

Heathkit of the Month:
by Bob Eckweiler, AF6C



Heath MR-1 & MT-1
Comanche & Cheyenne Mobile HF Twins.

Introduction:

Starting in the late fifties and into the sixties Heathkit named a lot of their ham radio equipment after Indian tribes. There was the **Pawnee** (HW-20) two-meter transceiver, the **Shawnee** (HW-10) six-meter transceiver, the **Mohican** (GC-1/1A) portable SW receiver, the **Apache** (TX-1) HF AM transmitter, the **Mohawk** (RX-1) HF receiver, the **Chippewa** (KL-1) Linear Amplifier, the **Seneca** (VHF-1) VHF transmitter, and probably others I missed.

There were also two more pieces of Indian tribe ham equipment that sold between 1959 and 1962: the **Cheyenne** (MT-1) mobile HF ham-band transmitter and the companion **Comanche** (MR-1) mobile HF ham-band receiver. These were small (for their day) radios meant to mount atop or next to each other in a vehicle for mobile operation; they could also be used in a fixed location. Each unit measured 6 1/2" H x 12 1/8" W x 9 15/16" D. Let's take a closer look at these twins:

The MT-1 Cheyenne Transmitter:

The Cheyenne transmitter runs CW and screen-grid (controlled-carrier) AM modulation on 80 through 10 meters. It runs at 90 watts peak input. The circuitry is very close to the DX-40 and DX-60 except the power supply was omitted and a VFO was added. A relay for switching antenna and power between transmitter and receiver was also built into the transmitter. One feature of the MT-1 is its rugged physical construction. This was necessary to assure adequate stability when operating mobile. The frequency was obtained directly from a VFO. No crystal reference and synthe-

sizer was used, as in most of today's radios, so the components in the VFO had to be very secure. For that matter, the MT-1 did not have any provision for crystal-controlled operation. All the tubes in the MT-1 (and MR-1 too), with the exception of the final, were shielded using bayonet shields. This, was for physical security and as well as for electrical shielding.



Heath MT-1

VFO:

The MT-1 uses a 6AU6 pentode tube as a Clapp VFO. Voltage for the VFO is controlled at 150V by an 0A2 gas regulator tube. The VFO tunes 1750 - 2000 KHz on 80 meters, 7000 - 7175 KHz on 20 and 15 meters, and 7000 - 7425 KHz on 40 and 10 meters. To increase stability the tuning capacitor is a high quality dual bearing, ceramic unit and the frequency components are mounted rigidly and away from heat generating components. Temperature compensating capacitors help correct for drift from temperature. The frequency dial scales are etched on a glass cylinder that turns with the band switch to show only the dial scale for the band in use, behind the slide rule indicator. The VFO tuning capacitor is two section to allow adequate bandspread on 20 and 15 meters. It utilizes a gear drive, and when properly adjusted, has the feel of a very expensive radio. The VFO output is doubled in the 80-meter position for an output of 3500 - 4000 KHz. A SPOTTING switch allows the oscillator to run while in receive mode so the transmitting frequency can be 'spotted' on the receiver.

Buffer:

The output of the VFO is fed into a buffer stage consisting of a 6CL6 pentode tube. This stage

provides isolation and some frequency multiplication. Output of the buffer stage is untuned on 80 meters, tuned to 40 meters when operating at 40, 20 and 15 meters, and tuned to 20 meters when operating at 10 meters.

Driver:

Following the buffer is the driver stage that uses a 5763 pentode tube. This stage provides frequency multiplication of two or three, depending on band, and increases the power to a level capable of driving the final amplifier. Coupling between the driver and amplifier is via a PI network. The PI network is tuned with the DRIVE tuning variable capacitor on the front panel and has fixed loading.

Final Amplifier:

The final amplifier uses a single, common, rugged, 6146 power tube. The amplifier runs 90 watts input on AM (peak) and CW. It uses a heavy-duty PI network output tank circuit that can drive 50 - 72 ohm loads. The final plate runs at 600V and the transmitter is tuned for 150 ma of plate current for 90 watts input power.

Modulator:

The modulation scheme was taken directly from the DX-40 and DX-60. A 12AX7 dual-triode amplifies audio from a high impedance push-to-talk (PTT) microphone in two cascaded stages. The audio response is shaped in these stages to favor voice frequencies. The audio is then fed into the lower power section of a 6DE7 dual dissimilar triode where it is amplified and directly coupled to the high power triode section that controls the screen-grid voltage of the 6146 final, and modulates the RF output. The microphone is included with the radio and is designed to respond only to voice frequencies needed for best communications clarity. The microphone uses a ceramic element to withstand the severe environment of an automobile. The microphone jack is on the right side of the MT-1 and includes a PTT connection that operates the transmit - receive relay.

CW Operation:

In the CW mode the oscillator and buffer run continuously when in transmit mode, and the cathode of the driver and final are keyed from the key jack on the rear of the transmitter. Key up voltage at the key is on the order of 75 volts, so care should be taken to avoid a surprise shock.

The MT-1 Front Panel:Top Row

- Meter
- Meter selector: **Grid – Plate** (Lever switch below meter)
- Tuning Ruler Dial

Middle Row

- **Spotting: OFF ON**
- **Function: OFF, Grid, Stby, Phone, CW**

Bottom Row

- **Final tune: 0 – 10**
- **Drive tune**
- **Band: 80, 40, 20, 15, 10**
- VFO Tune
- **Audio Gain**
- **Final Loading**

(Actual panel markings are shown in bold.)

Rear Panel:

Connectors on the rear panel are a 1/4" phone jack for the key, two SO-239 female UHF coax connectors - one for the antenna and one for the receiver, two six-pin Jones connectors - one for power input from the power supply and the second for power output to the receiver, and a ground post.

The Heathkit Cheyenne AM Mobile Transmitter cost \$105.95 in 1959. It was later replaced by the HX-20 SSB Mobile Transmitter which had no Indian tribe designation.

The MR-1 Comanche Receiver:

The companion receiver to the Cheyenne MT-1 transmitter is the Comanche MR-1 receiver. Physically they are identical in size and look

almost identical. The MR-1 is an eight-tube single conversion superheterodyne receiver with a 3 MHz IF. Three of the tubes are multi-section. A crystal lattice IF filter provides adequate selectivity of 3 KHz at 6 db and 10 KHz at 60 db. The receiver boasts a sensitivity of 1 μ V, par for good receivers of the day. All the HF bands of the day are covered in their entirety.



Heath MR-1

Front end:

The RF amplifier of the receiver is a 6BZ6 pentode tuned-grid tuned-plate amplifier. Individual coils are switched in for each band and the front panel ANT TUNE control peaks the input of the RF amplifier. The output coils are tuned by a section of the main tuning capacitor. Output from the RF amplifier is fed into the pentode section of a 6EA8 dual tube where it is mixed with the high frequency oscillator that uses the triode section of the 6EA8. Each band has its own oscillator tuning components, using temperature compensated capacitors, so each band to be calibrated without affecting others. The voltage to the HF oscillator is regulated to 150 volts by an 0A2 gas regulator tube. This tube also regulates the voltage to the product detector and S-meter amplifier. Surprisingly, there is no 100 KHz crystal calibrator built-in to the receiver.

IF:

The intermediate frequency stages operate at a frequency of 3.0 MHz. The mixer output is coupled to the first IF through a 3 MHz crystal lattice filter that provides good selectivity before the first IF (perhaps the beginnings of the roofing filter?) Two stages of IF amplification are provided using another 6BZ6 and the pentode section of a second 6EA8.

Detectors:

The output of the IF is fed either into a product detector for CW/SSB or a diode detector for AM. The product detector uses a 6BE6 penta-grid converter tube which also acts as a three MHz tunable oscillator. The oscillator frequency is varied by the BFO (beat frequency oscillator) front panel control. The product detector output is the difference between the IF and the oscillator setting. On CW this is usually a note of about 1000 Hz, adjustable by the BFO control; and on SSB this is the audio of the SSB signal when the BFO control is set properly. Marks on the front panel BFO control give proper settings for LSB and USB. For stability the voltage to the product detector is regulated by the 0A2 gas regulator tube.

AM signals are detected by one of the three diode sections of a 6T8 triode, triple diode tube. The other two diode sections provide AVC (automatic volume control) and a diode noise limiter that can be turned on or off.

Audio:

The triode section of the 6T8 tube used for AM detection provides a stage of audio amplification after either detector. That stage is coupled to a 6AQ5 audio output stage that drives an external speaker.

AVC and S-Meter:

One diode section of the 6T8 produces a negative voltage that becomes more negative as the signal strength increases. This negative voltage reduces the gain of the RF stage and two IF stages and is also fed to the S-Meter amplifier, the triode section of the second 6EA8. The meter is in the cathode of the amplifier tube and responds to signal strength. As was common on S-Meters of the day, the meter is mounted upside-down. When the receiver is off the meter rests on the right edge of the scale. When the radio is on, the meter moves to the left to the zero mark with no signal (actually full scale) When a strong signal is received the AVC voltage reduces the current in the tube, and thus through the meter, causing the meter to

move to the right. The meter amplifier also uses regulated voltage primarily for a stable zero setting.

The MR-1 requires an external power supply of 300V plus 6 or 12 volt filament voltage. If used with an MT-1 this is provided from a female 6-pin Jones connector on the back of the transmitter.

The MR-1 Front Panel:

Top Row

- S-meter
- Mode: **CW/SSB - AM** (lever switch below S-Meter)
- Tuning Ruler Dial

Middle Row

- **AVC: OFF – ON**
- **Noise Limiter: OFF - ON**

Bottom Row

- **BFO Tune**
- **RF Gain**
- **AF Gain/Power OFF**
- VFO Tune
- **Ant[enna] Tuning**
- **Band: 80, 40, 20, 15, 10**

The Comanche MR-1 sold for \$129.95. It was later replaced by the HR-20 Mobile Receiver which had no Indian tribe designation.

Power Supplies:

Heathkit made three power supplies for the Cheyenne/Comanche twins. The MP-1 mobile power supply, manufactured in 1960, is designed for 12 volt operation and uses two 2N442 switching power transistors that switch at 400 Hz. It provides the needed 500 - 600V at 150 ma, and 300V at 100 ma from a 12 - 14 volt source. The power supply also provides filament voltage straight from the 12 - 14 volt source.

The MP-1 was quickly replaced by the more efficient HP-10 from 1960 - 1963. This transistor

switching supply is more ruggedly packaged and includes massive heat sinks for the transistors.



Charles, K2CQK with his restored Heathkit Cheyenne and Comanche Mobile Twins.

For fixed location operation where 120 VAC is available, Heath manufactured the HP-20 power supply. This supply uses solid-state rectifiers and was a forerunner of the HP-23(A-C) AC power supplies that powered many of the SB series transceivers into the seventies. These later power supplies could be made to work with the Cheyenne and Comanche.

Unfortunately SSB was quickly becoming the voice mode of choice so the Comanche and Cheyenne had a short life. In a future column we'll look at their replacements.

If anyone has old Heathkit manuals or catalogs, (especially catalogs from the late fifties, sixties and seventies) that they are going to throw out, please pass them on to me. They help a lot with research on the older kits.

73, from AF6C



Remember if you come across any old Heathkit Manuals or Catalogs that you do not need, please pass them along to me.

Thanks - AF6C

This article originally appeared in the November 2008 issue of RF, the newsletter of the Orange County Amateur Radio Club - W6ZE.