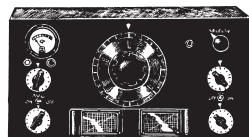


THE COMMUNICATIONS RECEIVER



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PLEASE INCLUDE SASE FOR REPLY.

The Remarkable National SW-3

The descriptive term “remarkable” is often used carelessly. But when it is applied to a little stripped-down regenerative receiver, born in the cash-scarce years of the early 1930s, which had a 14-year production run of over ten thousand units, which was used worldwide in all sorts of applications and environments, and which is now a sought-after collector’s item, the word is well chosen.

A number of communication receivers from the “golden age” have accumulated a substantial body of literature. The SW-3 is certainly one of them, and my file is replete with numerous articles from *CQ*, *QST*, *Electric Radio*, *The OTB*, and other publications. Noteworthy among these is the landmark *QST* article by Jim Millen, (then W1AXL and later W1HRX) (1) the two papers in *CQ* by Bill Orr, W6SAI (2), (3), and a superb article in *Electric Radio* by my fellow National enthusiast Jim Hanlon, W8KGI (4).

There are other delightful and informative articles by Faulstick (5), in *Riders Manuals* (6), in various National Company instruction manuals, and by Ruggere and Troe (7). Additional information on the coils, as well as a summary of the various power supplies, can be found in *The OTB* (8), (9). There are, of course, many other sources, but the above will give the reader a good overview.

Physically, the SW-3 in its various models is an ugly little black steel box with a hinged lid and a longest dimension of less than 10". It has four front panel controls. There are three tubes, with two plug-in coils for each frequency range. The power source is external: batteries or certain of the famed National “doghouse” AC supplies.

Background

The National Company began as a manufacturer of radio parts, and in time produced finished products using those parts. Thus, the SW-3 with its plethora of interesting features did not just suddenly emerge from the National laboratory. There was a considerable prior development history that included the distinctive tuning

capacitors, the unique dial and knobs, the 5880 “doghouse” power supply (with a circuit that eliminated “tunable hum”), and especially the distinctively-based National R-39 low-loss plug-in coils. (NOTE: The question is frequently posed as to why National didn’t use the standard six-pin tube base; the answer is simply that their version was designed first.)

One prior product was the 1930 SW-5 five-tube “Thrill Box.” It was a deluxe short-wave radio housed in an ornate metal cabinet and using grooved R-39 plug-in coil forms. The SW-5 sold for \$85.00, and the 5880 AB power supply cost an additional \$20.00.

Driven by the adverse economic conditions of the deepening Depression, James Millen’s National design group stripped the SW-5 circuit of everything not essential for communications use while keeping the fundamentals in place. They removed the power audio amplifier (the user would now need headphones), replaced the tuning capacitor’s fancy drum drive with the much cheaper Type C dial, and changed the capacitors to an inline configuration. The cabinet was now a simple, uncomplicated steel box with a hinged lid.

In short, the Millen group produced a very basic radio for a relatively low price, which the user could supplement with additional coils, an audio amplifier, and so forth as money permitted. Wholesale Radio Service Co. in New York listed the set at \$32.34. The price included three sets of amateur-band coils, but not the tubes. This was considerably less than the cost of the SW-5, and much more in line with prevailing economics. The price of the matching #5880 power supply was \$20.30, essentially unchanged.

The full-page introductory ad for the SW-3, reproduced here, appeared in the October 1931 issue of *QST*. This, of course, followed directly on the September *QST* article mentioned above, and is an excellent example of the sophistication of National marketing strategy under Millen’s guidance. Another example, of course, is the offering of accessory coil sets covering a wide range of frequencies. Who could resist spending

a few dollars now and then for coils that opened up new listening possibilities?

The Circuit of the SW-3

The three-tube SW-3 circuit includes an r.f. stage, a regenerative detector, and a single audio amplifier. There were eventually three versions, referred to now as Models I, II, and III. Model I is scarce today. Model II debuted about 1936. It is the one mostly found today, and is the subject of my restoration column elsewhere in this issue. See that column for a copy of the schematic.

The Model III, designated SW-3U, "The Universal," was manufactured in limited quantities in the late 1930s and up through 1945. It was designed to use either 6-volt metal tubes or 1.4-volt battery tubes. There are not many Model IIIs around today.

While the tubes and some of the components and circuitry varied somewhat as different versions of the SW-3 emerged, the basic circuit remained constant, as did the external appearance. One minor exception to the external appearance differentiates the first model from the succeeding versions; the lid of Model I is flat, while the later models has a raised finger lip in the front center. Also, looking down inside the Model I with the lid raised, the two-section tuning capacitor consists of two National type SE-100s ganged with an insulated coupler, and held to the chassis with four screws. Subsequent versions used a dual National 2SE-100 mounted with a special bracket in the rear, and directly to the main dial drive, a National Type C, in front.

The S-101 Audio Coupler, a potted transformer device mounted at the rear of the tuning capacitor, appears to have been introduced with the SW-3. I haven't found it listed in the earlier National catalogs at my disposal. The unit consists of a 700 Hy audio choke, a 0.01 mfd coupling capacitor, and a 250,000 ohm grid resistor. It is easy to check with simple radio bench test gear, and can be rebuilt if necessary. Details are in

the restoration column in this issue.

Special Features

William Orr began his *CQ* magazine series on classic radios with an article on the SW-3 (2). Orr was a friend of Jim Millen (formerly the VP in charge of product development for the National Company). He stated that the 1930 SW-3 design, which was years ahead of its time, was marketed to commercial airlines (for which its light weight was ideal) as well as radio amateurs. Pan American Airways, believing that good c.w. equipment was more efficient than the existing radiophone apparatus, used the SW-3s on its overseas clippers—mainly the South American routes.

One of the major features of both the SW-3 and the predecessor SW-5 was dependable sin-

Setting a New Standard in HF Receiver Design

NATIONAL SW-3

This new Ham receiver follows essentially the same circuit as the new NATIONAL SW-5 THRILL-BOX but being for headset use only, omits the Push-Pull Audio.

FULL A. C. MODEL

Uses Type No. 235 and 227 tubes, and operates on full A.C. with National type 5880 Power-Pack, specially designed for humless operation with RF filter, two-section Hum filter and electrostatic shield (eliminating "tunable" hum).

HIGH SIGNAL-TO-NOISE RATIO

The combined results of careful circuit design give exceedingly high signal-to-noise ratio.

BAND-SPREAD COILS STANDARD EQUIPMENT

Standard equipment are Band-Spread Coils for 20, 40, and 80-Meter Amateur Bands.

REAL GAIN IN RF STAGE

The design makes possible a real RF gain because of lower plate impedance of 235 tube.

SMOOTH SENSITIVITY CONTROL

Employing a hitherto unused and unused characteristic of the 235 Variable-mu tube, the point of maximum sensitivity is approached on an inverse exponential curve. Result—extremely stable operation at maximum sensitivity, without critical control-setting.

UNIVERSAL MODEL

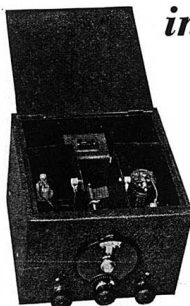
Uses new 6 volt, five-prong heater type No. 235 and 227 tubes for battery operation; or Type No. 235 and 227 tubes can be used with 2.5 volts A.C. on the heaters and batteries for B-supply.

COMPACT — ADAPTABLE TO PORTABLE, AIRCRAFT AND BOAT USE

Receiver is extremely compact: 9" x 9 3/4" x 7". Simple, attractive metal cabinet is standard equipment, and forms integral part of the shielding. It can be equipped with hooks for spring mounting on airplanes and will fit in a very small space.

THE PRICE IS RIGHT

The price of the SW-3 puts it within the reach of every amateur. Write us for full particulars and prices using coupon below.



SPECIAL SHIELDING

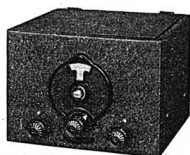
Special shielding in the SW-3, the result of careful research, is one of the reasons for its remarkable efficiency.

SINGLE CONTROL

The SW-3 has true single control. Set and forget the antenna trimmer. Special HF Variables have insulated main bearings and constant-impedance pig tails and are insulated with R-39.

CALIBRATED ATTENUATION CONTROL

In the SW-3, the attenuation-control is an Audibility Meter. Designed so that angle of rotation is directly proportional to the R-Rating of signal intensity, the signal intensity may be read directly on the control. The control wiper is so mounted as to be operated with the same hand as used for tuning, leaving the other free for sensitivity control.



NATIONAL SW-3 AMATEUR HF RECEIVER



Say You Saw It in QST — It Identifies You and Helps QST

COUPON

National Co. Inc.
61 Sherman Street
Malden, Mass.
1 Grafton.
Please send me full particulars and prices on your new SW-3 Ham Receiver.
Name.....
Address..... QST 16-7-31

Original announcement of the SW-3 receiver from the October, 1931 QST.

gle-dial control, with the rf and detector gang-tuned. The success of this system in National receivers was due to careful engineering and manufacturing, using quality parts.

The Tuned Circuits. The tuning capacitors, specially built by National, have two electrically-independent ganged sections. The rotors were isolated from the frame and each other. The coils were of moisture resistant R-39 molded formulation and wound with distinctive wire. They were grooved for the primary and secondary turns and had slot windings for the ticklers.

The bandspread coils had tapped secondaries, with a trimmer capacitor and grid leak located inside the detector coil. When these coils are used, the grid clips are removed from the caps of the r.f. and detector tubes and placed on fiber blanks provided in the cabinet. Grid leads from the coils are clipped on instead. These were very stable coils that functioned well under adverse humidity conditions, and the combination of quality components gave the tank circuits an inherent stability that was remarkable for the day.

Ten coil sets covered the useful range of 9 to 2000 meters, with bandspread coils available for the five major amateur bands then in use. Model I used the 10-20 series; II the 60-70 series; and III used the 30-40 series coils. The only apparent difference is the number of tickler turns in the slot winding.

The bandspread coils have the suffix "A" after the number. Early coils were not numbered, but color coded, with either a dot on the bottom, or a color-filled slot on the top edge. Coils from one series may be usable in another, but obtaining proper regeneration (it should occur about mid-range on the control) could be a problem.

Some signals can still be picked up even without proper regeneration, allowing you to check the frequency range of unmarked coils. If you have access to the coil specifications, you can rewind the tickler of a mismatched coil. Often a single turn, or a fraction of a turn, will make the difference.

As of this writing, coil specifications, as well as forms for winding new SW-3 coils can be obtained from James Fred (5355 S 275 West, Cutler, IN 46920, phone 765-268-2214). These excellent quality forms do not have the primary and secondary winding grooves of the original National parts, though they do have the tickler slot. Wind your coils carefully and they will work fine. You may also find some defunct original National forms that can be rewound. If you take this job on, a good source of quality wire is an electric motor repair shop.

Other Issues. Proper interstage shielding is

critical for a sensitive, controllable regenerative receiver. Any interaction between the RF and detector stages must be minimized. Not only does the SW-3 have a standard shield for the r.f. tube, but the RF and detector stages are isolated by distinctive metal shields welded to the cabinet. Details of the development of this and other features are in Millen's landmark *QST* article, which was often included in SW-3 instruction manuals.

The thumbwheel gain control is calibrated in R units (the signal-strength units of the day). I've seen various National SW-3 schematics placing this control across the antenna coil, in the cathode of the RF stage, in the RF grid return, or in the grid of the audio stage. The Model II described in my restoration column in this issue has the control in the audio stage, with the RF tube operating wide open. That approach appears less than satisfactory, and when time permits, some tinkering is indicated. This may in part explain a comment by Paul Bohlander, W3VVS, who has restored twelve SW-3s and found that while they all look alike, "they are all different."

Nowdays there is a romantic aura surrounding the SW-3, which after all was just one product among many offered by just one company in the growing electronics industry of the 1930s. Its popularity has to be traced to a combination of adroit marketing and careful engineering, coupled with over a decade of experience and National's reputation for quality products in this new field. For years the SW-3 was used by hams, government agencies, commercial stations, airlines, ships, expeditions, and anywhere else that a versatile, simple, light-weight dependable receiver could apply.

The radio worked, and it worked well. Its success certainly must have done a lot for National's reputation and cash register.

Additional Comments

I asked Jim Hanlon, who has contributed to this column in the past and written extensively for *Electric Radio* magazine, to review this article. His own article on the SW-3 has been previously cited (4). His paraphrased comments follow.

1. Your date of 1936 for the introduction of the Model II agrees with Orr's article. However, the fellow who sold me my Model II told me it was built in 1933 or 1934. He should have known, since he was a member of the radio club that originally purchased it and later bought it from the club.

2. Regarding a source of coil wire, I would
(continued on page 32)

a signal wave is shifted location has an intermediate step in transmission or reception". This makes pretty rough going for the average inexperienced reader.

Altogether this book is a good attempt at explaining many complex concepts in very few words. Much can be learned from it and it will serve its purpose if it leaves the reader wanting more, but it must not be taken for a basic or introductory text.



The History & Evolution of the Microphone

By Bob Paquette. Edited by Nathan St. Pierre. Published 1999. 414-645-1672. See related webpage <http://w1tp.com/mpermic.htm>, 8 1/4 x 10 1/2 inches, 842 pages, softcover, price?

Weighing in at six pounds, this gargantuan book has many of the earmarks of a self-published labor of love: each copy is hand numbered, the pages are oversize and there are many of them, there is uneven print quality ranging from very poor to very good, much of the text is reproduced directly from other sources, and the book was assembled over a period of very many years. Anyone with an interest in—or obsession with—microphones will want to spend time with this book.

The majority of the book consists of reproductions (some of which are unattributed or incomplete) of such diverse document types as bulletins, catalogs, internal memos, manufacturer codes and specs, instruction and technical data sheets, drawings, newspaper and periodical articles, book chapters, advertisements, monochrome and color photos (some of these are downright beautiful), patent specifications, museum and corporate publications, government documents, proceedings, personal correspondence, etc.

The wide diversity of sources here makes the book cry out for a comprehensive index listing including, at minimum, all makes and models and all personal names. Had that been included, the book could have become a standard in the field; as it stands the huge amount of information here will nevertheless attract researchers who will use it as a sourcebook or starting place for information not easily found elsewhere. For the microphone, there is nothing else like this book available. ☑

ALSO NOTED

Gavin Weightman, *Signor Marconi's Magic Box: The Most Remarkable Invention of the 19th Century and the Amateur Inventor Whose Genius Sparked a Revolution*, Da Capo, 2003, 312 pages.

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add that Antique Electronic Supply www.tube-sandmore.com lists magnet wire in at least 8 gauges. They sell full spools for reasonable prices, \$5.50 for a 100-foot spool of #21 or #22, up to \$4.95 for a 750-foot spool of #42. They also sell Celanese-covered wire, including Litz wire, by the foot.

3. You might want to tip off your readers about the information regarding winding a 30-meter bandspread coil pair that appeared in my 1993 article. I don't know of any other place that it has appeared.

4. Finally, I would also suggest that you assure your readers that the SW-3 is more than just an interesting antique. Several of them show up in the various AWA contests, usually paired with a 210 Hartley, TNT or TPTG. I've worked the east coast from New Mexico on 80 meters with my pair. The SW-3, while not at all selective, is sufficiently sensitive to hear atmospheric noise with

its tuned RF amplifier stage. With a little coaxing and given a not too crowded band, it will do just as good a job as a modern superhet. ☑

REFERENCES

- (1) Millen, James, *QST*, September 1931.
- (2) Orr, William, *CQ*, July 1971.
- (3) Orr, William, *CQ*, February 1978.
- (4) Hanlon, James, *Electric Radio*, August 1993.
- (5) Faulstick, Roger, *Electric Radio*, Dec. 1993, January and February 1994.
- (6) Riders Manual, Volume 14. (NOTE: There is gold mine of information on other National receivers in this reference.)
- (7) Ruggere, R., and Troe, James, *ARCA Gazette*, Vol. 19, #4.
- (8) Fizette, Wm, *The OTB*, August 1993.
- (9) Fizette, Wm, *The OTB*, February 1993.