The Mallory Bias Cell

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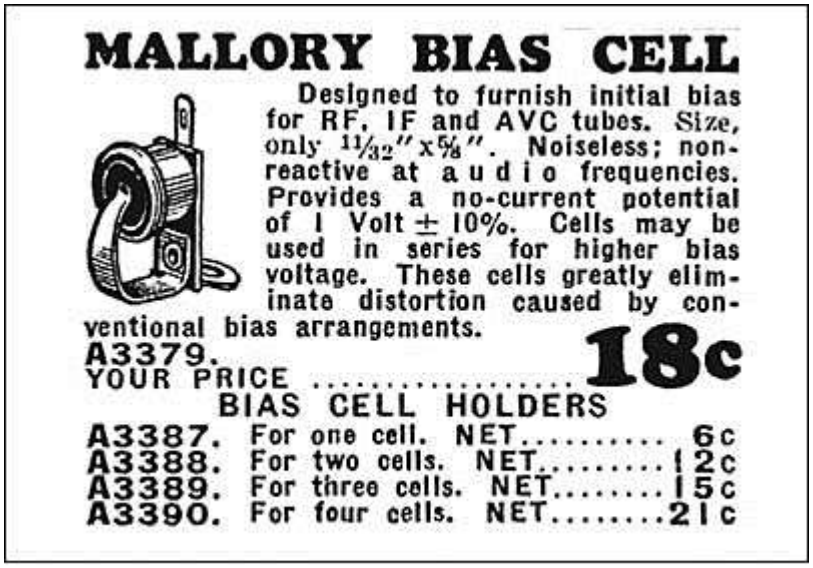
The P.R. Mallory & Company, named for founder Philip Rogers Mallory, was launched in 1916 as a supplier of tungsten wire filaments to manufacturers of incandescent lamps. The product line was later expanded to include resistors, capacitors, and timers. In October 1931, Mallory purchased the Yaxley Manufacturing Company of Chicago, expanding his range of products even further.

Mallory introduced radio designers to the bias cell in 1936. the Mallory bias cell was a hermetically-sealed dry cell intended to provide negative grid bias voltage for vacuum tube amplifiers. It was an innovation by inventor Samuel Ruben (1900-1988).

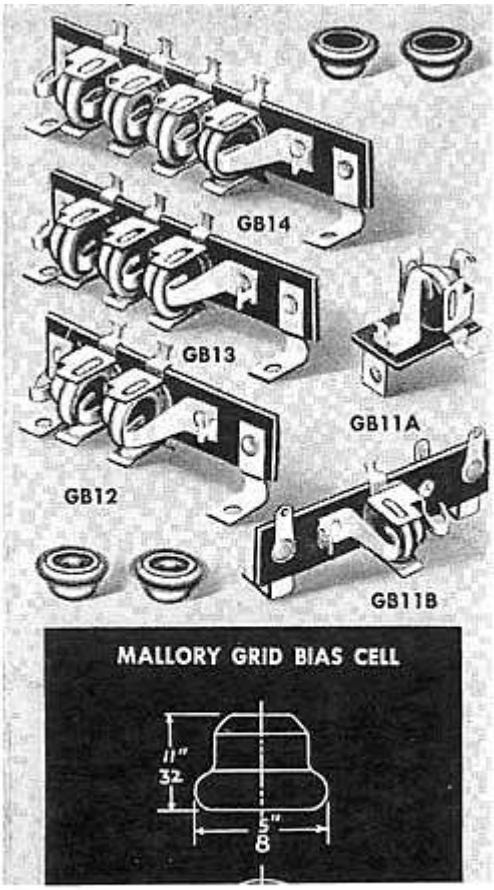
Ruben was born in Harrison, New Jersey and grew up in New York City. By the time he was eleven years old, he had become interested in amateur radio and was experimenting with electricity and chemistry. His formal education was limited, and he never received a college degree except for honorary doctorates later in life.

In spite of this, he was able to obtain financial backing to establish Ruben Laboratories in New York City in 1922. The company moved to New Rochelle, New York in 1930, and remained there until Ruben retired in 1984. Ruben's long-term relationship with the Mallory Company, lasting until Mallory's death in 1975, began in 1925 when he licensed a solid-state rectifier to the firm.

The concept of using a battery to provide grid bias was certainly not new. Battery-powered radios often included a “C” battery for this purpose. But the bias cell was intended to be a permanent component. Designers reasoned that, because the bias cell would not be required to provide any current, it would last as long as the resistors and capacitors in the circuit.



Bias cell illustration 1937 Allied Radio catalog.



Bias cell and holder illustrations from 1940s P.R. Mallory & Company catalogue.

Although I had read about bias cells in old radio textbooks, I had never worked with one myself. I recently had an opportunity to purchase a bias cell on eBay and decided to learn more about these interesting circuit components. My purchase appears to be unused and identical an illustration I found in the 1937 Allied Radio catalog.

The construction of the bias cell is similar to that of a flashlight cell. The cathode is made of zinc or similar metal and is a mushroom-shaped cup filled with an electrolyte paste. The anode is a carbon-like disk that seals the electrolyte paste inside the cup.

Spring clip holders were used to make connections to the bias cell. Holders were available for single bias cells or for connecting several bias cells in series where higher voltages were needed. To simplify installation, the anode connection was part of the mounting lug, and the cathode was connected to an insulated terminal on top of the bias cell assembly.

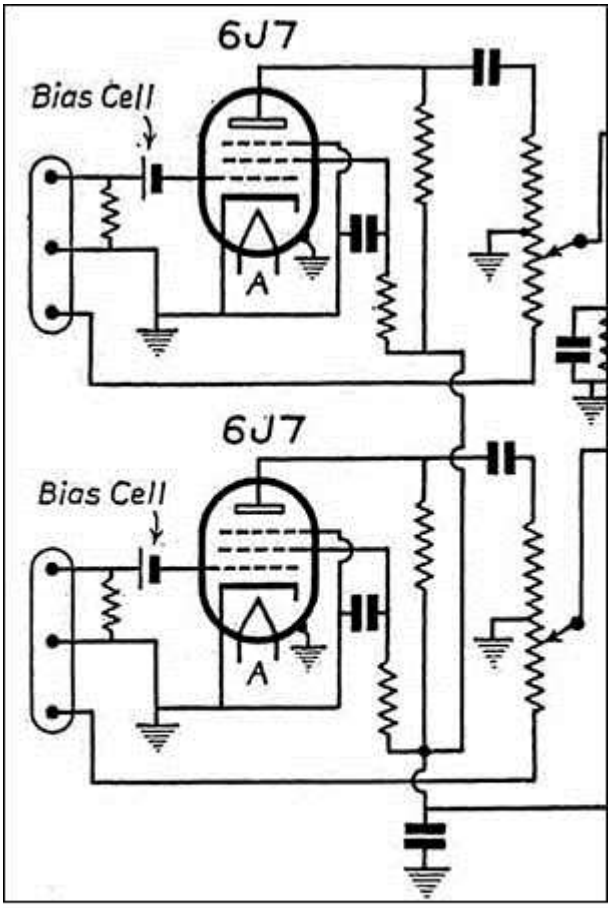
Bias cells were offered in both 1.00-volt and 1.25-volt models. My bias cell is not labeled, but I measured its voltage with a high-impedance voltmeter and was surprised to discover that it is still providing 0.9 volts of potential difference after being in storage for half a century!

The 1940 catalog published in Indianapolis, Indiana, by P.R. Mallory & Company, includes an entire page on the bias cell and its applications. Mallory cited the following advantages for using the bias cell instead of the more traditional cathode resistor and bypass capacitor:

• It saves money by eliminating the need for a cathode resistor and its associated cathode bypass capacitor. In 1937, at retail, a single bias cell was priced at about 18 cents while a cathode bypass capacitor and resistor might come in at over 30 cents

• It provides a constant bias voltage regardless of vacuum tube characteristics. With cathode resistor bias, the bias voltage would decrease as the cathode emission of the vacuum tube decreased with use

• It simplifies the circuit, avoiding "degeneration, audio howls, and other noises frequently found in high-gain amplifiers." I do not understand this statement, but perhaps it had merit



Bias cells as used for grid bias in input circuits of 1936 Lafayette amplifier design.

Bias cells began to appear in circuit designs in 1936 at about the same time that octal-based vacuum tubes were becoming standard. The most common applications were in preamplifier stages of audio amplifiers and in the first audio stage of radio receivers. The first application I found in my research appeared in the June 1936 edition of *Radio Engineering* magazine. It was a Lafayette audio amplifier design using bias cells in the 6J7 preamplifier stages of the audio mixer.

A review of radio schematics from the late 1930s shows a number of designs that used bias cells with first audio tubes such as the 6F5, 6J5, or 6Q7. While no manufacturer used them exclusively, the cells seemed to be more prevalent in Philco and Silvertone circuits. There were a number of different schematic symbols used for bias cells, the most prevalent being the familiar battery cell symbol with the words "Bias Cell" written beside it.

The popularity of the bias cell was short-lived. Perhaps there was a reliability issue. Even if the bias cell itself remained viable, oxidation or corrosion of the cell holder connections could easily cause problems with intermittent or microphonic operation. Although bias cells still appeared as replacement parts in the 1954 Allied Radio Catalog, I have never seen one used in a circuit designed after World War II.

But while the bias cell could easily be dismissed as a curious footnote in the history of electronics, its legacy is significant. Because of his experience with the bias cell, Samuel Ruben continued research that led to the development of miniature mercury batteries. These were widely used by the U.S. Army during World War II in portable radios and mine detectors. After the war, Ruben continued

to work with Mallory to develop alkaline batteries. The Duracell brand of batteries was introduced in 1964. Today, Duracell is a division of The Gillette Company.

References

Business and Economic History On-line, "Independent Inventors in an Era of Burgeoning Research and Development" by Eric S. Hintz http://www.h-net.msu.edu/~business/bhcweb/publications/BEHonline/2007/hintz.pdf. Hintz is a graduate student in the Department of History and Sociology of Science at the University of Pennsylvania.

1940 Catalog, P.R. Mallory & Company, Inc., Indianapolis, Indiana

1937 Catalog, Allied Radio Corporation, Chicago, Illinois

1954 Catalog, Allied Radio Corporation, Chicago Illinois

Duracell Company History from the Internet: http://www.duracell.com/company/history.asp?id=50&

Radio Engineering, January ,1932 and June, 1936, Bryan Davis Publishing Company, New York City