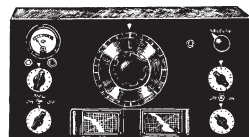


THE COMMUNICATIONS RECEIVER



BY **BARRY WILLIAMS, KD5VC**, 2002 MUSTANG LANE, ROSHARON, TX 77583
E-MAIL: barry.williams@nov.com

The National AGS

This is a two-part article which presents the various types of AGS receivers and describes some of the differences. Work could not have proceeded without the help of a dozen or so AGS owners who have provided information. Greg Gore and Henry Rogers have greatly assisted in tracing the history of the AGS series. I hope to hear from other owners of AGS receivers who have additional information or corrections.

One of the most interesting periods in the development of radio receivers is the era between the late 1920s and the mid 1940s. One driving force was the adoption of radio by the airlines industry. In order to provide a backbone for the development of commercial air mail and, later, passenger service, the Post Office developed a transcontinental airway system. By 1927 it stretched 2,612 miles from New York to San Francisco and was equipped with 101 electrically lighted beacons, 417 acetylene beacons, and 17 radio stations. (Perhaps all this lighting equipment explains why early airport radios were tagged for the Department of Lighthouses).

This airway was eventually transferred from the Post Office to the Department of Commerce's Aeronautics Division. In 1928 12 more radio stations were added. These stations were capable of keeping the pilots informed of weather conditions while in flight. In the United States, thanks to the foresight of Herbert Hoover Jr. and Thorp Hiscock, radiotelephony was standardized as the mode for air communications while other countries were still using telegraphy.

In 1929 the Federal Radio Commission set aside specific frequencies for aircraft communications. Beacons and weather or other information was transmitted by

ground stations in the low to medium frequency range (285 to 350 kHz). Transmissions from air to ground took place at two frequencies: 3105 kHz and 6210 kHz for day or night use.

In December, 1929 The Commerce Department suggested that the airlines jointly establish a research facility for the development of aircraft radio. Fifteen air carriers set aside a total of \$100,000 for this purpose. The non-profit company they formed, fittingly named Aeronautical Radio, Inc. (ARINC) still exists today.



RHM front panel.

In 1928 a receiver for aircraft beacons and radiotelephony was already being developed by Haraden Pratt and Harry Diamond at the Bureau of Standards. Their results were reprinted in the *Proceedings of the Institute of Radio Engineers* Vol. 17 No. 2, February, 1929 with the title "Receiving Sets for Aircraft Beacon and Telephony."

That article mentions three types of sets: (1) military for use over wide frequency bands; (2) for the reception of beacons and telephony from the Government supplied stations for the civil airways under the air commerce act; (3) for reception of high frequency signals (above 1,500 kHz).

The then current practice in Europe was centered in a narrow band of frequencies

between 315 kHz. and 350 kHz. The International Radio Conference of 1927 set aside the band 285 kHz to 315 kHz for beacons in general and 315 kHz to 350 kHz for aircraft beacons. The receiving sets for aircraft service developed at the Bureau of Standards covered the frequencies between 285 kHz and 350 kHz.

We believe that ARINC developed detailed specifications for ground receivers. These included low frequency receivers for listening to beacons and weather information transmitted by adjacent airports and a high frequency receiver for listening to the transmissions from the airplanes at 3105 kHz and 6210 kHz as well as government weather transmissions in the shortwave spectrum.

These specifications led to the production, during 1932-1935, of the National AGS (government designation RHM), the deForest RRH-10 (government designation RHO), and the National AGU (government designation RHQ), all for short wave reception. It is possible that the "RH" designation indicated "Receiver, High Frequency," with the M, O, and Q suffixes designating different models. The long and medium wave receivers included the National 58C and AGL. The government designation for the AGL was RIP, which may have been for Receiver, Intermediate frequency, model P. I have not found the government designation for the 58C.

There have been articles in *The AWA Journal* and several other publications that described the AGS and the requirements that led to its development. This paper was written to try to establish and describe the number of variants.

The AGS represented a landmark development in receiver technology and is now quite rare. Based on the serial numbers that have been found, we would estimate that approximately 450 units were built in four different variations. Most of these receivers were purchased by the U.S. Government to be used in airports. Probably less than 100 went into the hands of wealthy amateurs or short wave listeners, and almost certainly less than 100 remain in the hands of collectors.



RHM chassis top.



RHM coil set.

We are aware of at least 20 of these remaining examples and have gathered this information with the help of their owners. In order to keep the variations separate we will divide them by serial designation. The first type has a two digit serial number, though there may be a few units with single digit serials. These were all provided to the Bureau of Lighthouses for use in Airports. The governmental designation of these units is RHM and that will also be our designation. It appears that the initial order might have been for 100 units.

The second version of the AGS has a serial designation made up of one or two digits preceded by the letter "C." We will designate these as the "C" series. It appears that less than 80 of them were built. The serial designation of the third version is made up of one or two digits preceded by the letter "E." There appear to be less than 100 of this variation, which we will designate these as the "E" series. The fourth version of the AGS has a serial designation made up of one to three numbers preceded by the letter "F." It appears that perhaps 170 of this variation were produced, with this greater number probably due to the delay of the introduction of the HRO.

Though we found multiple samples of

each of these four series, we did not find any units using the letter "D" preceding one or two digits. It is known that the earliest serial designation of the HRO had that configuration, so it is possible that this letter was reserved for the HRO only. However there are HROs as well as AGSs with "E" and "F" serials.

The National Company AGS receiver was one of the first high performance superhetrodyne receivers. The preceding superhetrodynes include the RCA RAB, the National FB7, and the Hammarlund Comet. The RAB was a 455 pound monster that only the military could have afforded; the Comet lacked an RF stage, and at least initially it lacked an AVC and a crystal filter. Later, the AGS was replaced by the justly famous HRO.

The front panel of the AGS series is 1/8" aluminum with a black wrinkle finish, a much smoother finish than that used in the non-rack mounted National receivers. The chassis consists of a heavy aluminum forging of approximately the same thickness as the front panel. The front panel is correct for the standard 19" rack and uses 8 3/4" of rack space. Being of aluminum with an external power supply the receiver only weighs about 25 pounds. There are both top and bottom covers.

The AGS used an RF amplifier, local High Frequency Oscillator with separate mixer, two stages of IF amplification, Beat Frequency Oscillator, 2nd Mixer (Detector), Audio Amplifier and separate AVC tube. Similar circuits were used in receivers through the 1960s. Also available on at least some models was a crystal filter which gave superb selectivity for CW reception. The use of a tetrode High Frequency Oscillator in the Electron Coupled Circuit gave very good stability.

The receiver used five sets of coils made up of an RF coil, a Mixer Coil and an HFO coil. These plugged into the front panel of the receiver to allow it to be panel mounted with all controls up front. Plug in coils allowed each coil to be optimized for its frequency range without losses from unused coil sections.

Tuning was via a National Velvet Vernier

dial. The design of the dial allowed 270 degree rotation with 150 divisions. With the vernier scale, this allowed setting the dial with an accuracy of one part in 1500. The three variable capacitors were linked by a rack and pinion. The more important HFO variable capacitor is directly coupled with the RF Amp and Mixer tuning capacitors driven by pinion gears on the rack. Cleaned and with a small amount of light weight grease, this tuning system is quite smooth.

One mark of the high quality of this receiver is the voltage divider resistor design. Instead of a single tapped resistor, National used an insulating board on which individual resistors were mounted. Failure of one section of the voltage dropping network could be corrected by replacing a single resistor instead of a complete tapped unit.

The resistors used in the receiver are of high quality with the values written by hand in blue ink. Some capacitors were imported from Germany to get the highest available quality. These receivers were on the leading edge of the then current technology, and were works of art as regards their construction. Indeed, many of these receivers work with their original components after 80 years.

The intermediate frequency of these receivers was near 500 kHz. At least one had the original crystal holder for the crystal filter marked as 522 kHz. At this state of the art, it was easier to align the IF transformers to the crystal than to try to insure that each crystal was at exactly 500 kHz. Something I did notice on my favorite AGS is that the inductance of the IF transformers has decreased with age. William Orr mentioned finding this same phenomenon. He thought that it might be caused by shorting of some turns with age. Mine could not be brought into alignment with the original adjustment, so I added small NP0 caps to get them into range.

The IF transformers in some cases use compression trimmers (short IF cans) and in others use air variable trimmers (tall cans). The coils varied in design between the earlier and later receivers. In general the earlier coils have the finger pulls glued on; the later coils

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The schematic page also gave directions for radio alignment. I used old Eico and Heath gear for this step, so there was a slight déjà vu aura in the shop, as I trimmed the front end, local oscillator and IF stages. For all its uneventfulness, this was an exciting last step in the process. I proudly put up a noisy 18-second YouTube clip (under “AA2YV”), and then later a 2-minute clip, when it was hooked up to a good antenna and a Z-match tuner.

I ran the radio for a few hours just to make sure I could ship it. In the process I decided that the normal heat produced by the transformer should be abated, so I chose a small 12 volt DC donut fan and

powered it with 5 volts to reduce noise. The fan is mounted on a small stand I constructed out of double-sided copper PC board pieces, all of which I soldered together. Its “foot” will fit nicely under the radio to give it stability and help hide it. No hum is detected in the nearby radio.

I can’t tell you how the radio is faring today, as it is plugged into the wall of a Manhattan residence. It’s anyone’s guess if stray RF in that island neighborhood will permit easy listening to broadcast radio or one of the many shortwave stations from China. But it’s a fine piece of retro-furniture that should give more than just decorative pleasure for years to come. 

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had the finger pulls attached by two screws.

The vacuum tubes used in the AGS were originally of the 236, 237, 238 types. These were designed for use in automobile sets, so had a rugged internal structure, and worked well with some variation in heater voltage. Later the 38 was replaced by the 89, and in the last version some of the 70 series tubes are used.

The AGS used an external power supply. National offered single and double power supplies for rack mounting to match the AGS receiver. The GRSPU was a single power supply available for 2.5 or 6.3 volt AC filaments. The AGS used the GRSPU-

6. In the case of airport use, the receiver rack normally included a low frequency receiver. In order to power the two receivers National offered the GRDPU a dual power supply available again with 2.5 or 6.3 volts AC for the filaments. In the GRDPU the power supplies could provide the same filament voltage, or two different voltages.

Inside the power supply, the GRDPU has two complete power supplies that are totally separate from the AC Power switch to the type 280 rectifiers. The filament glow from the type 80 was used to indicate whether the power supply was on or off, there was no power indicating pilot. 