

THE RESTORATION OF TWO NATIONAL COMPANY RCDs

Bill Fizette nearly knocked me off my editor's chair when he announced that this collaboration with Tom Laszynski was intended for Bill's "The Communication Receiver" column. I try to keep our column articles at about a third the size of this one and there didn't seem to be a graceful way to separate it into parts. So after some thought, we decided to omit "The Communication Receiver" from this issue, running this as a long feature in its place—mfe.

Introduction

The history of this remarkable piece of radio engineering technology has been documented many times over, and will not be repeated here in detail. Briefly, the design of the RCD airport receiver was announced by James Millen of the National Company in October, 1935, with the first production early in 1936. In early 1937 a small production run of the RCD was manufactured under a CAA contract. Active production years for this, and other, sliding-coil designs covered the period 1936-1949, a remarkable record.

For readers who wish to follow up on the story of the National sliding coil receivers, an excellent reference is the landmark article by Larry Ware in the *AWA Review*, Volume 11, 1998. Larry has identified over 60 variants of this coil-catacomb design, not counting the battery-powered versions.

Early in November, 2006, W2DGB received an email note from correspondent K8JRM to the

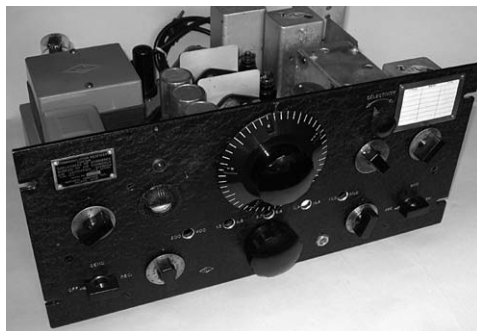
effect that he had a National Company RCD airport receiver that he was interested in restoring. Bill recalled that he also had an RCD which could be restored, and the two decided to work on their receivers in tandem, sharing information and procedures.

Collectors of early communications receivers, may recognize the RCD as a variant of the original NC-100 sliding-coil receiver. What most readers probably do not know, and the writers didn't know until some research was done, is that the RCD is somewhat rare.

The highest serial number which has been identified so far is #101. We speculate that, after the limited production run on the initial CAA contract, the need for design changes became apparent. The other, improved, variations took the place of the RCD. It is possible that the initial contract was a small test to see how well the design would perform.

The sales of these receivers to the civilian market remained weak, probably due to the continuing depression. But the demand by the growing military aviation and other government agencies, such as the CAA (Civil Aeronautics Administration), and civilian airline industries, for these high-quality AGR (Airways Ground Receiver) units, must have been substantial. Users appreciated that the set, while less complex than the HRO, was more versatile and lower in cost.

Design modifications and technological advancements were inevitable, and came in short



The RCD receiver after W2DGB restoration. ID plate confirms CAA history.

AUTHORS' ADDRESSES: SEE END OF ARTICLE

order. Some of the CAA variants, in order of appearance, were the RCE, RCF, RCK, RCL, RCP, and RCQ, plus others.

Receiver Design

The RCD is unusual in that it is almost identical to the first stock design of the NC-100, with its crystal filter and push-pull 6F6 audio output stage. The only change from the NC-100 was the replacement of the BC-band coils with low-frequency coils that covered the 200-400 kHz range, with appropriate engraving changes on the panel.

Subsequent designs replaced the unnecessary dual 6F6s with a single-ended audio output, and there were other circuit changes and additions such as the INS (Inter-channel Noise Suppression) system, and the CONS (Carrier Operated Noise Suppression) system.

The NC-100/RCD is a 12-tube superheterodyne with a built-in power supply and a push-pull audio output. For the RCD the frequency ranges are 200-400 kHz, 1.3-2.8 MHz, 2.7-6.4 MHz, 5.9-14.4 MHz, and 13.5-30.0 MHz. With the exception of the resistors, fixed capacitors, and tubes virtually all the components are of National manufacture.

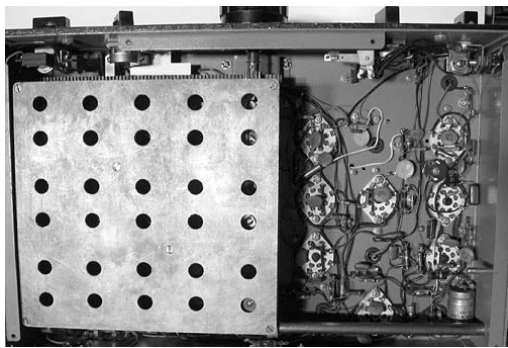
The massive movable coil catacomb occupies most of the sub-chassis area, and is home to high-quality fixed inductances—three for each of the five bands. These are connected to the main tuning capacitor with short, heavy leads. The main tuning control is the famous National PW dial, with its remarkable 12 feet of band-spread.

The matching loudspeaker is part of the power supply, and so is needed to make the set work. When the NC-100 was introduced in 1936 it was considered a Cadillac of short-wave receivers, and was instantly popular with the airlines and governments.

Literature Search Results

The restoration of any artifact must begin with a decision about where the emphasis will be. The options for a piece of electronic gear can include cosmetic restoration, electronic restoration, or a combination of the two.

A detailed literature search should also be carried out before the job starts. Back issues of *The OTB* and *The Old-Timer's Bulletin* (predecessor publications to *The AWA Journal*) included a number of restoration articles on the NC-100 series sets (1-5). And an internet search by K8JRM revealed a series of Larry Ware's informal post-



RCD underchassis view. The large catacomb takes up most of the space (W2DGB restoration).

ings to a news group on his own restoration of an RCD. The latter are quite detailed, including some 8,000 words divided into nine chapters. An interesting survey article, also by L. Ware, is in *Electric Radio* #119, March 1999. And prolific writer Jim Hanlon, W8KGI, has a restoration article of the NC-101X in *ER* #192, May 2005. The NC-100 diagram is presented in two volumes of *Rider's*: Vol. 8 and 14.

Larry's approach was classic, starting with the power supply and audio stage, then progressing through the circuit towards the antenna, and his postings included several gems. For instance, though the National manual called for a 250-ohm cathode load resistor for the audio stage, Larry changed it to 500 ohms to bring the current to the value suggested in the RCA tube manual. He was able to replace the broken fiber slide-rail shims (see below) with some brass tubing, and he discovered that the National manual has a major error in the 6E5 eye-tube circuit. As presented, the plate load resistor goes to the target plate, whereas the RCA tube manual shows it going to the triode plate, with the target connected directly to the B+ line. The latter is correct, and the change must be made to have the tuning eye work correctly.

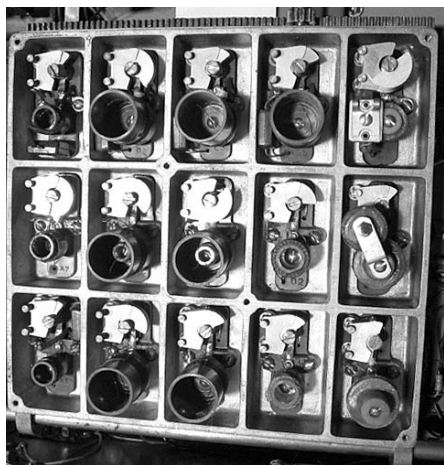
One more point about the 6E5 eye tube. They are somewhat rare, and it pays to treat them gently. Bob Roehrig, well known in "boat anchor" restoration, installs a 47k resistor in the common B+ lead from the eye tube socket to drop the supply voltage to 150V. This is recommended.

Larry also describes a procedure to replace the unusual, and often missing, main power transformer in these NC-100-type receivers. He fabricates an aluminum mounting plate to cover the gapping hole, then installs a vertical-mount replacement transformer (he has used both a Thor-darson P-T24R09U and a Hammond T270CAX,

both available from Antique Electronic Supply). This puts the radio back in service without hacking into the original chassis, and if a replacement original ever does appear, it can be easily substituted.

More Tips

Some procedures are standard for renovating these 70-year old receivers. The gear box, for example, is usually replete with dried oxidized grease. This must be picked out and new grease put in. A thin grease such as Lubriplate works well. The PW dial has the same problem; it must be taken apart, cleaned, and relubed. There is a definite procedure to follow with these (4). The power transformers used in these NC-100 variants, while similar in appearance, do seem to differ in some cases—having different wiring terminals. Use care when making any substitution, remembering that some transformers are for single-ended audio circuits, and have different part numbers.



A look at the catacomb interior. Removal of catacomb from chassis isn't difficult, if you know a few tricks—see text (W2DGB restoration).

Removing the catacomb (3) may pose a challenge to someone who has not done this little job before, but is not difficult. After removing the end screws, a piece of steel or hardwood is inserted between one end of the rod and the chassis, and the rod simply pried out using a large screwdriver as a lever.

When replacing the catacomb, the small white band indicator must be attached before any other work is done. Then, with the front of the receiver facing away, and the rod in place, the front of the catacomb is slid down into the receiver bottom area. The carrier rod is located and then tapped

into place with a wood block and a hammer.

There is one more point that deserves emphasis. The catacomb has two fiber inserts in the back, and the steel carrier rod rides on these. Quite often they are out of place and frozen on the rod, due to shrinkage over the years. These inserts are necessary, and must be treated gently.

With care they can be removed from the rod, cleaned, reinserted into the catacomb, and epoxied in place. Then, any excess can be removed using a large round file to ream out each insert until the rod slides freely. A coat of thin grease such as Lubriplate on the rod results in smooth action.

The rubber/silk covered wiring in these old National radios is usually oxidized to the point of futility if any work has to be done, and often has to be replaced. Solder joints have crystallized, and it is a good idea to resolder each and every joint. All ground connections, of course, must be verified.

If alignment is centered on the crystal resonant frequency, using the usual procedures. Larry notes he uses a scope with a stable HP606 generator and an HP 400H AC meter.

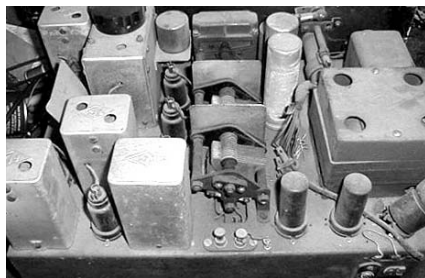
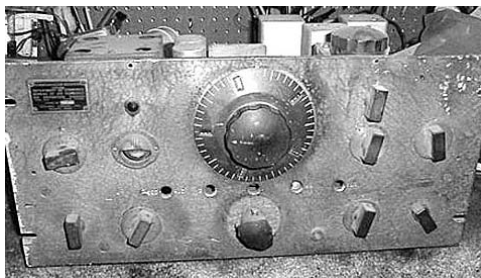
Finding knobs for these older National radios can be a real problem. There are lots of PW dials around, and they can be refinished, but the smaller, small-shouldered, knobs from early production runs such as the RCD are hard to find. If necessary, the later, high-shouldered variety make reasonable replacements.

The special ganged toggle switches can also be a problem; their internal contacts may have become oxidized, presenting a high resistance. The AC switch is the worst offender. The best/easiest way to resuscitate the switches is to spray contact cleaner in, and then work the toggle repeatedly until the internal resistance drops to a few ohms. Most of the time this does work.

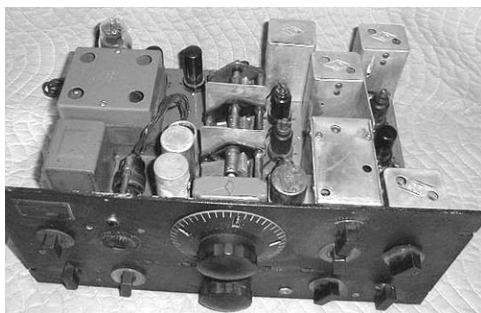
The National receivers, as received from the factory, came with a bottom plate and a dust cover. These are usually missing when the sets are found, but bottom plates can easily be fabricated by a sheet-metal shop. Because of heat considerations, and the considerable expense, it is hardly worth the trouble to make up a dust cover. However, it can be done.

The K8JRM Set, Serial #15.

The provenance on this radio has been lost, and at present it is part of a random collection of sliding coil receivers. When obtained it was in poor cosmetic shape, but the wiring seemed original, and the parts were all there, so the decision was made to clean and patch to the point where the set looked decent and carry out a total elec-



K8JRM's RCD as it looked before restoration.



The K8JRM radio after restoration.

tronic service.

The fixed capacitors and resistors received the usual treatment, and most were replaced. The filter cans were taken apart, gutted, new capacitors installed inside, and epoxied together. The rusted areas of the tuning capacitor and chassis were wire-brushed with a Dremel tool, then treated chemically with pieces of paper towel soaked in vinegar.

The front panel was oversprayed with several mistings of black gloss enamel, taking care to avoid filling in the existing crackle. The possibility of questionable ground connections was avoided by connecting all ground points with a common bus wire, and avoiding making it a loop.

Aluminum IF cans were cleaned using Formula 409, followed while wet with buffing with 0000 steel wool and an application of paste wax.

Alignment was straightforward. The IF strip was aligned with the catacomb still out of the chassis, powered up by shorting the B+ cut-off switch in the oscillator section.

The W2DGB Set, Serial #43.

This radio was obtained in 1989 from an estate in Albany, NY. It was in decidedly poor shape. Many parts were missing, including the catacomb with the coils, the crystal, and the audio interstage transformer. The three filter

cans had been removed, and the immediate chassis area was corroded and pitted. The steel parts of the tuning capacitor were badly rusted, and the PW dial and most of the smaller knobs needed to be replaced. Tubes were absent. All in all, it was a classic basket case.

In this case there was little choice but to strip the chassis to the bare metal and completely rebuild the radio. Paint remover took care of what was left of the original gray enamel, followed by sand blasting. Pits in the metal, mostly around the area of the filter capacitors, were filled with auto body putty.

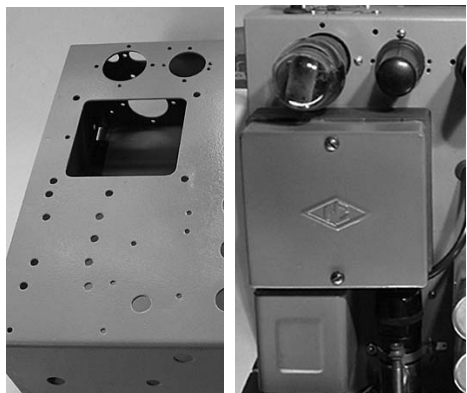
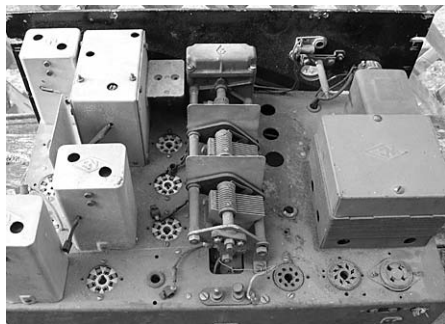
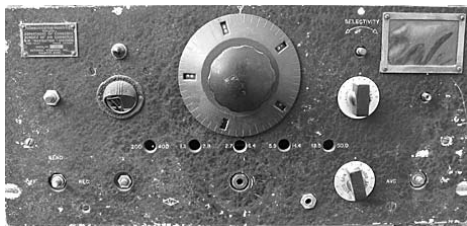
A former owner had chewed a hole in the back apron for a type N connector. This was cleaned up and a standard PL-259 substituted as an alternate antenna connector, mainly to fill the hole. Painting consisted of applying several spray coats of smoke-gray Krylon to the chassis, the power transformer, and filter choke.

Over time, the restorer had accumulated several of the missing parts, including the catacomb and coils—some of which needed repair. He had even obtained the unusual H coils for the 200-400 kHz band. The small metal band indicator was missing, so one was fabricated out of white flashing aluminum.

All parts were cleaned, and new hardware substituted for rusty pieces—such as the star washers, which needed to cut through the paint and make contact with the steel chassis as the originals did.

The original wire was unusable, so new was substituted. All of the original bypass capacitors and most of the original resistors were bad, and new ones were used. The filter cans, 8 μ F at 450V, were replaced with NOS units. Their connecting wires were trimmed and new, small cartridge capacitors were installed on tie points underneath.

Cleaning the main tuning capacitor was a particular problem. While Tom had used vinegar, this restorer experimented with carefully masking the critical parts and then sand blasting the rusty and other really bad areas. The end re-



A section of the RCD chassis after (left) sandblasting and repainting and (right) reassembly. (W3DGB restoration)

sult was an acceptably clean capacitor, with the exception that the formerly polished aluminum plates were now a dull gray.

Unfortunately, this may have affected the capacity to some degree. This approach would probably not be used again.

The front panel and brass ID plate were challenging. After a thorough cleaning, the missing black crackle finish, mostly around the edges, was filled in with two coats of black enamel, using a small camel-hair brush.

When that was dry, the whole surface was rubbed with more black enamel, diluted approximately 30% with thinner. When dry, any paint in the engraved markings was carefully removed by scraping with a pointed tool. The brass ID label background area was painted with some more diluted black enamel, and when that was dry the whole surface was burnished with a piece of wood to remove the paint on the raised parts.

The original brass rivets throughout the receiver were drilled out and replaced with 6/32 hardware. The front panel ID plate and chart frame were reattached with very small screws.

Alignment was standard, and no problems appeared until the RF alignment was tackled. At that point it was found that the dial values didn't quite agree with the chart in the National manual. This

W2DGB's RCD as it looked before restoration. (above and at left.)

could have been due to the fixed inductors having changed value with age or the method used to clean the tuning capacitor.

One procedure to fine-tune the coils might be to cement small pieces of ferrite inside them. This is tedious, and a new chart was made up instead.

My sincere thanks to those hams who contributed parts to this project, especially K2MP and W3VVS. Now, if someone has a suitable speaker, or two...

Other Comments

The speaker used with most of these NC-100 variants is of the "hot field" type, where the 500-ohm field coil serves as one of the filter chokes for the power supply. The push pull output transformer is mounted on the speaker, and the whole connected to the receiver with a four-wire cable. This was common with 1930s radios, and serves also as a safety feature; if there is no speaker load, the B+ cuts off.

If an appropriate working speaker isn't available (they are scarce), a substitute can be cobbled together using a PM speaker with a suitable output transformer. A 25-watt, 500-ohm resistor, or a 500-ohm choke, will replace the original field coil in the power supply circuit. The speaker assembly is integral to the radio package and is needed to make the set work (5). Lacking a replacement speaker, audio can be taken from the phones jack. The 6F6s should be removed and suitable B+ (about 230 V) supplied to the remaining circuit.

It is interesting that #15 did not have a chart frame, nor any indication that one had ever been installed, while #43 did. Perhaps a reader will offer a possible explanation. And while we are at it, how about it, readers? Let's hear if any more of these RCDs are out there. Contact W2DGB at
(continued on page 48)

chambers were nothing more than a pair of large wooden washers that helped maintain the shape of the horn (see diagram in the Qualitone ad shown with this article). It was claimed that these chambers absorbed all the mechanical noises (?).

The Qualitone came in two versions (same price for both). The Model 1 (illustrated) held two headphone receivers (complete pair), while the Model 1R held only one. The horn material was fiberboard painted to simulated a wood grain. Both the back piece that held the phones and the base were of turned mahogany. The only metal used was for the headphone clamps. This same piece of metal was attached to a fitting that connected the horn to the base and allowed a tilt adjustment.

The tapered horn is 10 inches long and mea-

sures 8½ inches at the bell opening. The base, which has a diameter of 5¼ inches, has green felt on the bottom. The model shown in my photographs has no manufacturer's name anywhere, but it's quite possible that a decal might have fallen off. The two wooden washers were missing from the horn pictured—probably because the flexibility of the horn material allowed them to become unglued.

This horn is owned by Bob Sukosky of Manchester, CT, who was kind enough to lend it to me for the article. I've treated it very carefully because it is so fragile and so rare. This not many of them have survived.

This Qualitone speaker is not to be confused with the "Quality Tone" gooseneck style horn and the "Quali-Tone" Junior Gooseneck horn made by Duro Metal Products Co. of Chicago. ☐

RESTORATION, continued from page 46

w2dgb@ptd.net or 570-629-0637.

One final comment: the radios of the 1930s were designed for 110 V.A.C. mains, while the current supply voltages can be as high as 120 volts or more. There are a couple of ways to approach the problem of protecting voltage-sensitive components, such as the power transformer. One is to use a Variac to reduce the line voltage; and another is to use a small filament transformer to buck the primary winding of the transformer.

The latter is preferred, the only problem being where to mount the thing. One suggested solution (K8JRM) is to mount the bucking transformer in the speaker area, along with an AC socket. A line cord is installed, and connects with the 120 volt mains. The receiver AC cord is then plugged into the new AC socket on the speaker assembly.

Aside from the considerable weight, this is a very attractive and appealing radio, and both restorers plan to mount the receiver in a suitable table rack, along with the speaker panel.

Even though some procedures could be done differently, the writers are pleased with the results, and recommend this radio to any "boat anchor" or communications receiver enthusiast. It is a piece of communications history well worth preserving. ☐

ADDITIONAL REFERENCES

- (1) "Restoring a Classic National NC-100 Receiver," Bill Fizette, *The OTB*, Nov. 2000, p. 11 and February, 2001, p. 37.
- (2) "Restoring National PW and NPW Capacitors," Bill Fizette, *The Old Timer's Bulletin*, May, 1992, p.33.
- (3) "Removing the Coil Tray From a Sliding-Coil Receiver," Bill Fizette, *The Old Timer's Bulletin*, August, 2000, p.41 (however, alternate procedure in the present article is simpler).
- (4) "Restoring the National PW dial Drive," Bill Fizette, *The Old Timer's Bulletin*, November, 1995, p.8.
- (5) "Loudspeakers For the Sliding-Coil Receivers," Bill Fizette, *The Old Timer's Bulletin*, May, 1998, p.20.

AUTHORS' ADDRESSES

William B. Fizette, W2DGB
RR1, Box 1634, Henryville, PA 18332
Tom Laszynski, K8JRM
7400 Sapphire LN, Oklahoma City, OK
73150-8028