The COMMUNICATION RECEIVER

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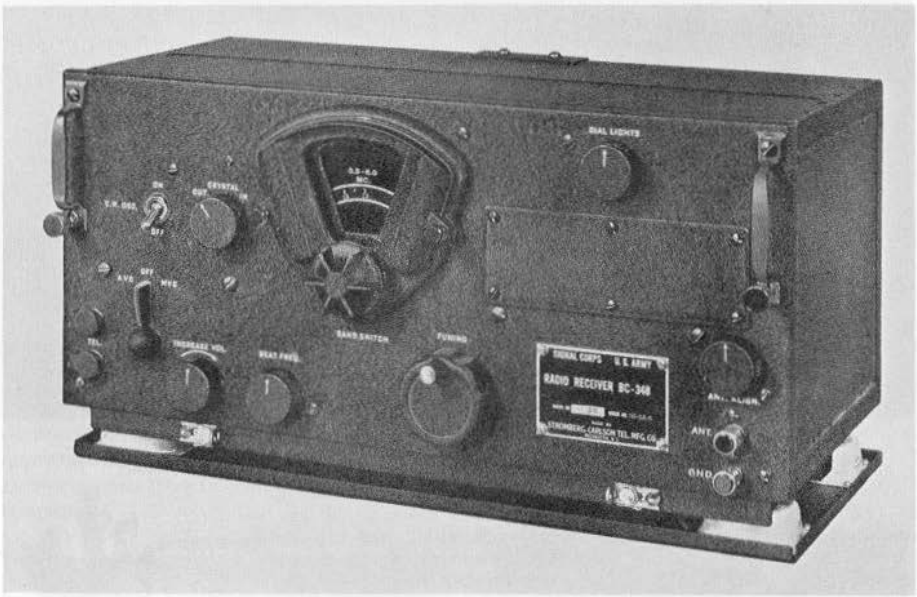
THE BC-348 HIGH FREQUENCY AIRCRAFT RECEIVER



A BC-348 receiver manufactured by the Stromberg-Carlson Mfg. Co. of Rochester, N.Y.

There are few American radio amateurs from the era of the 1950's and '60's who have not had some experience with classic items of WW II electronics surplus. One of the best and most sought after in those days was the BC-348 aircraft receiver. Designed in the mid-1930's, it remained in use by the Allies throughout the war and on into the Korean conflict as a multi-use general purpose communications set.

A great deal has been written on "improving" or otherwise modifying the BC-348, but virtually nothing has emerged from the literature concerning its origins. Moreover, retired government employees who were approached by the writer and who had been involved with production and maintenance of the receiver knew that it was in use before Pearl Harbor, but had little knowledge of its background. Finally, acting on a tip from K2LP, the original electrical design engineer, H. A. Robinson, was located and contacted, and the tale unfolded.

But let's let "Roby" Robinson tell his own story ....

Bill Fizette, K3ZJW

RADIO RECEIVER BC-224/348

by H. A. Robinson, W3LW

"In 1934 the Signal Corps of the United States Army invited interested design engineers and potential manufacturers of specialized military radio receivers to a technical conference in Washington, D.C. The purpose of this conference was to complete a technical specification for H.F. receivers, primarily for long-range aircraft (liaison) communication in the 1.5 to 18 mc frequency bands. The design engineers' comments for a comprehensive spec were presented and discussed from the standpoint of the military need, the then present state of the art and anticipated future performance. All phases of the design requirements to be covered in this specification were to include a minimum acceptable performance and a considerably higher performance objective. These phases included typically, sensitivity, signal/noise, frequency stability, dial accuracy/resetability, I-F/image spurious responses, fidelity/output, power input, size and weight.

"Performance parameters were established for standard (lab) conditions as well as performance over the full range of airborne military service. Any interested and potential manufacturers were to design and produce a prototype receiver at their own expense and submit the model to the Aircraft Radio Laboratory at Wright Field (Dayton) for measurement, service testing and evaluation by point scoring on each of the technical requirement - i.e., scoring points for the measured attainment in excess of of the minimum acceptable for each phase.

"Since this required design and prototype model was to be produced at the expense of the potential manufacturer it is not surprising that only a very limited number of companies submitted radio receivers – namely General Electric and RCA; these models were designated BC-224 X_1 and X_2.

"The GE receiver failed to meet some of the minimum acceptable requirements, while the RCA receiver successfully achieved all phases of the technical requirements. This receiver, designated the BC-224A, powered from the 12-14 V DC aircraft supply, went into the first production run at RCA, Camden, New Jersey (1936-37) in quantity of 650. In order to obtain the highest score in the evaluation, this receiver size and weight had been pared to the point where ruggedness and accessability for servicing (particularly around the multiple gang, six position RF band switch) could stand considerable improvement.

"By 1938 the Signal Corps released for bidding a somewhat revised specification incorporating and permitting many of these improvements and requirements. RCA was the successful bidder and the resulting prototype and production radio receivers were designated the BC-224B. These receivers included four separate, removable coil modules, each containing six RF coils and air trimmers for the six bands, an improved plug-in dynamotor power unit, improved and ruggedized tuning dial-mask assembly, and an invar (zero T.C.) 4-gang tuning capacitor with appropriate ceramic temperature compensating capacitors in the six-band oscillator module. This feature eliminated the dual thermostats and heat pack/insulation utilized in the earlier BC-224A for frequency stability.

"With the increasing usage of 24-28 V DC aircraft, the BC-224B was slightly redesigned with a 24/28 V dynamotor and revised tube heater circuits, and was produced by RCA as the BC-348B – all other characteristics remaining unchanged.

"As the long range military aircraft became involved in over-water flights, the need for a lower frequency band (200 to 500 kc) for ship contacts became an urgent need. Since the BC-224/348 receiver design already utilized an IF at 915 kc it became a relatively easy design modification to add this lower band and redistribute the 1.5 to 18 mc range in five bands. All later wartime production of both the 12/14 V BC-224 and 24/28 V BC-348 receivers included these modifications.

"In view of the escalating war needs, RCA was requested by the Signal Corps to make available all necessary sets of drawings and manufacturing information along with engineering assistance, as needed, to a number of qualified radio-receiver manufacturers. This was done and subsequent BC-224/348 receivers were produced by, in addition to RCA, Stromberg-Carlson, Belmont Radio, and Wells-Gardner, with each contract and order designated by a different letter suffix."

(Continued on next page)

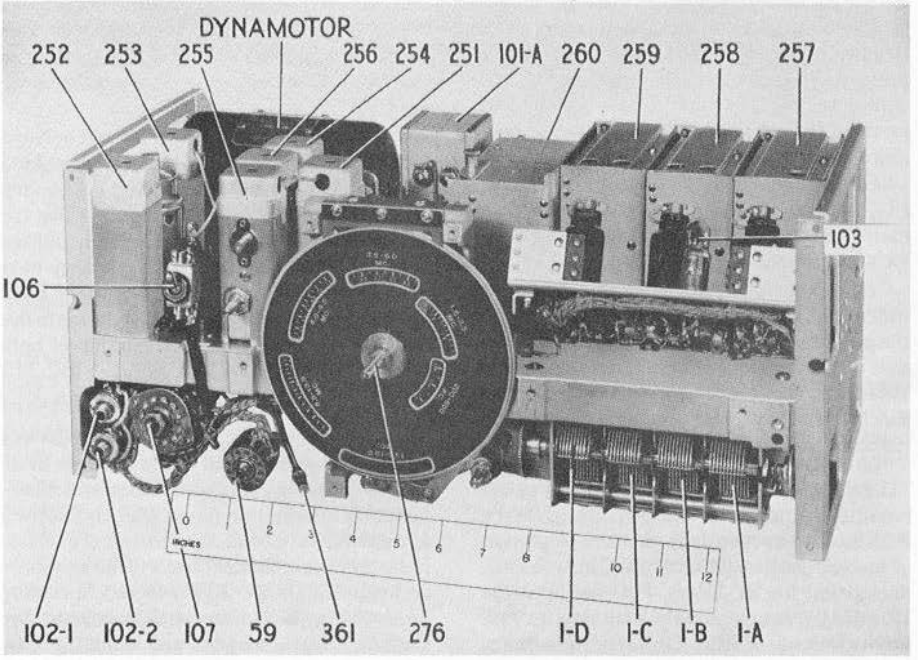
For those who have not experienced a BC-348, a brief description is in order. The receiver is a locally controlled, 8 tube, 6 band superheterodyne intended for use in long-range U.S. Army aircraft, covering the frequency ranges of 200 - 500 kc and 1.5 to 18 mc in 6 bands. Manual or AVC could be used in the reception of voice, tone or CW. The unit was complete, with all power components and coils entirely self-contained. Power consumption was 56 watts at 28 V DC.

The list of technical specifications provided by W3LW brought up some questions, and for the price of a phone call, a number of answers. Among other design requirements, the dial had to be direct reading with a calibration accuracy of 0.5%. Tuning and resetability requirements dictated a worm gear drive with no backlash. The mechanical design engineer, Jack Terrel, W3FDF (now a silent key), created a tuning/band-change mechanism which was a mechanical marvel, considering the state of the art in communications hardware at that time.

The receiver was required to be stable over a temperature range of −40 to +55° F, and this was accomplished by using invar alloy for the tuning capacitor along with temperature compensating capacitors in the oscillator. A spec for noise equalization across the dial was met by ganging a variable resistor in the cathode of the 2nd RF stage to the tuning capacitor.

Since the receiver had to be operated under combat conditions, the controls were required to be relatively simple. The RF and audio gain controls were ganged, with the proper circuit being chosen by the AVC/MVC switch. A dial light dimmer control was a must for night flying. All the small knobs were fitted with internal "drags" to preclude movement from aircraft vibration.

Progressing through the circuit, the front end used two RF stages, undoubtedly influenced by the success of the HBO design. The mil spec required a sensitivity of less than 7 microvolts, and this was easily met: the average sensitivity was 1.2 microvolts. And why an IF of 915 kc? The image rejection specs dictated an IF in the broadcast band, so Robinson chose a frequency in a low activity area, midway between the 10 kc station spots.



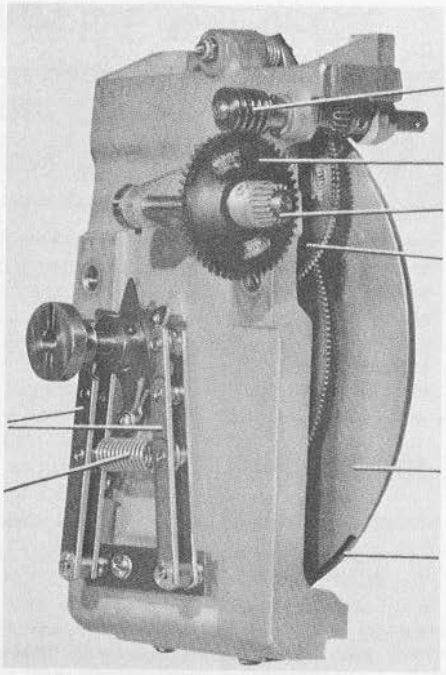
Chassis with panel removed

And why were two glass tubes, the large 6F7 and 41, used in the production models of a receiver which was to be subjected to substantial physical abuse? Simply because at the time the BC-224B design was frozen, there were no equivalent metal tubes available to replace them, and they remained in circuit, apparently without major problems. Later versions did use a smaller 6K6 audio output tube. Also, whether by accident or design, the use of a soft aluminum alloy for the panel and cabinet probably contributed to the receiver's ability to take punishment by absorbing shock.

The dual 4000/600 ohm output transformer was chosen because the majority of Signal Corps headphones at the time were of the 4000 ohm variety. The 600 ohm lower-impedance models were arriving on the scene, however, so both outputs were required. The average audio was 590 milliwatts on MVC and 830 mw on AVC, a little weak for a speaker, but more than adequate for headphones and connection into the aircraft interphone amplifier.

There are two basic versions of the BC-348 receiver, the original RCA design which was copied by most of the other contractors, and a revised and simplified model manufactured by Wells-Gardner, who began making them around 1943 - 44. Their redesign was more broadcast-set oriented, and used all single ended tubes. The external appearance and presumably the overall performance specs of the receiver remained the same.

For the collectors among the readers, the BC-224A first production run can be identified by having a tuning range of 1.5 to 18 mc, by its use of the older glass tubes such as the 6D6, and by the single large coil box. Aside from that, the models with the lower letter designations are probably from the earlier production runs.



The precision dial mechanism

The next column will spend more time with the BC-348, concentrating on getting it going again. It is still a good receiver, even today.

-- K3ZJW

Smithsonian Copes with $8.6 Million Budget Cut

Selective hiring freezes, curtailed equipment purchases for research and collections management, cancelled public programs and cutbacks in hours are among the ways in which the Smithsonian Institution will deal with the $8.6 million budget cut required by the Gramm-Rudman-Hollings Act. The institution's FY '86 federal budget is $199.9 million. The reduction of 4.3 percent required by the act follows a two-percent base reduction and other earlier cuts in FY '86 funds, representing a total of more than $20 million in reductions from the amount requested for the year.

Activities related to research have been reduced by $1.7 million, affecting the purchase of equipment, support of research projects and preparation of scholarly publications. Activities related to collections management will be reduced by approximately $1.3 million; exhibitions and other public programs will absorb a reduction of $1.2 million. Cancellations or postponements of exhibits will save an estimated $500,000; activities related to buildings and facilities management and general administration are being reduced by $3.4 million. The Smithsonian has also found that, given the budgetary restrictions, it would not be possible to institute extended summer hours in 1986.

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