

THE JAMES MILLEN MEMORIAL STATION AT AWA

By

Robert J. Raide, W2ZM* and Williamk B. Fizette, K3ZJW

INTRODUCTION

James Millen, W1HRX, of North Reading, MA, needs no introduction to the reader interested in the development of the communications art through the 1930s. As the father of the famous HRO receiver, considered by many to be the most famous and long-lived single communications device ever produced, he was also the guiding light and chief engineer of the National Company which manufactured the HRO and numerous other receivers and communications gear for more than four decades.

During a September 1983 interview with Jim Millen at his homestead to gather background information on the HRO, K3ZJW was struck by the time-capsule appearance of his famous amateur station, W1HRX; it was the same as it had been back in the 1930s. During this visit a tentative agreement was struck for the W1HRX station equipment to be donated to the AWA museum. Two years later this was finally accomplished when an AWA team led by Bruce Kelley traveled to "The Farm at the end of Tarbox Lane" and moved the gear to the museum annex where it sat on display until the fall of 1993.

HISTORY OF THE STATION

During the 1930s a close relationship developed between the National Company and the nearby headquarters staff of the American Radio Relay League, mainly in the persons of James Millen and Ross Hull, the brilliant editor of *QST*. Hull, a native of Australia and whose brother was the technical editor of the Australian publication *Wireless Weekly*, liked to converse with the folks back home using amateur radio, so the story goes. Millen's station, located at his home in North Reading, state-of-the-art and running the full legal limit, was admirably suited for this purpose. When obtained by the AWA, the station was set for the 20 meter band.

Millen also used the station as a testing ground for National's amateur products, and the published literature of the 1930s included descriptions of the various circuits. In addition to individual components, the station included complete units such as the HRO receiver and the NSA speech amplifier.

The AWA James Millen Memorial Station

ATTENTION ALL RADIO AMATEURS:

SPECIAL W2AN MILLEN TRANSMISSION

When: Sunday, Dec. 4 and Dec. 11

Time: 3 p.m. to 7 p.m. EST

Frequency: 3867 kc $\pm$

Mode: AM - SSB - CW

To celebrate the restoration of James Millen's famous 1936 W1HRX high-power phone transmitter and his personal HRO communications receiver, AWA staff members will work as many stations as possible on all modes at the times noted. Special attention will be given to CW states on the EVEN hour. An unusual QSL card will be sent to all stations worked. Send QSLs to:

AWA Station W2AN

59 Main St., Bloomfield, NY 14469

RESTORATION OF THE STATION

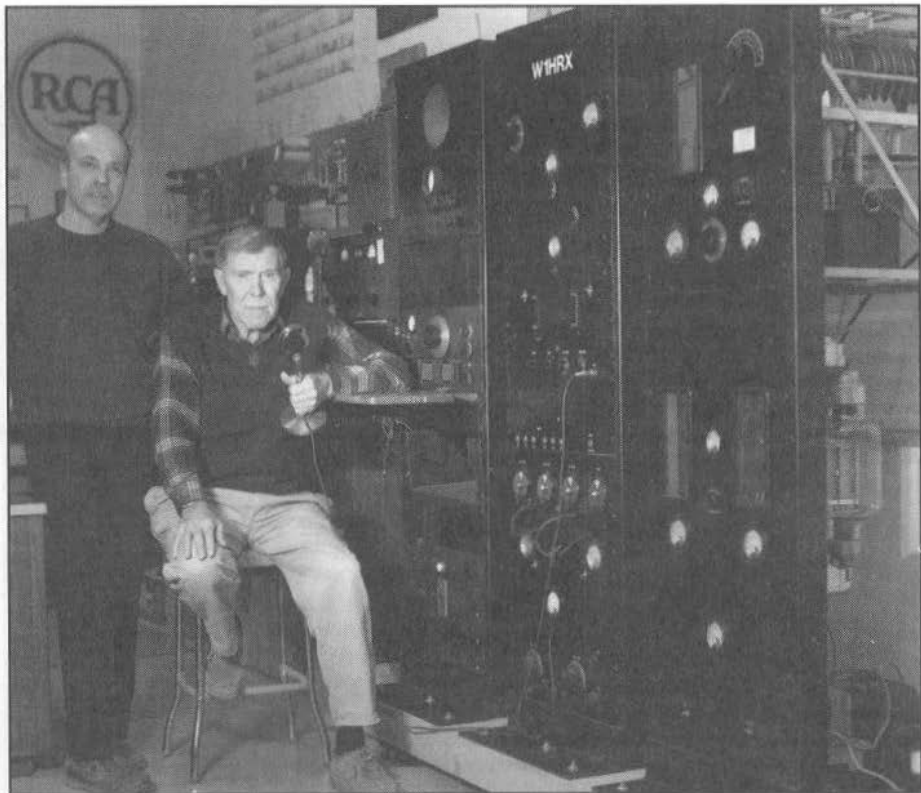
With the successful restoration of the AWA "Frank Jones 1930s AM transmitter" by W2ZM, the stage was set for work to begin on the Millen station. While conventional wisdom suggested that since the original modulation and plate power transformers were missing and the gear was so old that it was simply not feasible to put it back on the air, the writers accepted it as a challenge. W2ZM, with a commercial radio station background, agreed to redo the transmitter, and K3ZJW to redo the station's HRO receiver. With the blessing and willing cooperation of curator Bruce Kelley, the work began late in 1993. It was essentially completed by March 1994; the Millen transmitter was back on the air.

THE TRANSMITTER

Fig. 1 is a block diagram of the transmitter which consists of several discrete chassis mounted in three six-foot relay racks. A 53-crystal oscillator is followed by a pair of RK20s in push-pull, in turn coupled into the push-pull 204A finals. High level plate modulation uses a pair of 851s driven by a National NSA speech amplifier. Separate power supplies

* Robert J. Raide

893 East Lake Road., Dundee, NY 14837



Bob Raide, W2ZM (left), and Bruce Kelley, W2ICE, at the controls of the Antique Wireless Association's James Millen Memorial Station located at the AWA Museum Annex. The station operates under the call W2AN. The left rack of the restored station contains the operating desk with the HRO receiver directly behind the microphone, and the high voltage supply. The center rack has the IPA at the top with the NSA speech amplifier in the center. At the bottom are the high frequency multiplier stages which are not in use. The rack on the right contains the PA and the modulators. (Photo by Stan Avery, WM3D)

feed the oscillator and the high voltage needs of the RF and modulator sections. A conventional antenna matching unit mounted on the wall couples to the museum antenna, a large open loop.

Using detailed information provided by one of Millen's publications⁽¹⁾, it was apparent that the various chassis were in good shape; nothing appeared overheated, altered or missing. Notable exceptions were the modulation and power transformers, the originals of which were too heavy to transport from their Massachusetts location. Restoration consisted essentially of finding replacements for the missing transformers and reconfiguring the transmitter to transmit on the 75 meter phone band.

POWER SUPPLY AND POWER LEVELS

The HV plate supply originally was a large motor generator driven by a gasoline engine mounted outside the W1HRX shack. It would appear from the literature that the transmitter was operated at the then legal 1 kW input level with 2,200 VDC on both the PA and modulators. Plate current under these conditions would have been about 450 mA, and with the 0-1 amp. panel meter this seems about correct. This is further confirmed by the use of the 15 watt NSA speech amplifier to drive the UV851 modulators.

The immediate concern was meeting the present-day power limits, a maximum of 1,500 watts PEP output. With a plate supply of 1,500 VDC loaded at 300 mA to the 204As, and assuming 75 percent efficiency, an output of 1,350 watts PEP output could

be realized, close enough to the limit. A 1,500 volt supply capable of 525 MA was constructed using a pair of 866A rectifiers in full wave with a two section filter with a swinging choke for the input. The transformer selected was a Thordarson T44929, a 1,800 VAC each side of center.

This supply provided 70 MA to the RK20s IPA, 125 MA on voice peaks to the UV851 modulators, and 280 MA to the UV204A PA stage, a total of 475 MA. The -65 VDC bias supply for the UV851 modulators, heavily bled with a 100-watt rheostat for good regulation, is also included on this chassis.

THE MODULATORS

The replacement for the missing modulation transformer, a 1940s vintage 500-watt Thordarson multimatch type T11M78, was donated by AWA member Jack Wenrich, K2RY, along with the spec sheet, enabling us to set up a 1.15-to-1 primary-to-secondary turns ratio. This appeared to work perfectly, providing 100 percent modulation.

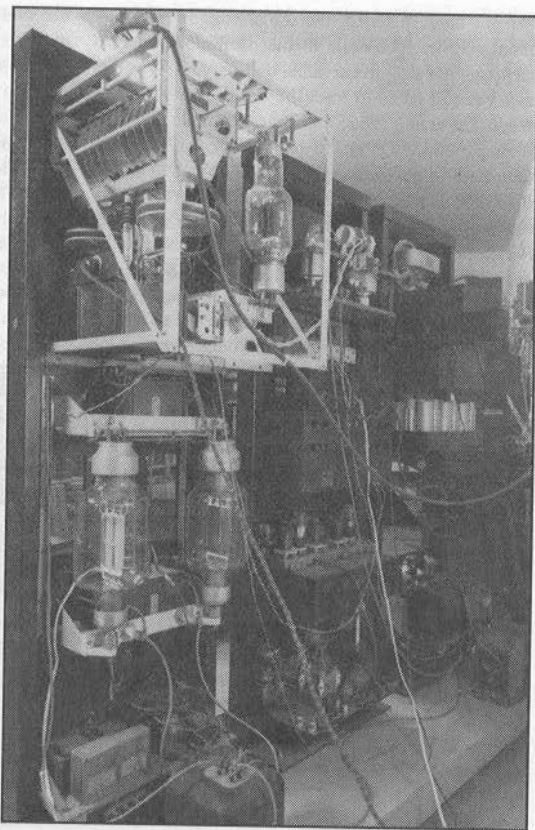
The NSA speech amplifier was made operational by replacing all paper capacitors with matching Mylars. The original can type electrolytics were left in place for appearance, and cartridge replacements were wired out of sight under the chassis.

THE RF SECTIONS

Because the decision had been made to put the transmitter on 75 AM phone and leave it there, it became necessary to move the RF stages from the 20 meter configuration. The crystal oscillator, using one section of the 53 dual triode, was already on 80 meters, and it was only necessary to inactivate the original multiplier stages and drive the RK20 IPA stage directly.

All of the coils and the grid and plate tanks of the RK20s and UV204A finals were wound to 75 meters. The final was a 34-turn, 3-inch coil of #12 copper wire.

On initial test, the original WE 251A 1,000-watt triodes in the final were found to have broken filaments and were unusable; several other 251As were also found to be defective. A substitutes had to be found. The venerable 204A appeared to be the best candidate. It is an early 250-watt triode of similar electrical characteristics and physical dimensions as the WE 251A. Also, with similar grid-to-plate capacity, the original neutralizing capacitors could be used, and best of all, a dozen spares are available. Two new sockets were made and the conversion was a simple matter.



The rear of the James Millen Memorial Station at the AWA Museum. (Photo by Stan Avery)

ON THE AIR!

After the transmitter was neutralized, an abundance of RF was generated on the crystal frequency. Loading a 660-watt dummy load, a using an early D104 crystal microphone, the scope showed "broadcast-quality" audio.

Using a 3,882 kc crystal, the first day of on-the-air testing dawned on March 19. Immediately a pileup of AMers responded with signal reports of S9 to 40 over, again with broadcast-quality audio. Since then the transmitter has been used ever week. The bugs have been worked out and excellent reports continue.

COMMENT

This transmitter, running the legal limit on 20 meters, and with the modern HRO receiver, was designed to play with the "big boys!" In other words, a 20 meter phone with daytime around-the-world communication capability.

In modern terms, the transmitter is not 'frequency-agile.' The coils in the oscillator and IPA stages are not plug-in but rather bolt-in types. It would have been possible to reset the transmitter for other bands (the tuning capacitors appear capable of maintaining a good "Q" on 80-10 meters), but it would have been time-consuming. Since coils for bands other than 20 meters were not in evidence, it appeared that single-band operation would be the mode of choice.

Special thanks to Bruce Kelley for his encouragement and cooperation once the decision to restore was made, to Mike Csontos for building the roll-around platform that allows the racks to be moved for ease of maintenance, to Mike Raide, KF2MW, and Mike Pires of the annex crew for their continuing contributions.

THE W1HRX STATION RECEIVER

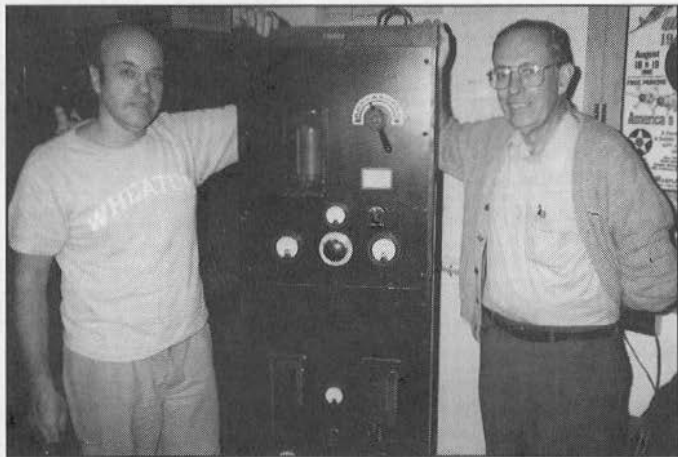
While the Millen AM station receiver was not from the first production runs of the original HRO, it was an early one bearing the serial number L-248 with a calculated manufacture date of February-March 1936⁽²⁾. Specifically, the IFs were the early round type, the panel finish was black alligator, the S-meter switch was the push-pull type, and the inside paint was gray. The tube sockets were marked for the 2.5-volt versions, but the actual tubes installed were the later, improved 6-volt types, a common practice with the earlier HROs.

When first inspected, the receiver appeared on the outside to be in almost mint condition with the original, matched factory coils. However, closer examination revealed that some liquid had been spilled inside the chassis causing considerable corrosion damage to the RF section; this included some of the leaf coil contact springs and it extended down into the coil unit. Unfortunately, the affected unit was the D coil, the one needed for the 75 meter band.

This was the first problem attacked. Three of the leaf springs broke off when lightly touched, and it was necessary to make replacements from some copper-bronze spring stock. Rivets were impractical, so small bolts and nuts were used instead. In the coil gang, sections D2 and 3 were the worse; a number of

the rivets were found to be loose, corroded inside the mounting blocks. These were also replaced with small bolts, checking to see that the heads did not interfere with the coil insertion and removal function. The damage inside the coil compartments was cleaned to the extent possible, and the units were then reassembled.

The intent was to use this receiver as an active part of the station, and since it was not considered a particularly valuable collectors' item, aside from the Millen association, the decision was made to completely "recap" the set. This process is absolutely necessary with any older receiver if any serious use is



The authors, Bob Raide, W2ZM (left) and Bill Fizette, K3ZJW, during restoration of Millen station. (Photo by Bruce Kelley)

contemplated. The early capacitors are universally leaky, and some of the 400- and 600-volt units from this receiver leaked at as low as 10 VDC. The two cathode electrolytics were left in place for appearance, and small replacements were wired into the circuit. The 24 original paper bypasses were removed and set aside. Replacements, a combination of Mylars and disc ceramics, were checked on a rebuilt Heath capacitor checker for both tolerance and voltage before installing.*

All resistors, the early ceramic versions with the molded metal ends, were checked for tolerance and, surprisingly, they were all good. All the original wiring was in place, and there was no evidence of alterations. All tubes were checked on a good mutual conductor checker and were found good. The PW dial

* An excellent treatise on leakage in early capacitors by D.K. Owens may be found in the May 1994 issue of *OTB*.

was removed, cleaned, relubricated and reinstalled. To add a touch of class, the knob was buffed on a cloth wheel with jewelers rouge to remove some surface scratches.

Incidentally, one of the most frustrating jobs was installing a replacement screw-type pilot bulb; there is almost no room to put a hand down into the limited space. This is probably why it was left out when the set was retubed.

A rebuilt National #697 power supply was used for testing the receiver, and it worked immediately. That is, it worked after the heavy oxide deposit on the power plug pins was removed. The alignment followed standard procedure as outlined in the HRO manual, and it was relatively simple, one of the joys of the HRO design. After all the RF general coverage adjustments were completed, the coils were set up for the bandspread modes on the 80, 40,, and 20 meter bands. The 14-30 mHz coil set was left at the GC position. Alignment was confirmed by tuning in WWV and CHU and checking for tracking across the dial.

After using the receiver for several AM contacts on the 75 meter band, its component design (that is, tubes of the era) shortcomings became apparent. It lacked the sensitivity of later receivers (a 75A-4, for example), and on nets it was necessary to ride the gain controls. On the other hand, the crystal filter

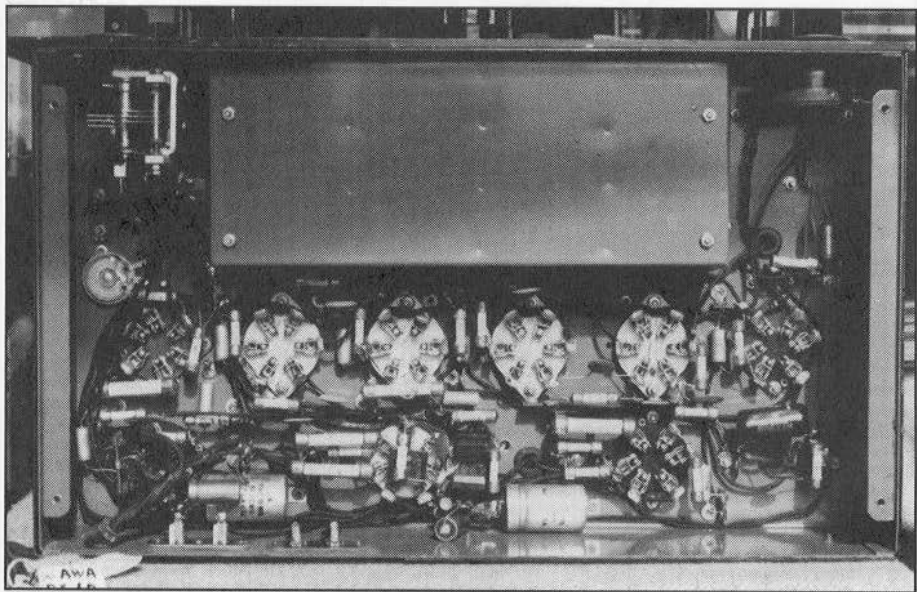
controls did enable AM contacts in the face of adjacent SSB channel interference, and the extended bandspread made tuning a delight. When a given frequency was dialed, the station was there every time. Drift on 75 meters, especially for AM, was easily controlled. SSB was trickier, but the receiver was usable even for that. However, to use the S-meter required putting the AVC on, setting the RF gain control to full, and turning on the meter switch. This is rather complicated since the receiver often overloaded and it was necessary to reduce the RF gain to clean up the signal.

The WIHRX station, complete with the original receiver, continues in operation from the AWA Museum Annex at selected times with a booming signal. The authors are proud to have had a part in restoring to operation this classic and historic amateur station, a fitting memorial to radio pioneer James Millen.

Unfortunately, the original Millen station logs have most likely been lost; the writers have no knowledge of them. What a story they might have told!

REFERENCES

1. Notes on Amateur Radio Transmitter Design, compiled by James Millen, 1938.
2. Dating the Early HRO, by Charles Fisher, *The AWA Review*, Vol. 4, 1989.



The bottom of the Millen station receiver after restoration. (Photo by Bill Fizette)