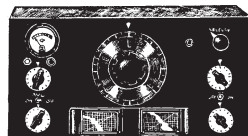


THE COMMUNICATIONS RECEIVER



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The National Non-Radiating Shortwave Tuner

Announcement

After 25 years and over 100 columns, the writer has decided it is time that younger blood took over the reins of the Communication Receiver column in the AWA Journal. Accordingly, starting with this issue, Barry Williams, KD5VC, will become the new Column editor.

Barry is no novice at this work. He is an engineer, a recognized radio historian, and an accomplished writer. He authored the landmark article on the development of the HRO receiver and its use in WWII in the 2004 issue of the AWA Review, and several of the AWA Journal Communication Receiver Columns, including the last three on the Pilot Wasp series of receivers. We are fortunate to have him, and Journal Editor Marc Ellis and I wish him all the best.

The Communication Receiver column was started at the behest of OTB Editor and

founder Bruce Kelley, with the first submission in the March, 1985 issue on the Hammarlund Comet Pro. While the writer has researched and authored the majority of the columns, it is necessary to recognize that guest writers, many unfortunately now "Silent Keys," have contributed significantly over the years, and our thanks go to them all. Special thanks go also to Journal Editor Marc Ellis, who has supported our efforts most faithfully over the years, and put up with the usual problems such as 12th-hour deadlines, so common to the publishing field. It has been a real pleasure working with him.

Finally, a special note of thanks to the readers, whose letters and emails have meant so much. A summary list of the columns has been prepared, and if there is enough interest, perhaps the editors will see fit to publish it.—William B. Fizette, W2DGB, Henryville, PA, August 2010

“**T**he Receiver That Started it All, The SW-2” was Bill Orr’s description of this simple two tube receiver. Researching early literature, I’ve seen no indication that National ever used the SW-2 designation, though they did call it the “Thrill Box” in one advertisement. What we call the SW-2 was available in two or three tube versions. The three tube version was not the SW-3 with which most of you are familiar. The title of this article is the one that James Millen used in his article introducing the receiver.

The SW-2’s RF Amplifier

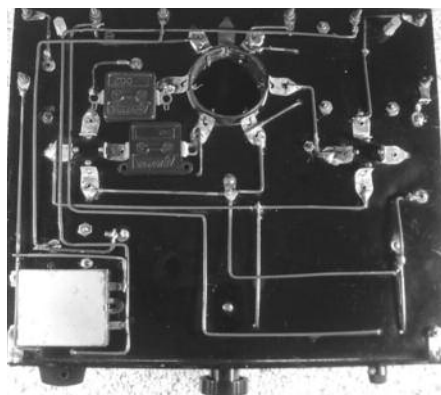
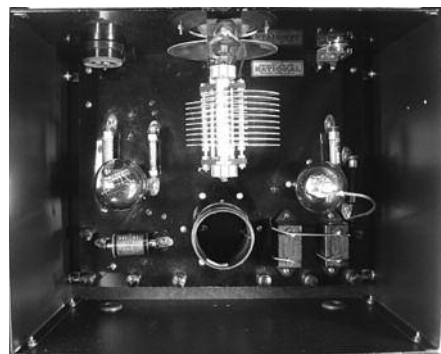
Like the typical amateur receiver of the period, the two-tube version is a simple set. Both designs used a triode grid leak detector. In the typical receiver this was followed by a stage of headphone-level audio amplification. However, in the SW-2, the then

newly-released type 222 screen grid tube was used ahead of the detector as a stage of untuned RF amplification. The detector was a 112-A triode.

In December of 1927 *QST* had several articles devoted to the new screened grid tube. The triode RF amplifier used prior to the release of the 222 had to be neutralized due to its high grid-to-plate capacitance. Neutralization counteracted the regenerative effect of this capacitance by using a capacitor similar in size to the tube grid-plate capacitance connected to produce a degenerative character to the circuit outside the tube.

Maintaining neutralization over a large frequency range was quite difficult. Several different circuits were used, including some that used inductive degeneration. However, the 222 with its low grid-plate capacitance generally did not need neutralization.

The use of the 222 RF amplifier helped



The SW-2 two-tube version. Note cabinet details in middle view (see text).

deal with antenna interaction, a problem with the simple receivers of the late 1920s. At various resonance frequencies the antenna, essentially a tuned circuit, would interact with the detector tuning, creating “holes” in the tuning range where no signals could be heard.

Moreover the antenna was not a stable frequency circuit. Wind or changes in weather or ground conditions would alter the resonant frequency, which also reacted with the detector tuning to vary the received

frequency. Though there had been prior work using the available triodes to isolate the antenna and detector circuits, the 222, even untuned, provided some gain as well as better isolation. It also greatly reduced the RF produced in the regenerative detector from being transmitted via the antenna.

The 222 stage was left untuned in order to simplify the tuning of the SW-2 (“As easy as opening a door with a single knob”). Millen indicated that the untuned amplifier gave gain of two to three over the range of the receiver. The maximum theoretical gain available in a neutralized triode was calculated by Browning and Drake to be about eight.

Since the 222 (like the 112-A detector tube) did not have a heater and cathode, it would require a DC filament supply. In the late 1920s, filaments were battery powered—typically by 6.3-volt lead-acid “A” cells, connected through a voltage-dropping resistor.

In the case of the 222, the voltage had to be dropped to 3.3; the 112-A required five volts. The filament voltages were developed by using “Equalizers,” actually high wattage fixed resistors (of 2 ohms and 15 ohms for this receiver). The 222 also required two “B+” voltages—about 45 for the screen and 90 for the plate, while the detector operated at about 45 volts.

Antenna and Detector Considerations

The antenna RF voltage was generated across a National type 10 “HF Impedance” (RF Choke). These looked like the plug-in grid leaks, having a cylindrical center and two large pointed ends about twice the diameter of the tube. The cylinder held a single layer of #29 wire.

Since any voltage from the antenna was impressed across this inductor, a strong overload from a local transmitter or lightning strike would burn it out. They were often advertised separately in a corner of the SW-2 advertisements at a cost of \$1.00 each.

The limited selectivity of the single tuned circuit at the detector of the SW-2 was the same as that of the regenerative grid leak detector and audio amplifier receivers that were standard prior to late 1927. However there were some differences in the circuitry. For in-

stance, instead of using a “throttling” capacitor or variable link coupling to control regeneration, the SW-2 used a fixed link and a variable resistor in series with the detector B+.

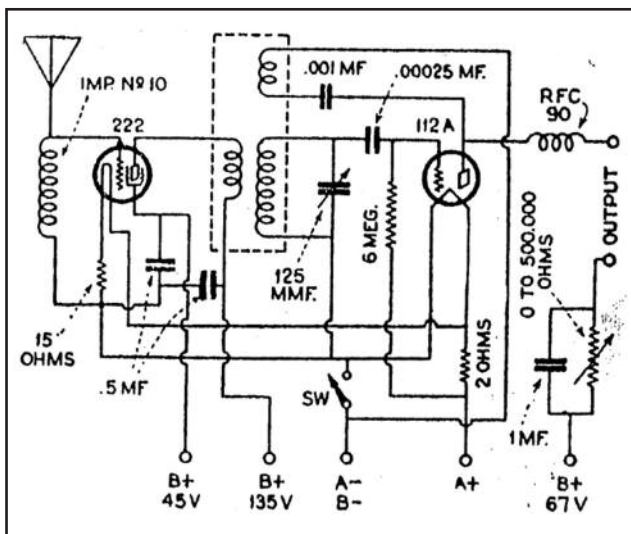
In triode circuits the grid will draw a small amount of current. By using a grid leak resistance of 2 to 10 megohms, that current would provide a bias voltage to the tube of about 2 volts. This voltage was variable, but the detector systems were not linear circuits, so distortion by the amplitude component of the incoming signal was not significant.

The triode grid current would also vary between tubes. Due to this, most manufacturers recommended trying several different values of grid leak if there was a problem.

The rest of the circuitry in the SW-2 is pretty simple. It used four interchangeable coils to cover from about 20 MHz to about 3 MHz. The coil coverage is shown in the included illustration. The output was taken from the detector through an RF choke to go either to headphones, or to an external audio amplifier. One other departure was the use of a 112A power tube in place of the 00, or 01A detectors in most receivers of the era. Since the untuned RF amplifier amplified any signal on the antenna with no discrimination between a broadcast signal and a weak amateur signal, a tube with a wider dynamic range was required to reduce overloading the detector.

Coils

At this time coils were wound on various forms, from the famous Quaker Oats cylinders to various blends of plastic resins. The coils used in the SW-2 were of a phenolic resin with wood dust as a filler. In operation these coils were found to be hygroscopic. The “Q” and inductance varied with humidity as the relative humidity changed. Because of this the tuning points and the



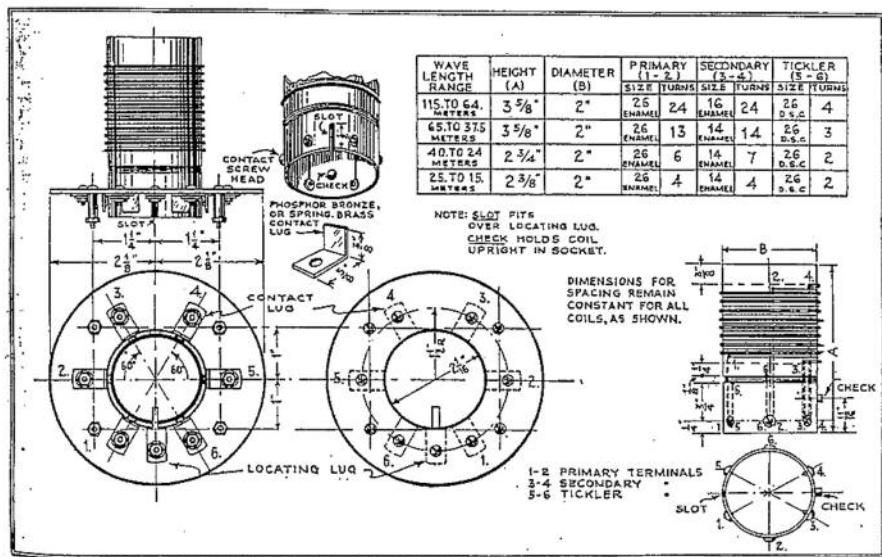
Schematic of the 2-tube SW-2.

performance of the receiver could vary from day to day. In 1929 this was corrected by substituting ground Mica as a filler in the phenolic resin (R39).

The SW-2 was produced for only about one year, mid-1928 to mid-1929, when the SW-4 receiver took its place. This made what was essentially a short-wave tuner into a short-wave receiver that, like the three-tube SW-2, could be used for headphone listening. Though the two-tube set is rare, it is seen more often than the three tube SW-2 or the follow up product, the four-tube SW-4.

The three tube version was laid out a little differently to allow the addition of an audio transformer and tube socket. One of the National advertisements for the “Thrill Box” appeared in the December 1928 *Radio News*. It claims that a customer in Haverhill, Massachusetts on September 15th, 1928 listened to the entire afternoon and evening broadcast of station 2ME of Sydney, Australia using the SW-2.

One SW-2 option rarely found today was the cabinet as shown in the pictures. This cabinet is very simple, as National did not yet have sheet metal tools for more elaborate designs. The cabinet sides are bent at each end, the back end is attached to the rear of the cabinet which is a flat plate with a second flat plate connected by hinges to



SW-2 coil data.

act as the lid. The front of the sides also have a small tab welded to each side to allow the front plate of the receiver to be captured between these tabs and the bend at the front of the sides. The bottom is attached with "L" brackets. Installing the receiver in the cabinet consisted of simply sliding the front panel between the tabs and the bent edge of the side panels. The original cost for the enclosure was \$6.50. One of these in excellent condition may cost almost 100 times that original cost.

Television

Why would National build a two-tube shortwave tuner without audio amplification? It happens the company had been producing short-wave tuners for Browning-Drake sets. At the time National was ready to bring out its own receivers, the spinning disk television system was at its peak. The signals for this system were transmitted by short-wave and required that a short-wave tuner be connected to a high fidelity audio amplifier in the receiving apparatus.

Because of that, and because of James Millen's personal interest in the medium revealed in his paper, the two-tube version of the set was the most popular. There were three product ads in *QST*, and one picture of

the SW-2 in the National annual. Three of these presentations show the Millen television set up including the SW-2, the audio amplifier and the spinning disk system. The audio amplifier was resistance coupled because the audio transformers available at that time did not have the required flat response over at least 10 kHz.

There were no production sets to allow reception of these television broadcasts. The prospective owner of a spinning disk set would have to buy or build a tuner, a high fidelity audio amplifier, and the mechanical system with a synchronizer, motor, and spinning disk designed for the format that he wanted to receive.

The original production of the SW-2 in two and three tube versions was estimated by different authors to be 50 to 500 units. Millen has said that there were fewer SW-4s than there were of the SW-2s. This would indicate something below 200 total pieces were produced.

I have an excellent version of the SW-2 shown in the National pictures. All the parts are correct. These receivers often have many of their parts replaced with modern components. For instance, the final RF Choke (National type 90) is often replaced

(continued on page 68)

map. These points had been used in previous field strength surveys. It was interesting to see the wide variation in signal strength. West of the station, the field strength was approximately 900 microvolts per meter, but in the null directions, the signal dropped to only 40 microvolts per meter.

WREN was sold to Pat Paton and Ted Cramer in 1985, but the new owners soon experienced financial trouble. The station was faced with IRS tax liens and lawsuits. It was forced to sign off on September 2, 1987, the same month that Governor Landon celebrated his 100th birthday. WREN was reactivated in 1993 by Michael Gliner with a southern gospel format, but this was apparently not successful.

The Topeka location went off the air permanently in March, 1997. The call letters were used for a brief time when the station



This statue of a wren, created by an unknown sculptor, became a symbol of WREN. It's now in a public park. (From www.roadsideamerica.com)

relocated to Kansas City, but WREN ceased to exist in 1999. Mean-

while, the Grantville transmitter building and towers were razed.

Today, the former transmitter site is farmland, with no evidence that a radio station was ever located there. The only remnant of this Topeka radio station is the large wren statue that formerly sat on the grounds of the WREN studio building on West Tenth Street. It is now located in Huntoon Park at 12th and Topeka Boulevard.

Most of the information for this article is from my own knowledge of WREN gained when I was an employee there. You'll find more information at <http://www.route56.com/radio/kc/wren.html>.

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with a later pi-wound choke or had added audio amplifiers.

I also have a front panel for the three-tube version, though I have not seen a three-tube chassis. If someone has a three tube chassis, please contact me. I would like a picture of one in any condition. The reference by Canfield is a home construction project which is a duplicate of the three-tube version of the SW-2. Please feel free to contact me concerning and questions or additions.

I would like to thank Bill Fizette for allowing me this chance to write for the most prestigious group of collectors and historians of radio and related gear. His help and guidance were instrumental in preparing me to attempt this challenge. I also want to thank Greg Gore for his help in acquiring the SW-2, and his guidance to the references shown below. I thought it fitting to choose the first National short wave tuner/receiver

for the first article under my byline. My thanks also to the people who have made the *Journal* such a fine periodical.
—Barry Williams

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