio "A" battery. Dry cells aren't fitted for this type of work for two reasons.

First, the number of service hours delivered by a cell depends on how that cell is used. If used five hours per day it will deliver fewer *total* hours than if used only two hours a day.

Second, a dry cell's voltage is not steady, as required by radio tubes, but decreases rapidly as the cell is used up. A dry radio "A" battery starts life at about 3-volts and ends up at about 1.8 volts. Radio tubes must have a steady 2-volts all through their lives.

Dissatisfaction over this widely variable life feature almost always results from promises or "guarantees" of a certain battery life at the time of sale. *It is impossible to promise any definite life for a dry cell "A" battery* because its life depends almost wholly on *how* it is used and no Dealer can predict or control the way a customer will use his radio.

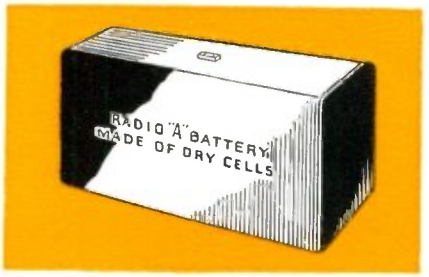
New radios are used excessively for the first few weeks until the novelty wears off and the customer settles down to a more systematic habit of listening. This means that the first battery gets severe usage and as a result it won't last long. *Very frequently the first dry cell "A" battery lasts less than a month.* If the customer has been led to believe that the battery ought to last six weeks, or any other definite time, he will claim short life and this makes trouble for everybody. The second battery probably will last longer than the first one. If the customer switches to another make for his second battery, he may conclude that it is a better battery because it lasted longer. This is not so. The second or third battery lasts longer, not because it is better but because it isn't being used as hard.

That is the whole story of the uncertain life to be expected of a dry cell "A" battery. As little as 3 or 3½ weeks or as much as 3½ or 4 months with the SAME radio and the SAME battery, all depending on whether the radio is used many or few hours per day.

DRY CELL "A" BATTERY'S VOLTAGE IS TOO HIGH FOR 2-VOLT TUBES!

2 VOLTS

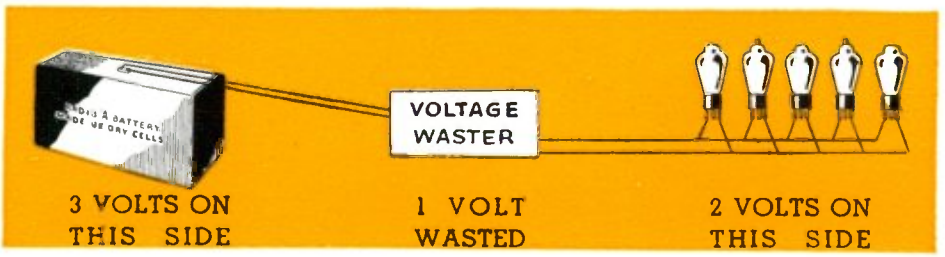
Tubes Require 2-Volts



3 VOLTS

Dry Cell "A" Battery Generates 3-Volts

Dry Cell "A" Battery's Excess Voltage Must Be Absorbed and Wasted to Protect the Tubes.



TOO MUCH "A" VOLTAGE

SHORTENS TUBE LIFE

It does not burn tubes out — just wears them out too fast — so they must be replaced too soon.

DRY CELL "A" BATTERY VOLTAGE IS VARIABLE

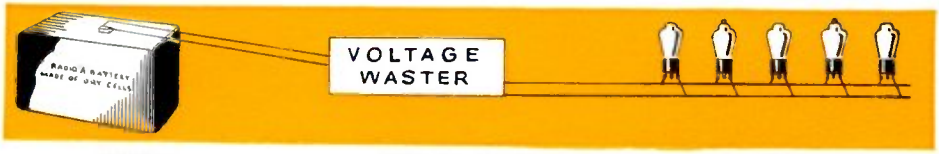
—STARTS OFF HIGH—ENDS UP LOW

2-Volt Tubes must have 2 Volts all the time—too much voltage shortens their life—too little voltage makes them quit playing

WHEN THE BATTERY IS NEW—

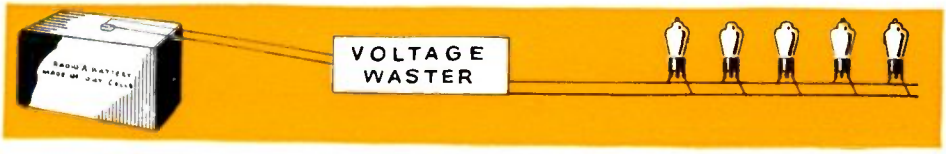
NEW BATTERY GIVES 3 VOLTS | RESISTOR MUST WASTE 1 VOLT SO— | TUBES WILL HAVE ONLY 2 VOLTS

WHEN THE BATTERY IS ½ USED—



BATTERY GIVES 2½ VOLTS | RESISTOR MUST WASTE ½ VOLT SO— | TUBES WILL STILL HAVE ONLY 2 VOLTS

WHEN THE BATTERY IS ¾ USED—



BATTERY GIVES 2 VOLTS | RESISTOR MUST WASTE NO VOLTS SO— | TUBES CAN STILL HAVE ONLY 2 VOLTS

THERE ARE ONLY 2 TYPES OF RESISTORS—BOTH CAUSE TROUBLE

NO. 1—TAPPED RESISTORS—MUST BE OPERATED BY HAND

if voltage reaching tubes is too high on one tap and too low on the next, the user must over-voltage his tubes because the radio won't play when tube voltage is too low. This shortens both battery and tube life and costs the user real money.

NO. 2—AUTOMATIC BALLAST TUBE

wears out and must be replaced. A worn-out ballast tube keeps on lighting up but will not hold back the dry cell "A" battery's excess voltage. This shortens both battery and tube life. Sometimes a worn-out ballast tube holds back too much of the dry cell "A" battery's voltage. This causes short battery life. In either case it costs the user real money.

As long as Dry Cell "A" Battery voltage wasters do not control Dry Cell "A" Battery voltage any better than they do, the use of Dry Cell "A" Batteries to run 2-volt radios is liable to result in:

1. Short tube life;
2. Frequent receiver stoppage at inconvenient times;
3. High operating expense.

A WORN-OUT TUBE STILL LIGHTS UP ...BUT IT WON'T PLAY!

One or more worn-out tubes in a radio makes it quit playing while the dry cell "A" battery is still well up in voltage and full of life.

Sometimes wrongly diagnosed as short dry cell "A" battery life, this really is a sign that the tubes may have worn out and need replacing with new ones.

THE ONLY  REALLY

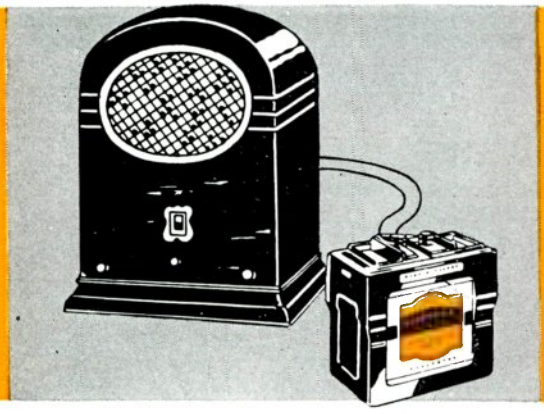
PRACTICAL "A" BATTERY

FOR 2-VOLT RECEIVERS

The same voltage all the time
Needs no controlling!

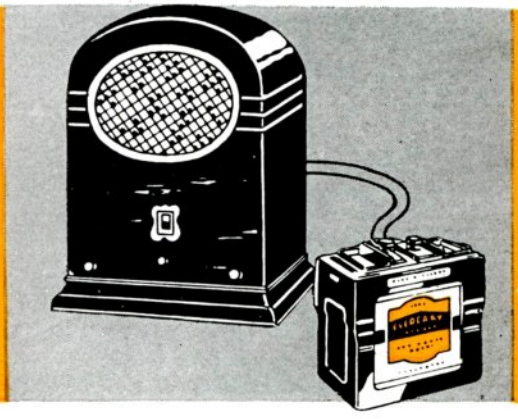
Does away with trouble-making, money-wasting voltage resistors which must be used with Dry Cell "A" Batteries.

HOW LONG WILL THE "AIR CELL" "A" BATTERY LAST?



TURNED ON
8 HOURS PER DAY
Based on 1/2 ampere drain

1200 HOURS
OR
ABOUT 5 MONTHS



TURNED ON
3 HOURS PER DAY
Based on 1/2 ampere drain

1200 HOURS
OR
ABOUT 1 YEAR AND 1 MONTH

COMPARE this uniform service life with the uncertain life of the Dry Cell "A" Battery as shown on Page 3.

The life of the "Eveready" "Air Cell" "A" Battery is determined ONLY by the amount of "A" current the radio consumes. Daily hours of usage may be heavy or light, the battery still gives the same number of service hours.

On a 4/10—ampere radio the life will be at least 1500 hours.
On a 1/2 —ampere radio the life will be at least 1200 hours.
On a 6/10—ampere radio the life will be at least 1000 hours.

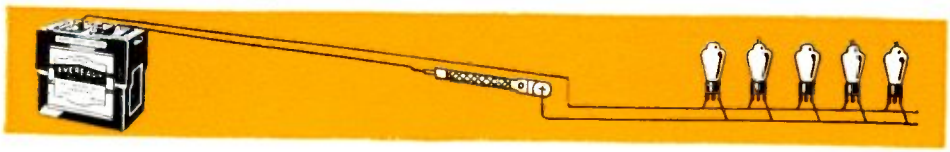
The "Air Cell" Radio "A" Battery is the ONLY primary battery for which a definite life guarantee can be made. This is because it is different. It is not like any other battery. It was designed for one purpose only—to supply "A" current to radio receivers.

You can guarantee the "Air Cell" Battery to give at least 1000 hours of service because *we* guarantee it to do so. There is no uncertainty about what to expect of the "Air Cell" Battery and this means satisfied customers and a profitable business.

The "Air Cell" Battery costs more to buy but gives from 2 to 3 times as many hours per dollar of cost as dry cell "A" batteries of the "Eveready" No. X-125 class.

How THE "EVEREADY" "AIR CELL" "A" BATTERY WORKS

WHEN THE BATTERY IS NEW—

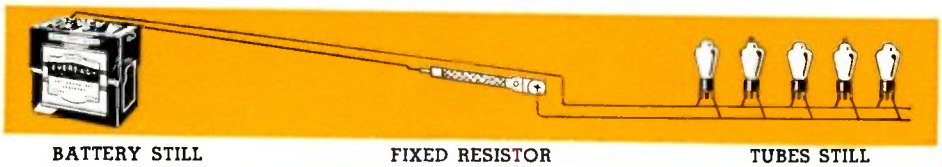


BATTERY GIVES 2.35 VOLTS *

FIXED RESISTOR USES .35 OF A VOLT

TUBES HAVE ONLY 2 VOLTS

WHEN THE BATTERY IS ½ USED—

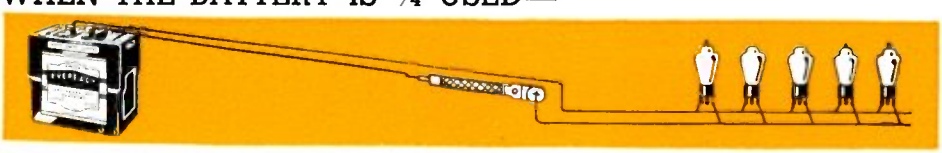


BATTERY STILL GIVES 2.35 VOLTS *

FIXED RESISTOR USES .35 OF A VOLT

TUBES STILL HAVE 2 VOLTS

WHEN THE BATTERY IS ¾ USED—



BATTERY STILL GIVES 2.35 VOLTS *

FIXED RESISTOR USES .35 OF A VOLT

TUBES STILL HAVE 2 VOLTS

"Air Cell" "A" battery. Constant voltage—can't abuse tubes—can't shorten tube life.

"Air Cell" resistor. Non-regulating—non-adjustable—can't be tampered with—can't wear out.

* Average Figures. Slightly higher when battery is new, slightly lower when battery is used up. Variation too slight to affect tubes.

"Air Cell" BATTERY

SAVES MONEY 2 WAYS

THE LIFE OF THIS "EVEREADY" "AIR CELL" BATTERY ---------- EQUALS THE COMBINED LIVES OF ALL THESE DRY 'A' BATTERIES

ONE "AIR CELL" COSTS HALF AS MUCH AS FOUR DRY CELL "A" BATTERIES

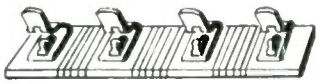
THEREFORE

THE "EVEREADY" "AIR CELL" BATTERY GIVES TWICE AS MANY HOURS OF SERVICE PER DOLLAR OF COST AS DRY CELLS

NOT ONLY THAT...

Tubes in Receivers Powered by the "Air Cell" "A" Battery Are Lasting Two to Three Times as Long as Tubes in Receivers Powered by Dry Cell "A" Batteries.

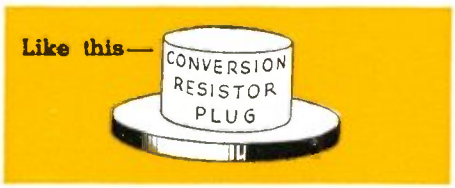
ALL genuine "Air Cell" receivers have the correct "Air Cell" resistor built into them. Receivers not equipped with built-in "Air Cell" resistors can be changed over for "Air Cell" operation very simply. If it is a tapped resistor set, throw the tapped resistor away and substitute the correct "Eveready" "Air Cell" Resistor for it.



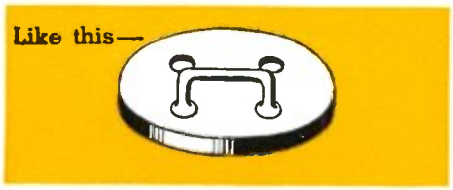
Throw this gadget away and

— Install this fool-proof resistor

If it is a ballast tube receiver, throw the ballast tube away and plug-in the correct conversion resistor plug in its socket



Or, Short Circuit the Ballast Tube Socket



Then Attach the Correct "Eveready" "Air Cell" Resistor to the End of one of the "A" Battery Leads

Resistor "A" Battery Lead

IMPORTANT

If a Dry Cell "A" Battery has been used before changing over to "Air Cell" operation, test all tubes in the set. Some or all of them may be weak because of the ruinous action of the Dry Cell "A" Battery's high voltage and will no longer play with the rated 2 volts supplied by the "Air Cell" Battery and the "Air Cell" resistor. Replace all tubes damaged by the Dry Cell "A" Battery before using the "Air Cell" "A" Battery.

HOW LONG WILL "B" BATTERIES LAST?

'B' batteries are made of dry cells. The life of any dry cell is determined largely by the way it is used and this means that "B" battery life will be long or short depending on whether the service is light or heavy. Since heavy usage actually reduces a "B" battery's total service hours, *it is impossible to tell how long any "B" battery will last.*

Regardless of whether the service is heavy or light, *a large "B" battery will give more service hours than a small one and a "Layerbilt" "B" battery will give more service hours than a round cell "B" battery of equal size.* Most radios get heaviest usage during the first few weeks after purchase. If small cheap round cell "B" batteries are sold with the radio to "keep the price down," dissatisfaction over short "B" battery life is liable to result. The way to insure satisfaction and keep battery complaints out of your store is to sell the best "B" battery money can buy as initial equipment with the radios you sell. This is the "Eveready" Heavy Duty "Super-Layerbilt" No. 386. Second choice is the "Eveready" Heavy Duty "Layerbilt" No. 486.

If the customer insists on low-priced round cell "B" batteries, such as the "Eveready" No. 772 or the equivalent of other makes, don't make any promises or "guarantees" as to the life it will give. "B" batteries in this class are made to sell at a price. They give all the service hours possible for their size and cost, but at best their life is relatively short and liable to be unsatisfactory to the customer. Under the heavy use conditions typical of newly purchased radios, *they may not last a month.*

Larger "B" batteries not only give more hours of service, they give more hours per dollar of cost. Under normal use conditions "Eveready" Heavy Duty "Super-Layerbilt" No. 386 will last at least 3 TIMES AS LONG as the little "Eveready" round cell "B" battery No. 772, yet it costs only about twice as much. The service life of 3 batteries for the price of 2!

Sell "EVEREADY" "Layerbilt" "B" batteries and avoid having dissatisfied, complaining customers.

HOW LONG WILL THE "C" BATTERY LAST?

The most important rule for Dealers to observe is this:

> BE SURE YOUR CUSTOMERS CHANGE THEIR "C" BATTERIES EVERY TIME THEY INSTALL NEW "B" BATTERIES. *NEVER* PERMIT A CUSTOMER TO INSTALL NEW "B" BATTERIES ON A RADIO WHICH HAS THE OLD "C" BATTERY FROM PREVIOUS USAGE STILL CONNECTED TO IT.

Failure to observe this rule will mean short "B" battery life and general dissatisfaction on the part of the customer.

The "C" battery is a small, inexpensive unit but it plays a most important part in radio reception and in the life of the "B" battery. Through the valve action of the vacuum tube the "C" battery actually controls the flow of current from the "B" battery. If the "C" battery voltage is high, the "B" battery current will be low; if the "C" battery voltage is low, the "B" battery current will be high, and high current means rapid exhaustion and short life.

For best reception there always should be a certain relationship between "C" voltage and "B" voltage. When the "B" voltage is high, the "C" voltage should be high; when the "B" voltage is low, the "C" voltage should be low. The "B" voltage naturally becomes lower with use and in order to maintain this ideal relationship, the "C" voltage must be made to fall off in step with the declining "B" voltage. Almost all battery radios on the market today accomplish this automatically by switching a resistance unit called a "bleeder" across the "C" battery during periods of listening. This "bleeder" pulls the "C" battery voltage down in step with the falling "B" voltage with the result that the radio continues to play almost as well when the batteries are nearly exhausted as it did when they were new and fresh.

This "bleeding" of the "C" battery means that when the "B" battery is exhausted and needs replacement, THE "C" BATTERY IS EXHAUSTED, TOO, and must be replaced.

If new "B" batteries are installed with the old exhausted "C" battery still connected to the radio, the "B" voltage will be high but the "C" voltage will be low. This places an excessively heavy drain on the "B" batteries which runs them down rapidly. In some cases failure to replace the "C" battery overloads the "B" batteries so seriously that they actually break down physically and leak under the destructive load.

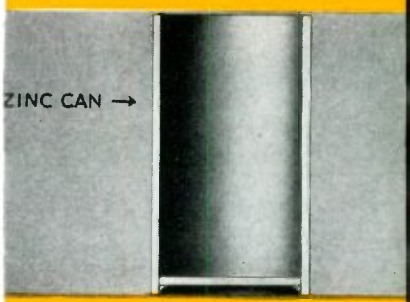
There is no choice in this matter. The "C" battery MUST be changed every time a new "B" battery is installed.

NEVER PERMIT A CUSTOMER TO INSTALL NEW "B" BATTERIES ON A RADIO WHICH HAS THE OLD "C" BATTERY FROM PREVIOUS USAGE STILL CONNECTED TO IT.

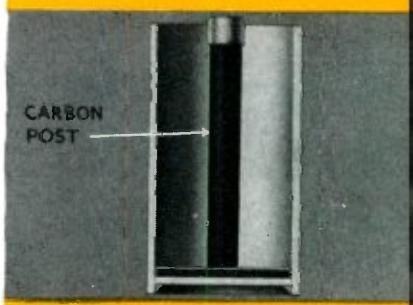
HOW DOES A DRY CELL PRODUCE ELECTRICITY?

A DRY battery is made up of two or more cells each of which generates 1½ volts. An ordinary 45-volt radio "B" battery, therefore, contains 30 individual cells. There is much waste space between cells in the common round cell battery as shown by the grey background in this picture. These round cells look like flashlight cells and in order to see how a battery "works," we can consider just one of these . . .

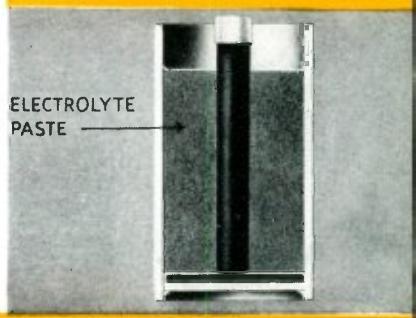
The container is a cylinder of zinc which, in addition to holding the ingredients of the cell, is itself a vital element in the making of electricity.

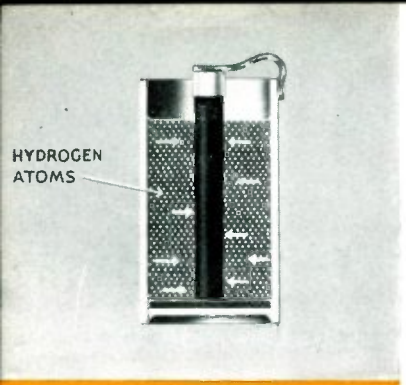


A carbon post with a brass cap is in the center of the cell and is the positive electrode which collects the current and conducts it to the outside circuit. The current is created by—

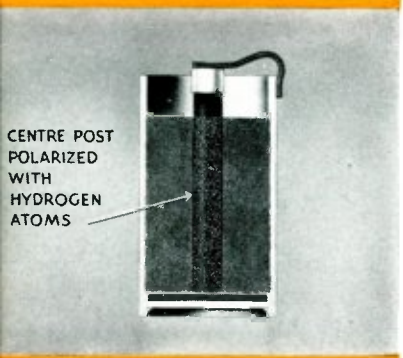


dissolving the zinc with an electrolyte paste which is placed in the cell next to the zinc. As the zinc is consumed—

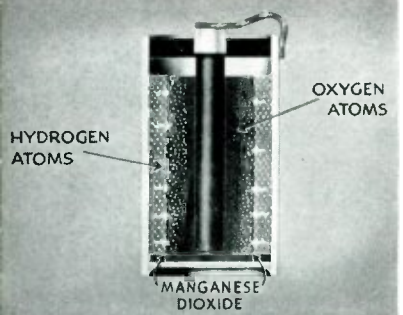




current flows and hydrogen atoms are released. The current and the hydrogen atoms are attracted to the center carbon post, or positive electrode but—



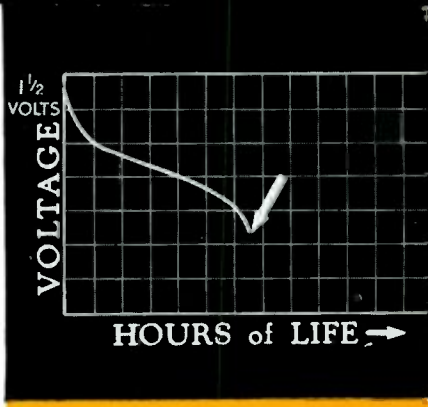
when the post becomes coated with hydrogen atoms the cell becomes "polarized" and ceases to produce electricity. This must be prevented if the cell is to have any practical life and so—



oxygen-producing manganese dioxide is packed into the cell between the electrolyte and the carbon post. Oxygen atoms, released by the manganese dioxide, attract and absorb hydrogen atoms; the cell is then "depolarized" and continues to produce current.

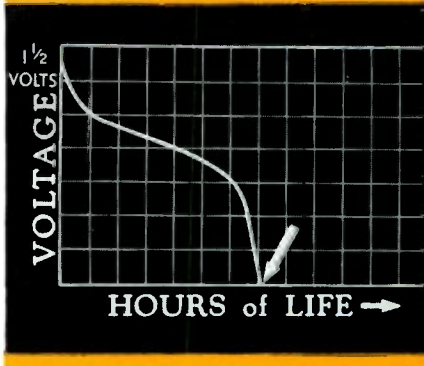
Generally speaking, the more zinc and manganese-dioxide put into a cell, the longer it will last. As the cell is used, the zinc gets thinner and thinner and eventually it is eaten through. Up to this point—

its power curve will look like this. Starting at 1½ volts, the cell's voltage gradually drops to the point where—



holes begin to appear in the zinc caused by the action of the electrolyte. When the zinc can is perforated, air filters in, dries out the cell and—

since a "dry" cell isn't dry at all, but depends on moisture for its very life, the curve suddenly drops like this and the cell goes "dead."

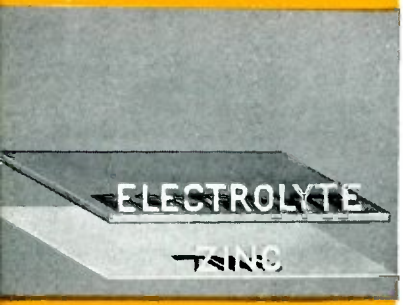


As a result, all this zinc must be thrown away when a round cell becomes perforated. This picture shows the wasted zinc in just one cell which could have produced electricity but didn't because of the perforations, which are indicated by the arrow. There is thirty times as much wasted zinc in an exhausted 45-volt round cell "B" battery.

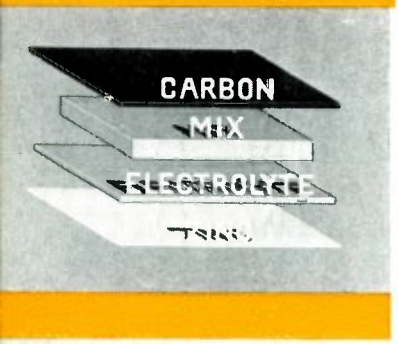
HOW IS AN "EVEREADY"

"EVEREADY" "Layerbilt" construction is far superior to the common, round-cell type of "B" battery. Although an "Eveready" "Layerbilt" "B" battery looks like a round cell type on the outside, its inside construction is completely different and its cells are flat. There is no waste space between cells. Every ounce of active material is used.

Electrically a "Layerbilt" cell is just the same as a round cell, but physically it is different. In a "Layerbilt" cell, the zinc is flat and is not used as a container for the other elements.



A flat, electrolyte-saturated pad is applied to one side of the zinc plate. This, of course, is to consume the zinc and create current. In these flat cells this current flows—

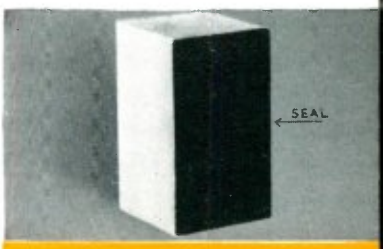


through the flat oxygen-producing manganese dioxide mix cake, which is shown in this picture and which absorbs the hydrogen atoms caused by the consumption of the zinc.

This 22½ volt stack would not produce electricity for long, however, if left in this condition. All edges are exposed to the air and the cells would quickly dry out so—

"Layerbilt" "B" BATTERY BUILT?

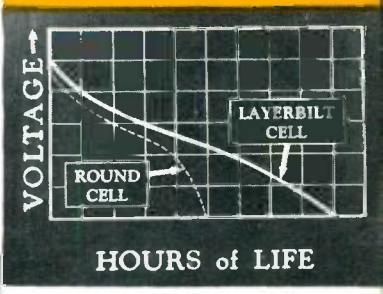
each stack is dipped in a special compound which fills every nook and cranny and completely excludes outside air—



the result of this complete sealing—which is only possible with "Layerbilt" construction—is that practically all the zinc in a "Layerbilt" "B" battery is used to produce electricity—

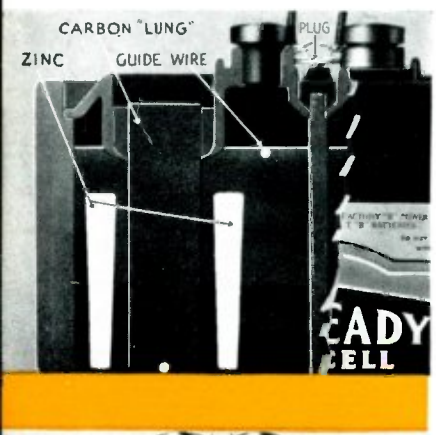
This is a picture of a "Layerbilt" cell removed from an exhausted battery. Every bit of zinc, except the extreme edge of the plate has been used and there is no waste. Air cannot filter in to dry out the cell when perforation occurs and so the action continues until all the zinc is used.

The power curve of a "Layerbilt" cell therefore looks like this. The round cell curve drops quickly when perforation of the zinc takes place, but perforation doesn't stop the "Layerbilt" and that is why it lasts longer and gives more service per dollar of cost.

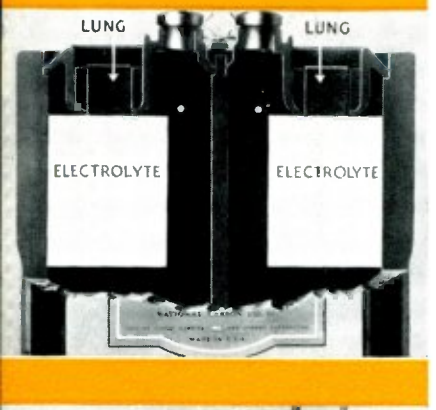


The two finest and most economical "B" batteries on the market.

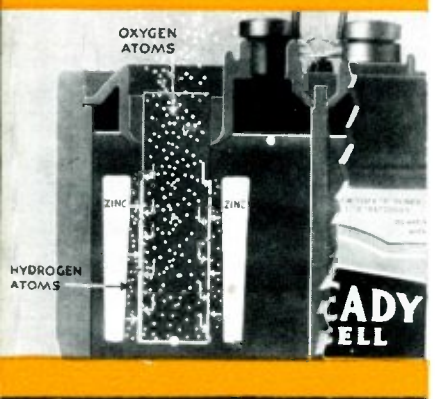
HOW DOES THE "EVEREADY"



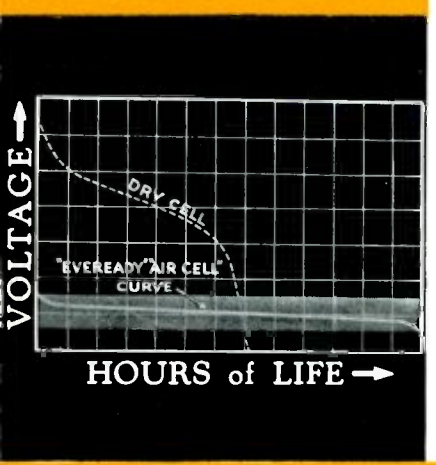
Here is one half of the two-cell "Eveready" "Air Cell" Battery. The porous carbon electrode is also the "lung" that breathes in oxygen. It is flanked by two slabs of zinc.



The electrolyte is in the form of a cake which is dissolved when plain water is added to each cell. It is a self-mixing electrolyte and needs no stirring.

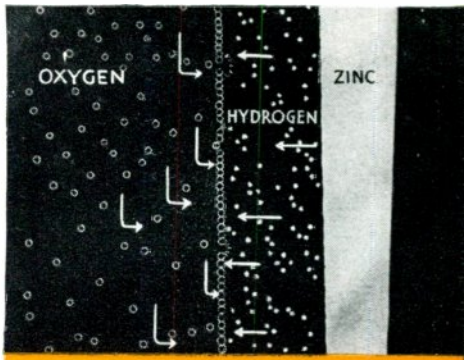


These "lungs" breathe in oxygen from the air. Oxygen is sucked down through the porous electrode and its atoms absorb the hydrogen and so the "Air Cell" is constantly depolarizing itself without the use of manganese dioxide.

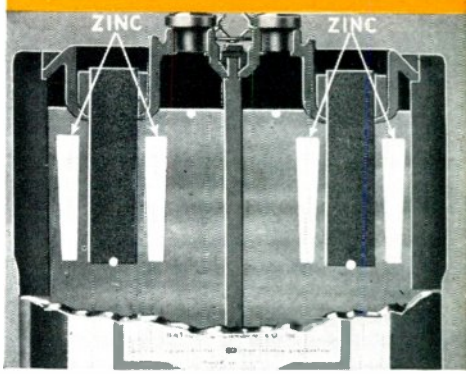


Constant voltage radio tubes must have a constant voltage "A" battery to give best results from battery power. Such a battery, too, must give long, trouble-free life and not be expensive. With these requirements in mind, Eveready engineers developed the "Eveready" "Air Cell" "A" battery. This battery, throughout its long life, never rises above or falls below the proper limits of safe tube voltage as shown in this chart.

"Air Cell" "A" BATTERY BREATHE?



If manganese dioxide were used to produce the necessary depolarizing oxygen, the battery would have to be three times as large, three times as heavy and would cost twice as much; but—because the oxygen used is "breathed" in from the air and is always right at the surface of the carbon, hydrogen is absorbed completely and instantly and the voltage does not fall off.



There are five *pounds* of zinc in an "Eveready" "Air Cell" Battery and of course there is plenty of oxygen in the surrounding atmosphere so that this battery produces electricity for more than 1,000 hours and—

—since air depolarization is instantaneous and complete, it makes no difference whether this battery is used two hours a day or twenty-four—it still gives a minimum of 1,000 hours of service—a statement that is guaranteed by National Carbon Company, Inc.

NATIONAL CARBON COMPANY, INC.

specifically

GUARANTEES

That the "Eveready" "Air Cell" A Battery, No. A-600, when properly installed on an approved "Air Cell" receiver, and maintained according to directions provided with this battery, will supply "A" current for a minimum of 1,000 hours, no matter whether the receiver is used two or twenty-four hours each day.

NATIONAL CARBON COMPANY, INC.

General Offices: New York, N. Y. Branches: Chicago • San Francisco

Unit of Union Carbide UCC *and Carbon Corporation*

THE ABC OF

BATTERY QUALITY

National Carbon Company, Inc., has been making batteries for forty years and today is the largest producer of radio batteries in the country and the leader of the industry.

This accumulated experience has given us a sound knowledge of what may be expected of any type of battery in any given service.

With this background behind the trade name "Eveready", you can install the correct set of "A", "B", and "C" batteries on your customers' receivers with confidence. You know, and your customers know, that "Eveready" stands for quality in the battery industry. There is a correct "Eveready" battery for every radio need and each one will produce the most power for the price and give the longest possible life in the work it is designed to do.

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