Design Excellence: the R-390 and the R-390A

The R-390, first introduced by Collins in 1950, was the military evolution of the 51J. Designed with no compromise, the receiver used 32 vacuum tubes and one semiconductor diode. It used double or triple conversion over its 32 bands covering from 0.5 to 32 MHz. It was the first communication receiver with true digital tuning indicator. Its accuracy was derived from the crystal oscillators in the first local oscillator and even in the second one, when switched to triple conversion, and from the use of an ultra stable thermostated PTO, acronym of 'Permeability Tuned Oscillator', in the latest conversion stage.

Soon later Collins introduced a highly innovative component, the mechanical filter, whith its very high Q and its ideal frequency response, steep rise and fall edges and flat top. In 1954 Collins introduced the R-390A, the simplified version of the early model. The main difference was just in a redesigned IF deck, using mechanical filters instead of the many cascaded LC filters.

Both the R-390 and the R-390A were classified equipment until the mid sixties and production of the R-390A ran up to the mid eighties.



Fig. 1 – The front panel of R-390A, with frequency digital readout.

Specs of the R-390A receiver were absolutely exceptional, its accuracy and stability being comparable with those of solid-state frequency-synthesized receivers.

- Frequency range: 0.5 to 32 MHz
- Type of signals: CW, MCW, FSK, SSB, AM
- Sensitivity: 5 µV at 10 dB rise in AM, 1 µV in CW
- Temperature range: -40 to +75°C operating, -62 to +75°C storage
- VFO stability less than 500 Hz drift between -40 to +60°C
- Overall stability less than 300 Hz drift between -40 to +65°C
- Calibration accuracy within ± 300 Hz, with calibration points every 100 KHz

To grant the above specs in a fully analog receiver, its design was a marvelous masterpiece, both from electrical and mechanical points of view.

As said, R-390A uses double conversion when operating from 8 to 32 MHz and triple conversion below 8 MHz. Kilocycle tuning, linear through each 1 MHz range, is accomplished by moving ferrite cores inside RF and variable IF coils, while moving the core of the **PTO**, the variable local oscillator. Coarse positioning of the RF and variable IF cores is controlled by the 'Megacycle Change' knob, through a mechanical arrangement of gears, differntial coupler, shafts and cams.

For ease of in-field maintenance, the mechanical design is modular, based upon a central main frame holding six removable sub-chassis.

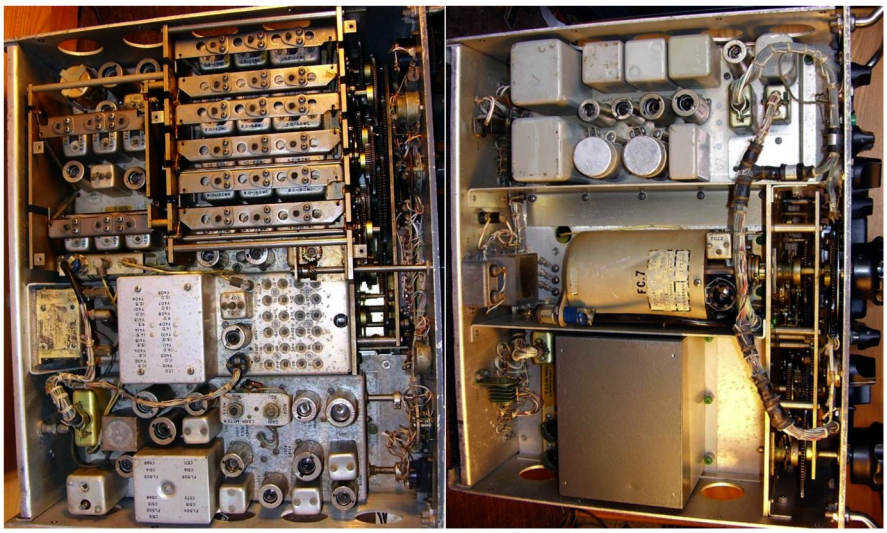


Fig. 2 – Two views of the inside arrangement. Left, on the upper side of the frame we see the RF and variable IF, the crystal oscillator and the fixed IF modules. Right, the AF, the PTO and the power supply modules are visible under the frame.

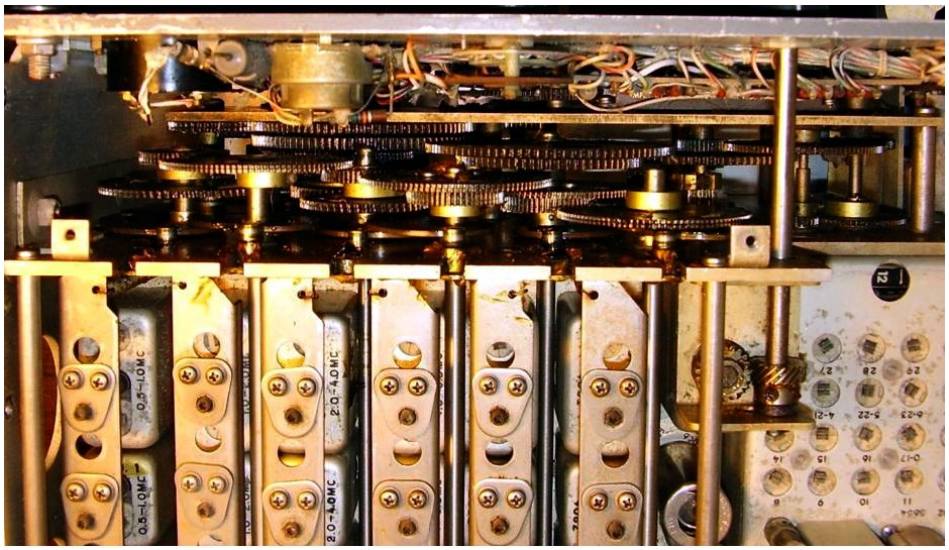


Fig. 3 – Details of the tuning gear train also showing part of the tuning racks.

The innovative architecture of the R-390A was forerunner of all the frequency synthesis receivers built still today.

Keep them alive!

Here is an article on the Collins PTO.