



Every effort has been made to build into this single-signal superheterodyne every feature and refinement that contributes to improving short-wave C.W., I.C.W., and phone reception

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HRO COMMUNICATION RECEIVER NATIONAL COMPANY, Malden, Mass.

The electrical details of the HRO are of such interest that it is with reluctance that they are omitted here except in their relation to mechanical design. However, the mechanical features are no less original and important.

GENERAL DESCRIPTION: The HRO receiver is designed specifically for 1.7 to 30 mc. (175 to 10 meters) although two additional coil units are available covering 500 to 1,000 and 900 to 2,000 kc. Tuning is accomplished by a 4-gang precision condenser (see 1-A-4, Second Section) and a micrometer dial, (see 2-A-3, Second Section).

The tubes, transformers, and associated parts are mounted above and below a chassis plate which is high enough to fit above the plug-in coil units. Since the tubes are above the chassis plate, the coils and the various trimmer condensers are protected from frequency drift introduced by temperature rise when the set is turned on. Furthermore, the power supply, which in ordinary sets is responsible for most of the temperature rise, is not built into this receiver, but is mounted separately.

So accurate is the construction of the main tuning condenser that no auxiliary tuning control is provided or required, once the trimmers have been given their initial adjustment. Two frequency calibration charts are mounted on each plug-in coil unit one: for general-coverage tuning, and one for band-spread tuning.

On the front panel, at the left, are the signal strength meter and its push button, phone jack in the 2nd detector output, audio gain control or volume control in the diode detector, a switch to cut the A.V.C. in or out, and the C.W. switch and vernier tuning adjustment for locating weak carriers of phone stations. At the right are the variable selectivity control of the single-signal filter, the phasing control and crystal filter switch, a toggle switch to shut off the receiver during transmission or when coils are being changed, and an R.F. gain control connected to the second R.F. tube and the two I.F. tubes.

The electrical circuits comprise, briefly, two R.F. stages designed for uniform gain over the entire frequency range of the receiver, a crystal filter following the first detector, an electron-coupled oscillator,

two I.F. stages, second detector and output stage and a C.W. oscillator.

TUBES: Either 2-volt or 6-volt tubes can be used. They are:

	R.F.	1st D.	Osc.	I.F.	2nd D.	Output	C.W.Osc.
2V. —	58	57	57	58	2B7	2A5	57
6V. —	6D6	6C6	6C6	6D6	6B7	42	6C6

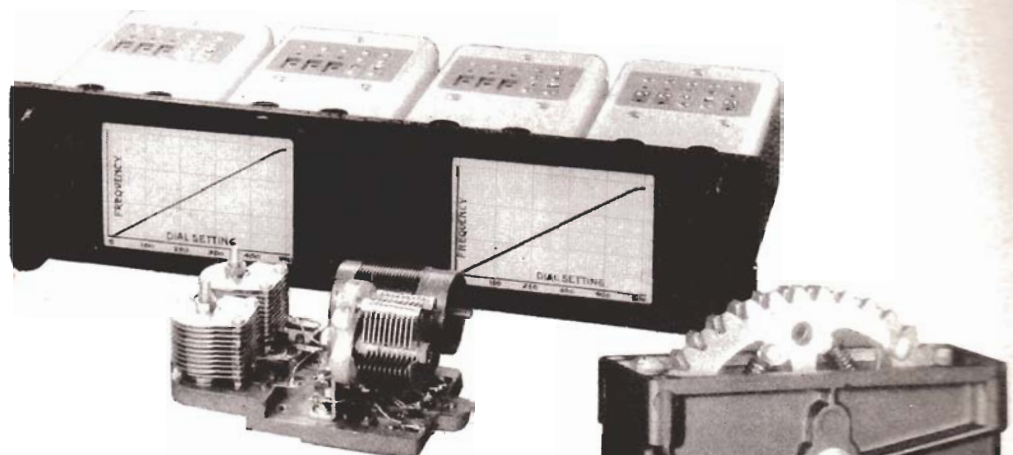
TUNING EQUIPMENT: As auxiliaries to the sections of the 4-gang condenser, each of the four coil assemblies in a plug-in unit contains three midget variable condensers as trimmers. Two of the condensers, mounted with their shafts vertical, can be adjusted, if necessary, through holes in the chassis plate and in the coil shields. The right hand condenser in each shield, looking at the set from the front, is a trimmer for general coverage tuning. The left hand condenser in each shield is a trimmer for band-spread tuning. The third condenser in each shield is put in series with its corresponding 4-gang condenser section when connections are shifted for band-spread tuning.

There is a connecting link on the contact block of each coil which, in one position, shorts the midget series condenser, opens the band spread trimmer, and connects the general-coverage trimmer. In the other position, the short is removed from the series condenser, the band-spread trimmer is connected, and the general-coverage trimmer is opened.

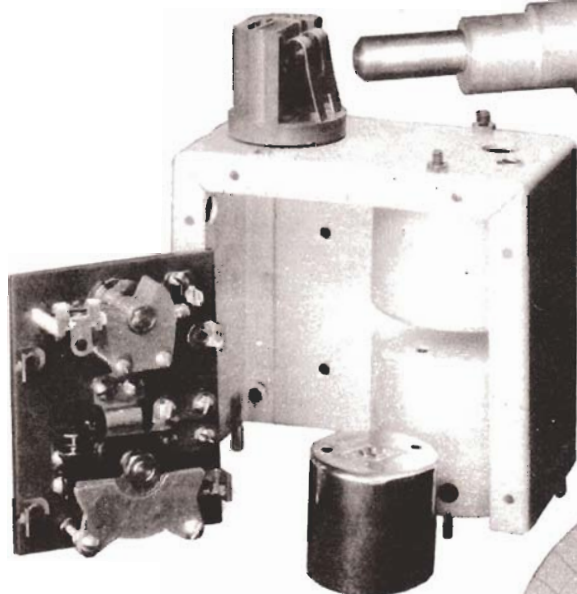
The extreme accuracy of control, and the rigid requirements of maintaining high efficiency in four tuned circuits over such a long frequency range bring up problems not encountered in most receivers. For example it is necessary to match the inductance of the coils, as well as to adjust the capacities. In the small coils, wound on R-39 forms $\frac{3}{16}$ in. in diameter, an end turn is brought out in a semi-circle at the end of the tube. Bent up or down, this half-turn acts as the rotor of a variometer, and permits a final, precision adjustment of the inductance.

On the larger coils, wound on a 1-in. form, the inductance is adjusted by a screw carrying a metal disc concentric with the form. The inductance is varied by screwing the disc toward or away from the middle of the winding.

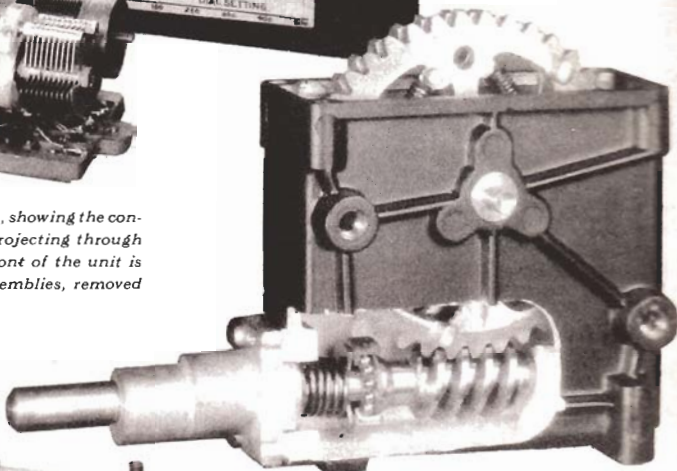
The mounting block which carries one coil and its trimmers is also the terminal board which extends through the shielding. This is a part of



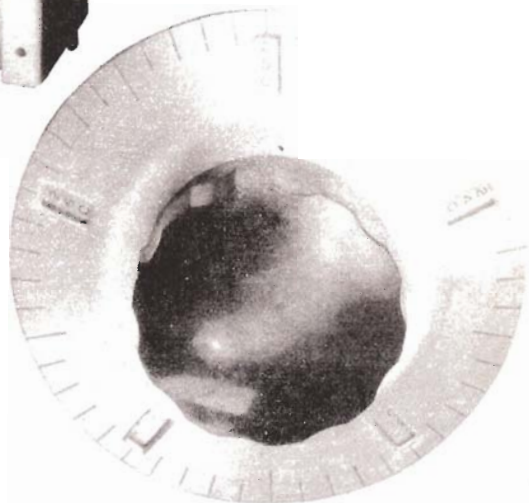
Above: One of the plug-in coil units, showing the contact studs, set in R-39 Bakelite, projecting through the openings in the shields. In front of the unit is one of the coil and condenser assemblies, removed from the shield

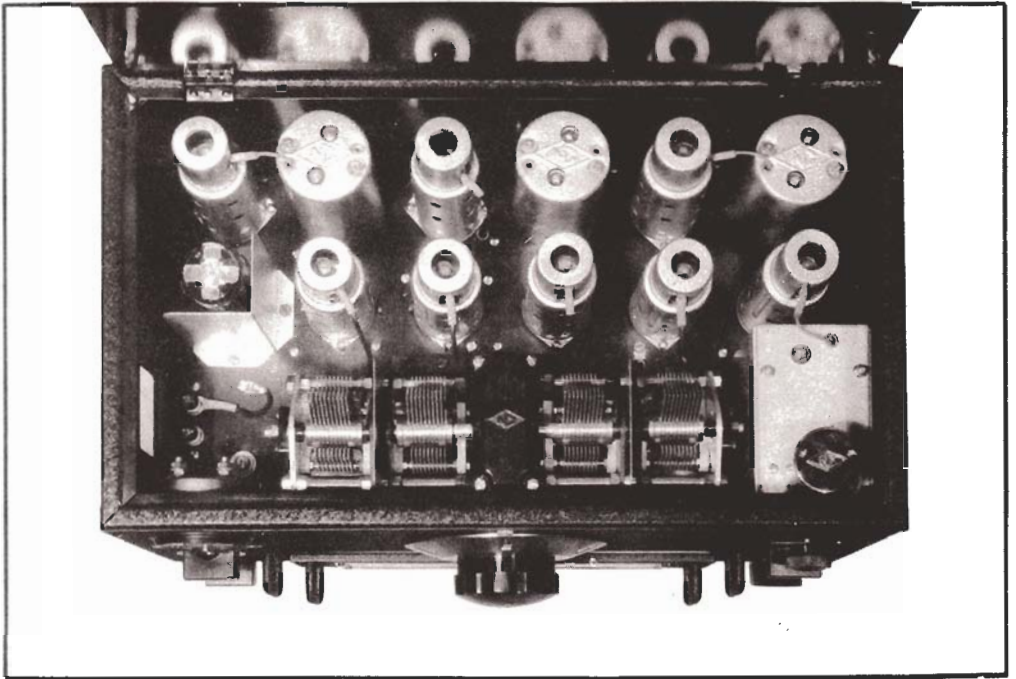


Above: Details of the crystal control section, and the new quartz crystal mounting. Right, the dial with its automatic number-changing scale, which is equivalent to a scale having 500 divisions for 180° rotation of the condenser



Above: A view of the condenser driving mechanism, with the top cover removed and a part of the case cut away, to show the split worm gear, and the spring-loaded, ball-bearing arrangement of the worm





A plan view of the chassis, showing the four-section tuning condenser with the associated tubes and transformers, and the single-signal crystal control section in the front, right hand corner



The front of the HRO, with a coil unit partly removed. By changing connections on the terminal plate of each coil in the unit, band-spread or general-coverage tuning can be obtained. This is one of the features that makes the receiver adaptable to a wide range of service

the tuning circuit wiring arrangement by which the total lengths of the leads in each tuning circuit are matched to within less than $\frac{1}{4}$ in. At 28 mc. a greater variation is sufficient to upset the alignment of the circuits.

While the arrangement of the various components has been planned to keep the heat from the coil units, the HRO is designed to operate under all conditions which may be met in any part of the world. Therefore, the trimmers are so constructed as to compensate automatically for any tendency to change capacity as a result of temperature variations. This has been accomplished so successfully that similar means are now being applied to air dielectric capacity standards.

FREQUENCY RANGES: The following table gives the general coverage ranges of all six coils, and the amateur bands for the band-spread adjustment. No band-spread arrangement is provided for the two coil units which cover the broadcast channels.

Coil Unit No.	General-Coverage	Band Spread
1	14.0 to 30.0 mc.	30 mc. band
No. 2	7.0 to 14.4	14
No. 3	3.5 to 7.3	7
No. 4	1.7 to 4.0	4
No. 5	.9 to 2.0	
No. 6	.5 to 1.0	

S METER: The meter on the front panel is calibrated arbitrarily in 5 units to give the S value in R-S-T system of reporting amateur

signals. It is calibrated to indicate the signal input in **microvolts** as follows:

Scale Reading	Microvolts Input
1	.4
2	.8
3	2.0
4	4.0
5	7.0

Since the use of this meter assumes a predetermined amount of amplification between the antenna and the second condenser, it is necessary to make a circuit adjustment to obtain zero reading. This is explained fully in the instructions issued by the manufacturer.

SINGLE-SIGNAL UNIT: The quartz crystal holder is mounted on a shield which contains the associated circuit. Details of the crystal holder are given at 6-A-1 in the Second Section. The arrangement and mounting of this assembly are shown in the accompanying illustrations. It is interesting to note that the crystal is held in a vertical position, with a clearance of .002 to .003 in. between the plates and the crystal.

INSPECTION AND SERVICE: All tuning trimmers and I.F. adjustments are accessible from the top of the chassis, with the coil unit in place, when the cover of the metal cabinet is raised. The resistors and fixed condensers are mounted under the chassis, at the rear.

RACK MOUNTING: The HRO is also supplied on a standard 19-in. panel for rack-mounting. It makes a very attractive assembly when mounted on a table rack (see 3-First Section) with the power supply.