

A BIOGRAPHICAL HISTORY OF THE AR88, RCA'S "WORLD CLASS" COMMUNICATIONS RECEIVER

Bob Haworth, W2PUA

112 Tilford Rd., Somerdale, NJ 08083

Author's note: The AR88 and related biographical data in this article were obtained in a personal interview with Lester T. Fowler, the 87-year-old designer of the AR88. The remaining material was derived from the author's records and the RCA "Trend" for December 1976.

Design and production of the AR88 communications receiver began when the General Electric Company hired an eager young engineer, Lester T. Fowler, fresh out of Washington State College. The year was 1924, and Mr. Fowler had developed an intense interest in the then-fledgling entertainment medium called radio.

In the mid-1920s, GE and Westinghouse were using RCA simply to distribute their own radio products. The two firms eventually established a design and manufacturing capability at RCA, causing that company to develop rapidly as a prime supplier of radio and television sets, parts, and services.

Lester Fowler worked at the General Electric plant in Schenectady, New York, from 1924 to 1929. He specialized in equipment test and specification verification, eventually heading the department of the same name. He also performed production-follow and test verification on such sets as the Radiola Super 8, one of the very first superheterodyne table radios. Les transferred to Engineering and designed the Radiola 18.

On December 15, 1929, Mr. Fowler was transferred, together with about 100 other GE employees, to the RCA plant in Camden, New Jersey. The purpose was to create an effective design and manufacturing staff as the newcomers joined the RCA engineering personnel already present.

Les' first assignment at the Camden facility was to design battery-operated superhets and then automobile radios. At that time a large aftermarket existed for car radios, since few automakers inclu-

ded a radio as either standard or optional equipment. Aftermarket radios tended to be "universal" in that they did not fit into any particular hole in the dashboard, but were simply one or two boxes bolted to the firewall; a tuning head with flexible cables was attached to the steering column. All carried the RCA nameplate and were sold by the company to electrical jobbers, auto repair shops, and so on. Les Fowler was responsible for the design of all but one of these radios from 1931 to 1938. His reputation as a radio design engineer was assured.

At this same time, another group of engineers at RCA, known as the Amateur Radio Section of the Engineering Products Division, was designing

commercial receivers. These sets were known as "General Purpose Communications Receivers," and had heretofore been intended strictly for amateur use. The Section's products included such receivers as the ACR-136, the "Magie Brain" radio Type ACR-155,



and the celebrated ACR-111 and -175.

By 1938 this group had changed its equipment designation from ACR (Amateur Communication Receiver) to AR (Amateur or Allwave Receiver), and had produced the AR77. The latter unit had all the best technical features of the day, including crystal filter and calibrated amateur band spread. It was "the" receiver.

The AR77 was a short-lived design, however, since by 1939 the rumblings of what was to become World War II were reaching America. It is not known what happened to the Amateur Radio Section; however, in late 1938 or early 1939 the Home Instrument Division decided to build a "world-class" communication receiver. Its designation would be AR88.

For some reason, design of the AR88 was not to be based on the AR77, but was rather to be a

fresh start with a respected electrical designer - Lester T. Fowler. The lead mechanical engineer was George Blaker.

For those not familiar with the AR88, a few specifications should be cited. This receiver covers the 535-kHz to 32-MHz range in six bands. It does not have amateur-calibrated bandspread (as did the AR77), but uses the tried-and-true 0-100 logging scale. It does possess such modern features as a five-position selectivity (bandwidth) control switch, three of whose settings are crystal-determined. This gives bandwidths of 14 kHz, 8 kHz, 3 kHz, 1.5 kHz and 400 Hz. An adjustable series-type noise limiter which operates on percentage of modulation is provided (Les held the patent on this circuit). AM and CW are the operational modes. The circuitry consists of 14 tubes, including two completely tuned RF stages - 6SG7 with g_m twice that of the 6SK7 - and a three-stage IF system. All bands are individually temperature-compensated, assuring maximum

stability and alignment. A 6K6 tube provides 2.5 watts of audio power. The weight of the AR88 is a hernia-inducing 100 pounds. In sum, the sensitivity, gain, and selectivity offered by the AR88 are fantastic.

The picture shows the author's CR88, a descendant of the AR88 (1945-46), prior to restoration efforts. Note the misfit knobs and nameplate holes, together with the V-shaped cluster of RF, audio, and phasing controls in the center bottom of the panel. The original AR88 had the phasing control fixed inside the unit; hence only RF and audio controls were exposed on that model.

The new AR88 went into production at the Camden plant late in 1939. Because of Lend-Lease agreements with Great Britain and the USSR, demand for the radios exceeded Camden's scheduling capacity; the RCA plant in Bloomington, Indiana, began production to fill in. Later the Grigsby-Grunow Company of Chicago was commissioned to produce AR88s.

The Canadian Government then became interested and, after mandating some modifications by RCA, started buying the units from the RCA plant in Montreal. The Canadians had decided that the lower frequencies were more important than the broadcast band, hence a design change to provide coverage from 73 to 550 kHz and from 1.48 to 30.5 MHz. Six bands were still used. The

Canadians must also have anticipated using their AR88s near high-power transmitters, since their design changes also included the incorporation of a "gas discharge" type arrester on the antenna circuit. The resulting Canadian variant was designated the AR88LF.

The Soviets also required low-frequency capability. Apparently, a great deal of their prewar equipment operated between 70 and 500 kHz; the AR88LF proved compatible with this gear. To provide the low-frequency bands, a new IF frequency was required. The standard 455 kHz was therefore changed to 735. The designation of the Russian sets is unknown. They did not include the gas-discharge arrester, and their units generally became known as the Third Version.

The Fourth Version was configured as a triple-diversity receiver (DR89). This was actually three AR88s (with IF level-sensing receiver output) in a six-foot rack, together with signal monitoring and sampling panels that were used to select the

receiver output with the strongest signal and pass it on to a tone keyer. The system used three antennas, spaced about 1000 feet apart, configured as an equilateral triangle. An antenna was coupled to each receiver. For military use, this assembly was coded OA-58/FRC.

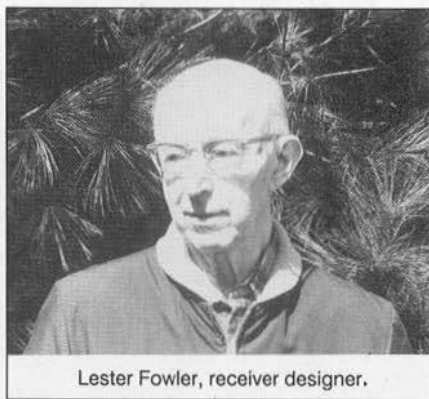
Les told an interesting story associated with this design. When completed, it was evaluated at an RCA installation on

Long Island. With the standard receivers (type unknown) in place, only noise was present on many of the long-path links that were in use. With the DR89 diversity system in place the first link tried provided reliable communication with India. The future of the diversity AR88 was assured that day.

AR88s were thereafter installed in all major stations run by RCA, including WCC at Chatham, Massachusetts (Cape Cod), and WSC in Tuckerton, New Jersey. These receivers were still in use through at least December 1976 - 35 years and more after their initial design.

As time went on, spare parts for these 24-hour-a-day operational receivers had to be obtained from such far-flung parts depots as Tangiers, in Africa, and San Juan, Puerto Rico. The AR88 family was displaced only by the advent of communications satellites.

Les tells us that, during the initial design phase,



Lester Fowler, receiver designer.

the Naval Research Laboratory in Washington got wind of the development of the "world-class" receiver and requested that RCA provide them a set for evaluation. They were particularly interested, it seems, in testing the radio's stability under shock conditions (such as when 16" guns were fired), and for oscillator radiation. Les took a receiver to Washington and, while the receiver withstood the shock well, the shock machine disintegrated! Oh well, gobs, back to the drawing board! The radiation problem was tougher to beat but the design of the AR88 lent itself to the shielding and filtering requirements laid down by the Navy. The two tuned RF stages decouple the antenna from the oscillator. The NRL had established a maximum value of $20\text{ }\mu\text{W}$ for this function. With the shielding modifications, Les states that a value of $40\text{ }\mu\text{W}$ (40 pW) was obtained at any frequency over the dial. I wondered how values of this magnitude were measurable with the equipment available in 1939. Les informed me that he used another calibrated receiver to verify these values.

Les neither helped design nor saw the Fifth Version of this famous receiver. It featured a shock-mounted enclosure and was installed on all manner of landing craft first used on D-Day. These units apparently performed well since the operation was a success; I am not aware of communications breakdowns on that day other than those to be expected as part of such a massive undertaking.

The AR88 continued in production during the war, along with such other notable receiver designs as the BC-348 (a product of the "Old Man" - H. A. Robinson, W3LW) and countless other military units. It is unknown when the last '88

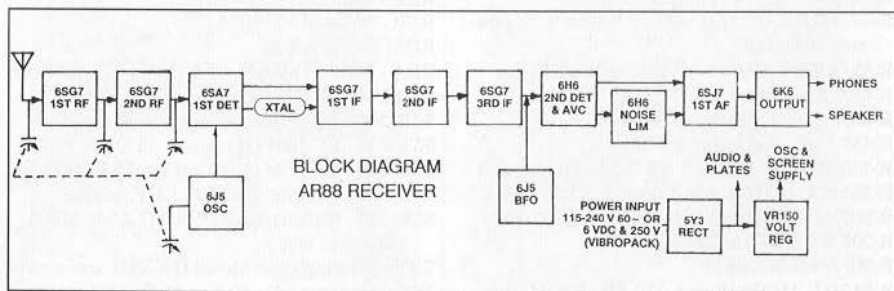
rolled down the assembly line, but it may have been as late as the early 1950s.

Sam Thompson, W6H DU, an avid '88 collector, has filled in a few blanks regarding AR88 configurations. Apparently, a large number of AR88s were produced during the war with the customary black wrinkled finish (for example, the Navy's version, RDM-1). We would assume that the same was true of the large number of Lend-Lease units. Sam knows of a government station in the Pacific which reported that their unit had a smooth black lacquer finish. Les further states that, to his knowledge, all AR88 units were painted a flat black. The author can only assume, therefore, that the AR88 and its variants came in "all flavors."

The CR91 is a low frequency version with a smooth, grey-finish panel. The CR88 likewise has a grey panel. A version known as the SC88 is also known to have been made, but little is known about it.

The CR88B variant was probably the last produced. This unit had push-pull audio and a crystal calibrator, among other refinements. Sam and I are still working on getting a look at this model.

RCA Camden did not return to the amateur-radio market after the war. RCA also curtailed its commercial HF and communications receiver design effort. Instead, the U. S. Government beckoned for HF, VHF, and UHF systems. Eventually, microwave transmission and satellites took precedence. Today, the only vestige remaining of RCA's HF business is a namesake of the famous AR88, the AN/URC-88. This is a military transceiver which provides communication for many of our front-line defense systems. Time marches on!



Radio  **Corporation**
of America

