

THE HRO REPORT: DATING THE EARLY HRO

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INTRODUCTION

The June 1986 AWA Old Timers' Bulletin (p. 24) reported on a survey project to analyze a large sample of prewar National HRO receivers. The motive was to sort out the minor manufacturing variations that allow dating them accurately. The results, based on questionnaire results from owners of about 70 sets with plug-in crystals, can now be reported.

Note: I make frequent statements of opinion. It is certain that others will uncover more facts and better data. This is not the last word, and shouldn't sound like it.

FROM AGS TO HRO

The HRO was not National's first professional-grade communications receiver. The story begins with the unique AGS, a highly stable and reliable set that worked nearly as well at 20 MHz as at two. Its merits were obvious and it faced no competition, but by the end of 1933 it was evident that it soon would. It seemed too expensive for any Depression consumer market, and lacked some increasingly important performance features.

Tetrodes and pentodes cleared the way to efficient high-frequency circuit design, and sunspots made those frequencies more and more attractive during the mid-Thirties. But even the AGS with one excellent RF stage before the first detector — only one — could not provide decent image rejection above 10 or 12 MHz, a frustration to the new explorers of 20 meters and beyond.

Then, the tuning of the AGS, while accurate, readable to four places, and repeatable, was certainly fussy. So was the condenser ganging by spring-loaded rack and pinions, to say nothing of the "built-in" alignment (see the Aug. 1987 OTB, pp. 14-17). However, the AGS embodied so much advanced technology reduced to practice that the target of improvement seemed clear and achievable. The goals were improved image rejection, extended high-frequency range, and economies and packaging for a broader and growing market. There was to be no sacrifice of stability or reliability.

A second RF stage could provide the required improvement in performance, but achieving alignment of four stages from one end of the new high coil range to the other was a major challenge. In the final design, an elegant electromechanical accomplishment of virtuoso magnitude was the tuning condenser assembly: four-gang, pedestal-mounted, double-insulated, anti-backlash, gear-driven. Less obvious but just as fundamental was the other half: the integrated plug-in coils with built-in trimmers, positioned at the cool bottom of the chassis. The cost of the complex phenolic moldings with inserts for mounting coils and trimmers was minimized by the inevitable large production quantities, with an average of 16 moldings for each HRO.

With electrical and mechanical stability thus secured, it was practical to save on the cost of the chassis by using light-gauge steel, which also served for the front panel of the new and basic table model. The economies just about paid for the new features: a table-model HRO with four coil sets cost just about the same as an AGS-X; the rack model with engraved aluminum panel cost about \$20 more.

Production of the HRO, in its familiar form, was preceded by an interval of mystery. Ads in QST announcing the new set in late 1934 show some strange things to illustrate the copy. These may be lost prototypes corresponding with serial numbers as yet unreported (see below), but I am more inclined to think they were mockups made for promotional use. The October 1934 QST ad shows an AGS-HRO hybrid, with the former's quaint knobs from 'way back in National's products, as well as its distinctive crystal-filter controls. Inconsistent with this is the absence of the BFO-pitch control, which was clearly a feature of the late AGS-X as advertised only four months earlier.

National clearly felt it urgent to announce their dazzling successor to the AGS-X as early as possible; the hybrid or prototype may have been cooked up as far back as April, 1934.

Other early ads, and even the photos in the January 1935 (first) edition of the instruction manual, show nonexistent (or rare!) features: on the rear page is a set with a knob just visible on top of the BFO coil can. The white coil charts have quaintly fictitious extra-straight-line frequency curves. Page 15 shows bus-bar wiring on the tuning condenser, which I've never seen. On page 18 is a rear view showing end plates on the condenser unlike any production, as well as tube shields from neither AGS nor HRO.

THE SURVEY

The objects of the survey were to (A) deduce chronology and dates of all substantial changes from "the beginning" through the end of production with plug-in filter crystals, (B) determine to what extent the serial

numbers advance in an orderly fashion, and (C) get an idea of the total number of sets made in the chosen group.

One basic finding is that the serial numbers are substantially chronological; initial letters appear to apply to batches of about 250 sets, with evidence that a new batch was occasionally started by a second team before a current run ended. I discount the story attributed to Jim Millen that the numbering system was designed to conceal production quantities. Another finding is that, with a few exceptions, the sequence of changes is obvious, logical, and well correlated with serial numbers. I estimate that 5000 to 5500 sets were made through the "Y" batch of mid-1938, with perhaps 2500 to 3000 more ending in late 1940 or early 1941. (This group may be larger, based on a recently reported set from the nnK batch numbered 684.)

Serial numbers reported on nearly 70 sets run from D1 to Y114, and from 49B to 169L. Table 1 summarizes the number of samples reported for each series letter. It appears that when the alphabet was used up with the letter as a prefix, another series began with the letter as a suffix. Prefixes A, B, C, I, O, Q, W, and Z as prefixes are unreported so far. I believe that A, B, and C were not used in production, none being reported, while from D onward there are several reports for each letter. A, B, and C may have been used on pilot models or very limited production, or may have been bypassed to avoid confusion with existing AGS numbers. A theory that they might apply to first-run sets "given to VIPs" is dubious: such sets would be the most likely to survive, and few small companies have ever given away expensive new products in quantity. (I do have a record of a set Jim Millen gave to an engineer "for evaluation.")

I and O are frequently omitted from such numbering to avoid ambiguity; Q, possibly also. For several letters, there are only one or two specimens, so that none for W or Z suggests rarity rather than nonexistence. There are certainly many unreported sets "out there" waiting to be heard from.

The most interesting observation, through prefix Y, is that all the numbers following are evenly scattered between one and 322, except for D where all are below 100. The most numerous survivors reported are E, F, and G with seven or eight specimens each, with numbers distributed from six to 244. It is on this that I base my estimate for total production, by assuming an average of 250 sets per letter.

The filter crystals, at least for half the alphabet, have hand-scribed numbers on the base molding, the highest number being 5721. But the series has clumps, skips, and blocks of missing numbers. This could be explained by the way crystals were parceled out to HROs and FBXs. Allowing for that, they correlate with the serial numbers fairly well.

TABLE 1
SAMPLE RECEIVERS REPORTED PER LETTER-SERIES

<u>Series</u>	<u>Samples</u>	<u>Series</u>	<u>Samples</u>
D	4	S	1#
E	7	T	4
F	8	U	2
G	9	V	1
H	2	X	2
J	2	Y	1
K	1*	nnB	4
L	4	nnD	1
M	5	nnE	1
N	5	nnK	2
P	2	nnL	1
R	4		

* Instruction book only.

An HRO Junior.

TABLE 2
ESTIMATED PRODUCTION DATES

<u>Series.</u>	<u>Dates</u>
D, E	January-March 1935
F, G	April-July 1935
H	August-September 1935
J	October-November 1935
K	December 1935-January 1936
L	February-March 1936
M	April-May 1936
N	June-July 1936
P, Q, R	August 1936-February 1937
S, T, U	March-September 1937
V, W, X	October 1937-April 1938
Y, Z, nnA	May-December 1938
nnB - end	January 1939-early 1941

Two D-series sets have 713 and 717; E66 to E244 have crystals running from 1544 to 2017; F113 has 2069. Naturally, there is no way to identify interchanges and replacements.

I believe the scribed numbers indicate inspection approval in the order of processing, with one individual perhaps doing the entire 5700 over a two- or three-year period. With the then-state of the art, it is probable that the crystals were tested not only for frequency and activity but for adjacent spurious responses and temperature stability.

Why are there conspicuously more survivors from almost the earliest production, E, F, and G? I believe it is because those buyers knew in early 1935 that they were getting something utterly unique. They were conservative, thrifty types, and would have seen no reason to trade for several years. An owner would take pride in having "one of the first fabulous HROs." Later buyers, on the other hand, would have chosen from a wide selection of comparable sets, and would have been more inclined to "trade in" fairly soon. These later, second-hand HROs would succumb to the wear and tear and kinds of modifications which soon make a set nearly worthless, and not a likely survivor.

A number of survey reports contain highly important dates. Some are from dates of purchase or putting into service. Some are from dates inside power supplies; a few are from other documents and personal recall. I used these to block out the total, from a guess of January 1, 1935 (based on Jim Millen's production forecast in the December 1934 ad) for a beginning, to an end of the letter-prefix series near a fairly definite date for the beginning of the letter-suffix series. I then interpolated and smoothed the curve to fit the credible dates, and produced Table 2 with batch-production dates.

The questionnaire inevitably sought too much detail on some things and not enough on others (see Note 5 below). However, it established a sequence of changes and patterns nicely related to the serial numbers. Here are the main conclusions:

D-series: As mentioned before, the first known sets are the D-series, with silver tuning dial, white coil charts, three round IF cans with only one adjusting hole each, metal shallow-rim S-meter with five-unit scale, white pushbutton, no pilot light, "NC" on red diamond dial pointer, no break-switch terminals, hand-written values on white-body resistors, black chassis, no nameplate, and small vent holes in the cabinet (only 1/4" in diameter). Small dials have short hubs and shallow-etched figures. Crystal filter shafts are positioned by a strip screwed to the front panel. There are other details which changed later, but they seem to me too trivial to mention.

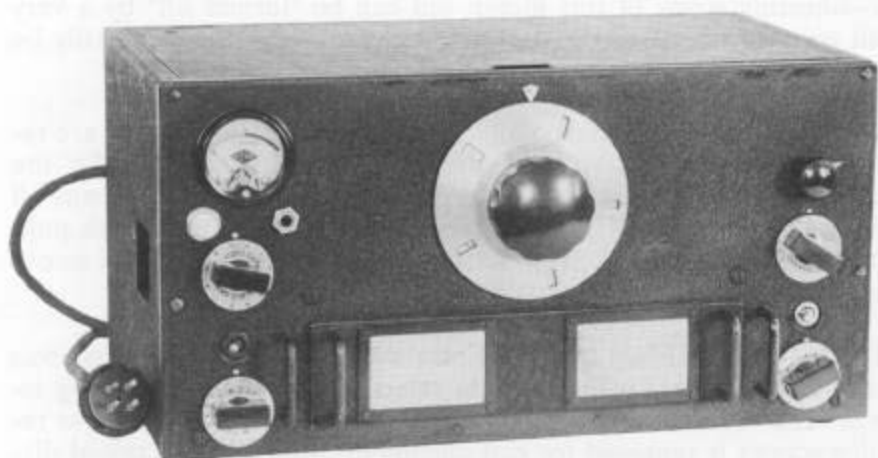


Fig. 1. Early 1935 HRO (E 171). Identical to first production except for raised-rim meter (with much later 9-unit scale) and plated replacement B+ switch.



Fig. 2. Example of earliest HRO without white pushbutton, also showing engraved panel rack model (F 213, mid-1935).

E-series: The first known change was to the S-meter with raised rim. This continued through the E-series, then changed back to the original low-rim model over a period including F, G, and H – evidently a supplier problem. I might mention here that B+ may be present on the zero-adjusting screw of this meter, but can be "turned off" by a very small reversal of the screw after finding zero. The pin can easily be centered in the fork, preventing contact.

Late E- and early F-series: Coil charts printed black on white are replaced by the reverse, with identical graphics. No reason for the change is obvious, unless it was to conceal glue stains. Coil cans all have two holes each. The white pushbutton changed to a black pull-switch during this period. The button was electrically noisy and inconvenient.

E- to G-series: Main tuning pointer with "NC" in red diamond was used interchangeably with the plain raised diamond during a long interval. The red diamond was costly and fragile, as one of the three retaining screws is removed for coil alignment. Some of the raised diamonds in this interval may be replacements.

F-series: Stamped insulators between sections of the tuning condenser are replaced by molded ones, less susceptible to humidity changes, for better stability. This change apparently occurred within the series. The pilot light, essential to maximum tube life, appears and is found in all later sets. Values of the white-body resistors change from hand-lettered to stamped; a very few later sets have hand-lettered ones.

G-series: The break-switch terminals appear, accompanied by a lengthened cabinet cutout. This feature was essential to anyone operating a transmitter. The manufacturer's decal appears inside the lid. Both these features appear in a very few sets in the F-series also. The decal does not identify the product; it implies only that the cabinet is "made by National."

Data thus far are based on a total of 27 sets. "H" and "J" are represented by only four; the only report of a "K" is from its instruction book, which is stamped as usual with a serial number.

J-series: Three conspicuous changes seem to distinguish what was perhaps the "new 1936 HRO." The S-meter now has a plastic case, concealing the "hot" zero-adjustment, and reads to S9. (It is electrically the same; the "S" unit was changed from about six to about four decibels.) The cabinet now has one-inch ventilating holes along the back, soon accompanied by louvres on the ends, for better stability. (This is a useful feature when scanning an HRO at a distance.) Finally,



Fig. 3. Very late plug-in crystal HRO (169 L, about 1940). Note illuminated plastic-case meter and rectangular selectivity knob.

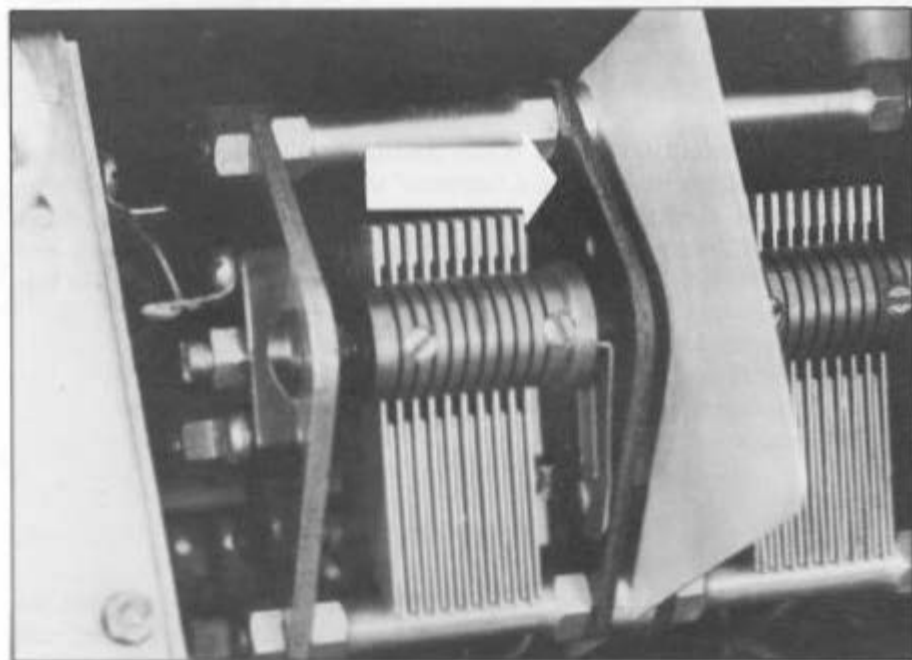


Fig. 4. Detail of earliest tuning condenser showing rough edges of insulator stamped from phenolic sheet (E 171).

the handsome "silver" dial, actually nickel-plated zinc alloy, is changed to black lacquer, probably a cost reduction.

L-series: At almost the same time, the chassis changes from eccentric black to conventional gray. (Black bottoms continue for a long time.) The flat fiber tube sockets become the raised-center type.

P-series: The last of the so-called early features disappears: IF cans are now rectangular. I suspect they have improved performance.

T-series: Condenser spacer posts, previously machined from hex stock, are now plain cylindrical, a cost item. The S-meter is now illuminated, in response to competition.

U-series: Resistors of National's own make are replaced by commercial brands, yet another cost factor.

X-series: Surprisingly, the nameplate appears only at this late date. I believe this coincided with the appearance of the printed patent-license sticker, found on the rear of the chassis when the cabinet is removed. This was about the time that Jim Millen left National; perhaps, after that, they had to pay dues like everyone else.

The HRO as evolved to this point, late 1938, continued with only one important change into 1940 or 1941, when the plug-in crystal disappeared, in the HRO-M. The latest known set with plug-in crystal, 169L, has the much-changed condenser insulators that are standard in the HRO-M.

Although production of the HRO declined up until the demands of war production, its survival as a "current" model is impressive. During a time when a dazzling array of competition appeared (the Hammarlund Super Pro and the Hallicrafters Skyrider Diversity, to name just two), the HRO continued for over six years with literally only the following performance-related changes:

- Tuning-condenser insulators,
- S-meter and switch,
- IF transformers,
- Coil construction details.

FURTHER NOTES

1. The variously marked coil terminal moldings seem to have no chronological significance. Assortments are found in individual coil sets having matching serial numbers. I conclude that two mold cavities were added quite early in production, and that there was no design or functional difference in the parts.

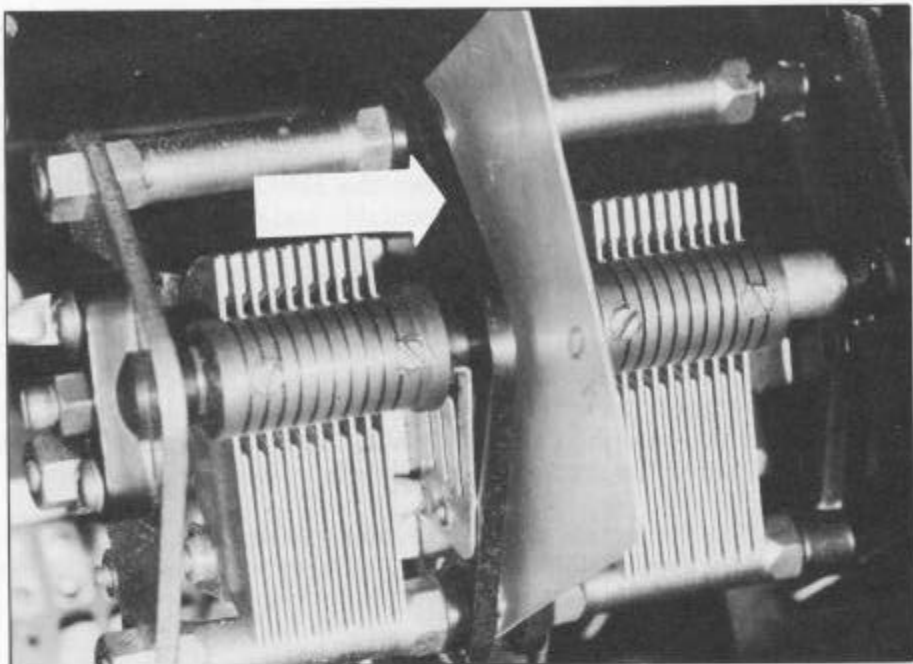


Fig. 5. Tuning condenser with molded insulators. Note integral raised hub meeting spacer (F 213).

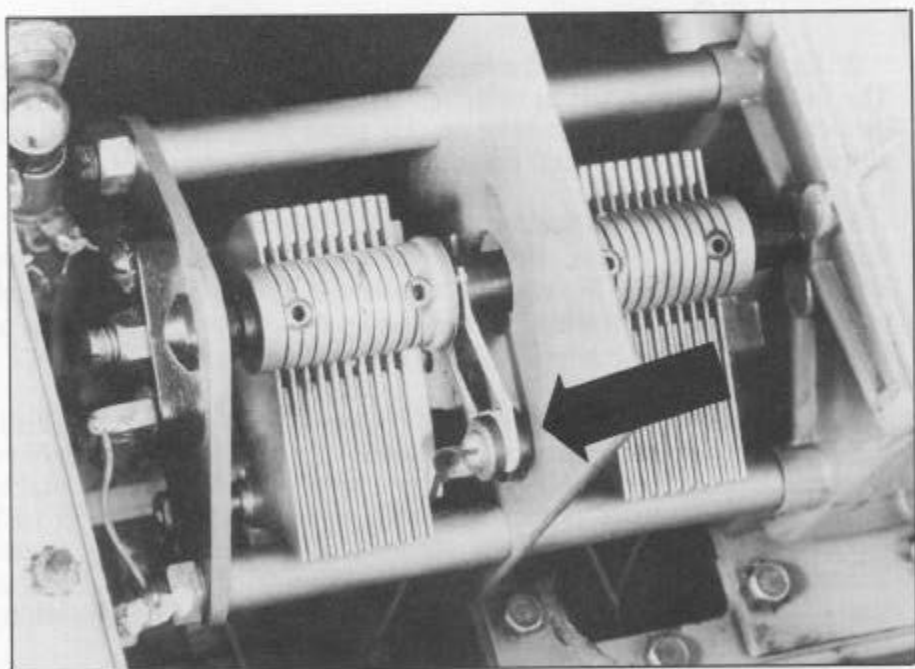


Fig. 6. Much-modified late tuning condenser from 169 L, also as found in HRO-M. Large insulators replaced by bushings.

2. A similar condition exists among the small dials, except that they were not mixed in any one set. There are two hub types and three kinds of metal discs, varying as to thickness and typeface.

3. A number of attractive so-called direct-reading dials appeared, with various bandspread schemes, but the HRO's PW dial and condenser combination was the most repeatable and precise-reading in any prewar receiver.

4. The survey question about coil-tray fronts was miscalculated. It turns out that all the sets with plug-in crystals have, or originally had, coil trays with aluminum fronts approximately 3/16 inch thick. The thinner steel fronts are from HRO-5s and military sets. A further late discovery is that, for the coils with white charts, the aluminum fronts have machined or file-dressed edges, while later ones are as-stamped.

5. Based on the survey, the HRO Junior was not popular. It is very rare now, only three being reported. Two have no letter in the serial number.

SOME THOUGHTS ABOUT "COLLECTIBILITY"

1. Very early sets often authentically have power supplies labeled as made for FB-7s.

2. Coil sets originally had a serial number corresponding to the set. The number is often lost in cleaning. A set is more desirable with its own coils. Coil-tray fronts have crackle paint if for table models, and alligator (or other matching) paint for rack models.

3. Rack models have tended to have a lower market value, which I think unfortunate, as the engraved panel is an attractive and massive addition to an HRO. Note that there should be a cabinet with a rack model. If authentic, it will not have the lip for opening at the front of the lid — a refinement permitting easy removal from a rack.

4. A late set is most desirable when it has a National speaker. This is the black-crackle box with red cloisonne "NC" diamond medallion. Original Jensen PM speakers are rare, as they had very un-durable cones. Speakers were not offered with early HROs, except in rack models that included the power supply, coil box, and speaker panel. This combination requires a mini-rack, an outfit that takes a lot of space, and is therefore not as desirable as a table model with matching speaker.

5. As with any production series, the early specimens must be more valuable than the late. That makes for a curious situation here be-

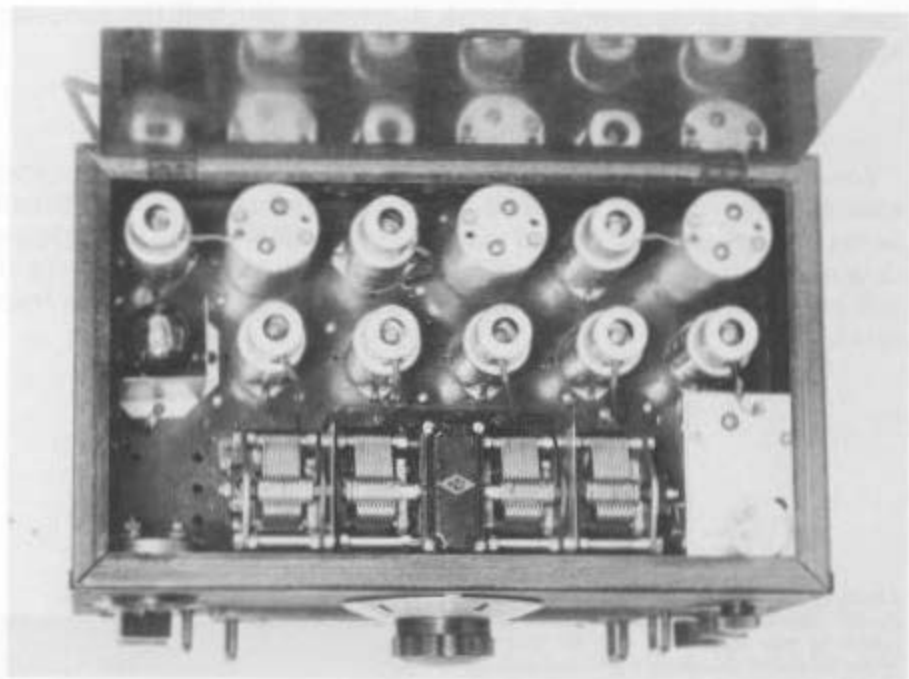


Fig. 7. Early chassis, black paint, round IF cans.

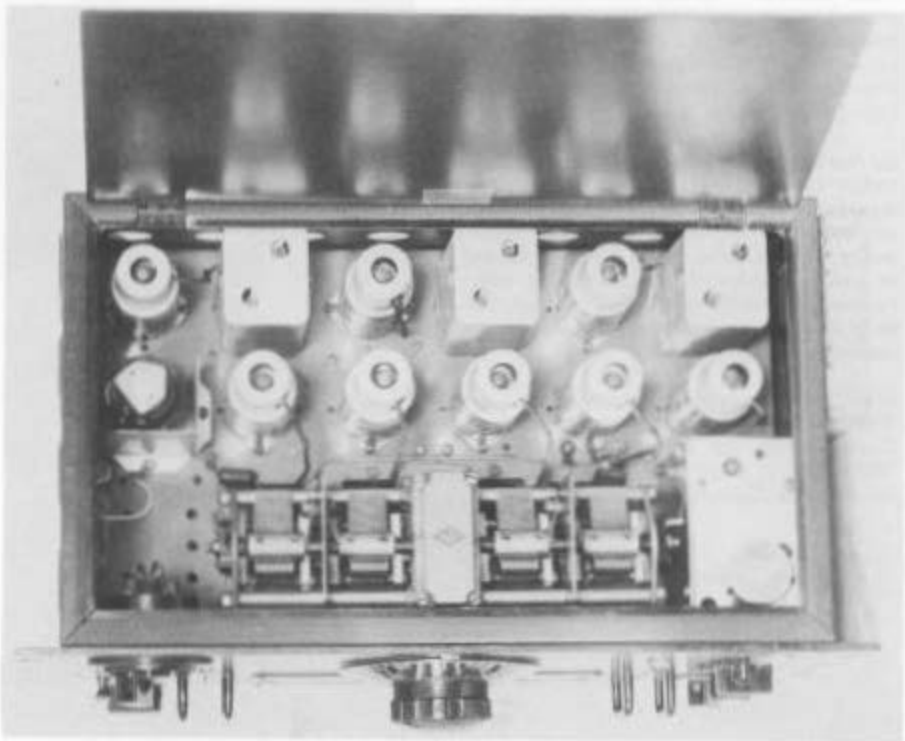


Fig. 8. Late chassis with gray paint and rectangular IF cans.

cause, if my survey sample is good, it appears that half the surviving sets were made before the summer of 1936. See Table 2.

A NOTE OF THANKS

I would like to thank most sincerely the many, many enthusiasts who took the time to send me filled-out questionnaires – their combined hours of labor equal or exceed mine. Everyone is welcome to send new data and corrections, which I will conscientiously add to the archives. I will answer questions and publish a supplement as the occasion warrants.

Charles P. Fisher

Charles Fisher was born in 1921. In 1941 he left Harvard to work in a defense plant where he was associated with the inventor of the National Company's dancing-doll toy and Tobe Deutschmann's Veritas resistors. He was a designer of sensitive relays and allied items until 1961, when he began a second career as a recording engineer and producer of classical LP records. Soon after, he developed and patented an important improvement in ribbon microphones for high-fidelity recording.

He has actively collected and researched old radios since 1978, concentrating on early superhets, communication receivers, and any others meeting his definition of "smart" radios. He has also had a life-long interest in antique keyboard instruments, in connection with which he received an appointment as a Research Associate of the Smithsonian Institution in 1981.

Besides articles on the National AGS in the "Old Timer's Bulletin" and on Western Electric equipment in the "Antique Radio Classified," he wrote the entry on the Piano for the New Harvard Dictionary of Music.



Photos: C. Fisher