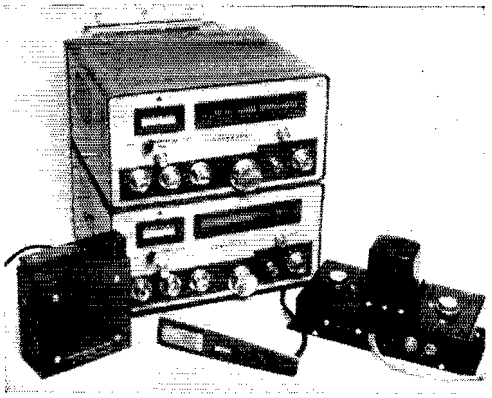
Heathkit Mobile Equipment

An appropriate title for the units pictured would be a "cubic-foot QSO" — the receiver-transmitter combination offers v.f.o. control and 80-through 10-meter operation, yet the total volume occupied by both units is a mere cubic foot. The transmitter and receiver, although primarily designed to be used mobile, also comprise a very compact and flexible home station. The manufacturer, more than likely having this in mind, makes available two different types of power supplies: one a conventional 115-volt a.c. supply for home installations and the other a 12-volt d.c. transistorized supply for mobile operation.



The complete Heathkit mobile installation, including receiver, transmitter, speaker, microphone, and transistorized power supply. The mounting rack, bolted to the back of the receiver and transmitter, is partially visible at the top of the receiver-transmitter assembly.

Comanche Mobile Receiver

The Heathkit MR-1 mobile receiver is a single-conversion amateur-band superheterodyne using a bandpass crystal filter in its 3-Mc. i.f. amplifier. It is designed for reception of a.m., c.w. and s.s.b. signals on all amateur frequencies from 3.5 to 30 Mc. The block diagram of the receiver is shown in Fig. 1. The front end uses a 6BZ6 r.f. amplifier, and this stage is followed by a 6EA8, the pentode section of which is the mixer and the triode section the high-frequency oscillator. The high-frequency oscillator and mixer tuned circuits are tracked to give an i.f. output frequency of 3 Mc.

The output of the mixer goes into the 3-Mc. crystal filter, which has a bandpass characteristic 3 kc. wide at 6 db. down and a maximum width of 10 kc. at 60 db. down. The crystal filter contributes the receiver's adjacent-channel selectivity and the high intermediate frequency takes care of image rejection. After the crystal filter,

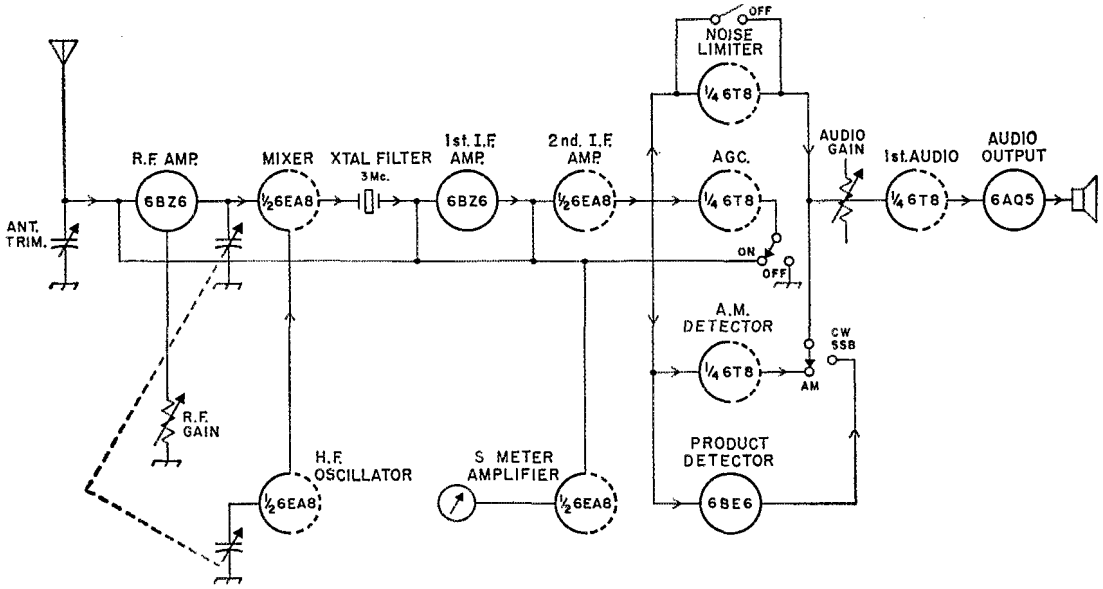
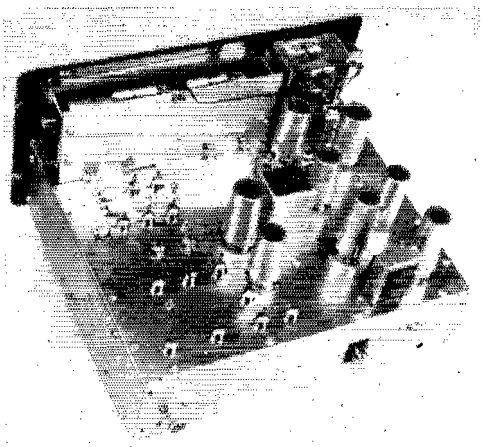


Fig. 1—Block diagram of the Comanche receiver.



Top view of the Comanche receiver chassis. Tubes from panel to rear and from right to left in this view are, front row, the 6T8 first audio-noise limiter-a.m. detector, 6BE6 product detector, and 6AQ5 audio output; second row, 6EA8 second i.f. amplifier—S meter amplifier, 6BZ6 first i.f. amplifier, 0A2 voltage regulator; third row, 6EA8 mixer—h.f. oscillator, 6BZ6 r.f. amplifier. The i.f. coils, in small shield cans, are at the upper right. The crystal filter is at the center.

another 6BZ6 is used as the first i.f. amplifier, and the output of this stage is impedance-coupled to the second i.f. amplifier, the pentode section of a 6EA8. The output of this tube is impedance-coupled to the detectors. Automatic gain control is applied to the r.f. stage and both i.f. stages when the a.v.c. switch is in the "on" position. With the a.v.c. "off," both i.f. stages are operated at maximum gain, with the manual r.f. gain control operative only on the r.f. stage. The triode section of the 6EA8, with the a.g.c. voltage applied to its grid, is used to drive the S meter.

A choice of detectors is available. A 6T8 is used as a conventional diode detector for a.m., as a series noise limiter, and as the first audio amplifier. A 6BE6 product detector is used for c.w. or s.s.b. reception, generating its own b.f.o. signal with a circuit resembling the type used for frequency conversion, as shown in Fig. 2. The audio output of the detector in use goes to the first audio amplifier, the 6T8 triode section, and thence to the 6AQ5 output stage. The 6AQ5 is transformer-coupled to an external 8-ohm permanent-magnet speaker.

An 0A2 regulator is incorporated to supply a constant voltage to the high-frequency oscillator and other critical circuits.

As shown in the bottom view of the receiver, the tuning mechanism uses five gears. The tuning capacitor drive gear is spring loaded to prevent backlash. Band calibrations are on a plastic cylinder which rotates into proper position behind the rectangular Lucite window in the panel when the band switch is turned. The dial drum is string driven from the band selector switch. The slide-rule dial pointer is also string driven from a large pulley located on one of the gear shafts. The dial scale is approximately five inches long, and thirteen rotations of the tuning knob are required for covering each band. The dial is calibrated every 20 kc. on 10 meters and at 10-kc. intervals on the rest of the bands. If more accurate frequency interpolation is desired, the flat dial pointer can be given a half twist at the time of assembly, so that its edge is perpendicular to the dial drum.

Assembling a kit of this sort is definitely not an undertaking for the beginner or inexperienced constructor. However, anyone who has previous kit-building experience under his belt and is willing to follow the well-laid-out and detailed construction manual can come up with a very satisfying finished product. Wiring of the r.f., high-frequency oscillator and mixer coils in the front end must be completed before the band switch is installed, since the coils become fairly inaccessible afterward. Because of the confined quarters, use of a pencil-type iron is highly recommended.

Alignment of the finished receiver requires an accurate signal generator, or a frequency meter such as the LM or BC surplus series. Included with the kit is the required alignment tool and a soft plastic nut starter which is an invaluable aid in starting nuts on screws in tight spots.

In the unit this reviewer constructed, the r.f. stage was slightly regenerative at maximum gain setting; however, this was readily cured by

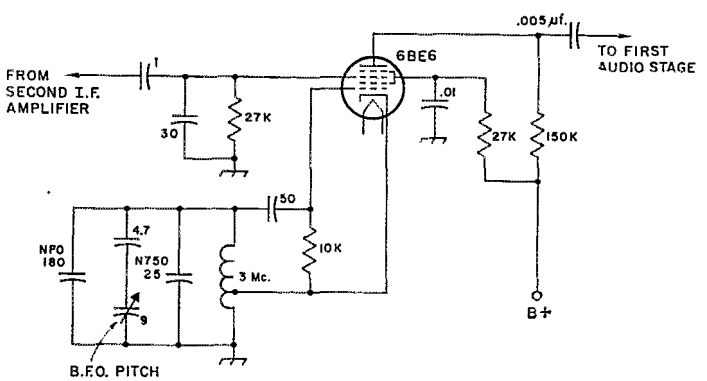
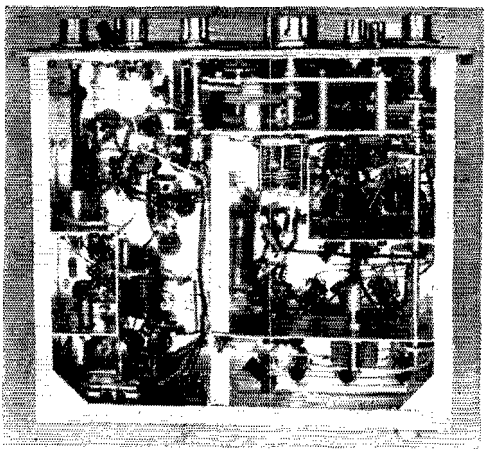


Fig. 2—Product-detector circuit uses a converter tube with self-excitation. The rectified d.c. voltage developed at the oscillator grid (No. 1) is one or two volts (negative) as operated in the Comanche.



Bottom view of the Comanche receiver. At the right, from bottom to top, are the r.f. coils, mixer coils, oscillator coils, and gear-driven tuning mechanism. The three sets of coils are shielded from each other, and a vertical partition separates the front end from the i.f. and audio sections. The rectangular shield compartment at the left houses the product detector.

installing small parasitic chokes in the plate and grid leads of the r.f. amplifier. When peaking the r.f. stage be sure the antenna trimmer is carefully set; its adjustment is critical. One slight improvement which perhaps might be desirable would be to increase the available audio level, which is a little on the low side.

Power requirements for the Comanche receiver are 350 volts d.c. at 125 milliamperes, maximum, and either 12 volts at 1.65 amperes or 6 volts at 3.3 amperes. The finished unit weighs 15 pounds and measures 6⅛ by 12⅛ by 9 15/16 inches — slightly less than a half cubic foot in volume. Our total construction time, including alignment, was 31½ hours.

Cheyenne Mobile Transmitter

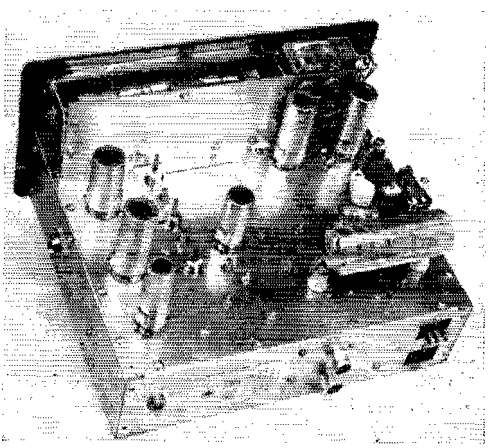
The Heathkit MT-1 mobile transmitter is a v.f.o.-controlled all-band (80 to 10 meters, inclusive) rig with a built-in controlled-carrier modulator. Referring to the block diagram, Fig. 3, it can be seen that the r.f. tube lineup is fairly conventional, with a 6AU6 v.f.o., 6CL6 buffer, 5763 driver, and 6146 final. The audio section has a 12AX7 speech amplifier and 6DE7 screen modulator. The controlled-carrier screen modulation system permits peak-envelope inputs up to 90 watts, which should result in an effective maximum carrier output of about 30 watts at 100 per cent modulation.

The v.f.o. is a series-tuned Colpitts circuit with output on either 1.75 or 7 Mc., the proper range being internally selected depending on the setting of the transmitter band switch. A spotting switch arrangement allows the v.f.o. to be turned on for frequency checking prior to putting the transmitter on the air. The v.f.o. screen and plate voltages are regulated by an 0A2 tube. The buffer stage is untuned on 80 meters, slug-tuned to 40 meters for operation on 40, 20, and 15, and slug-tuned to 20 meters for final output on 10 meters. The driver is straight-through on 80 and 40, doubles to 20, triples to 15, and doubles to 10 meters. Pi-network interstage coupling is employed between the driver and the final stage, and the correct coil tap is selected by the exciter-section wafer of the band switch. The final amplifier tank is a pi network, shunt-fed through a 2.5-mh. r.f. choke. For c.w. operation the buffer and v.f.o. run continuously, with the final amplifier and driver cathode-keyed. The metering circuit in the transmitter can measure either final amplifier grid current or final amplifier cathode current.

The modulation system is similar to that in the DX-35 and DX-40 transmitters,[1] using a triode as a series screen modulator. The modulator tube in the Cheyenne is the "heavy" triode section of the 6DE7. As in the earlier transmitters, the modulator's average plate current is adjusted, by means of a control tube which responds to the average speech level, to vary the r.f. carrier level to correspond to the modulating level. The "light" section of the 6DE7 is used for this purpose. The speech amplifier preceding the modulator and control tube is a cascade resistance-coupled affair using a 12AX7.

Many of the mechanical details in the Cheyenne are similar to or identical with those in the Comanche mobile receiver. Both the dial drive arrangement and front panel are alike. The dial length and frequency calibration are also the same — that is, 20 kc. per division on 28 Mc.

[1] "Recent Equipment," *QST*, September, 1956, p. 29.



In this view of the Cheyenne mobile transmitter the tubes starting at the top right, are the 5763 driver, 6CL6 buffer and 6146 final amplifier. The 6AU6 v.f.o. tube is in the center. Along the left are the 12AX7 speech amplifier, 6DE7 modulator and carrier control tube, and 0A2 voltage regulator. The plate r.f. choke, tank coil, and tuning capacitor are grouped around the 6146 tube at the right. Located from right to left on the rear wall of the chassis are the power plugs, antenna connectors, and key jack. The microphone connector is mounted on the left-hand chassis wall.

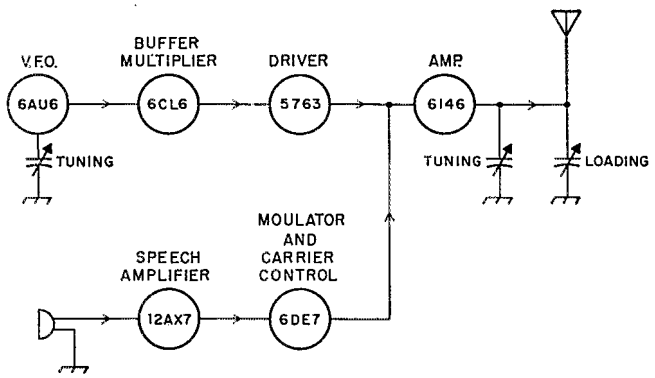
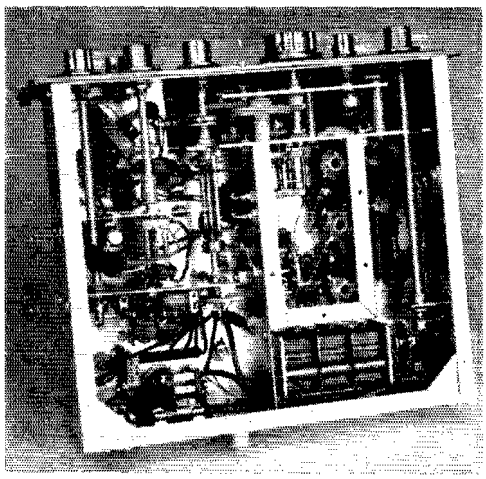


Fig. 3—Block diagram of the Cheyenne transmitter.

and 10 kc. per division on all other bands.

The v.f.o. is completely shielded, and power connections are brought out through feed-through bypass capacitors. The buffer, driver and amplifier stages are isolated from one another by rectangular shield plates, minimizing stray coupling between stages which could result in instability. The plate tuning capacitor, mounted above the chassis beside the 6146, is driven by a right-angle gear arrangement. The loading capacitor, underneath the chassis at the rear, is also driven by a set of right-angle gears.

All control switching, including antenna changeover from receive to transmit, is handled by an internal relay. Power input and output receptacles are mounted at the back of the chassis, and are wired for the compatible Heathkit power supplies (MP-1 and UT-1) and Comanche receiver. Included with the transmitter is a ceramic-type push-to-talk microphone.



Underneath the chassis of the Cheyenne transmitter. The center shield compartment contains the v.f.o. To its left are the band switch, buffer, driver and final amplifier circuits. The relay for control switching and antenna changeover is at the lower left. The speech section is to the right of the v.f.o. compartment. The 3-section capacitor at bottom right center is the final amplifier loading capacitor.

Power requirements for the Cheyenne are 300 volts d.c. at 100 milliamperes, 500 to 600 volts d.c. at 150 ma., and either 12 volts at 2.35 amperes or 6.3 volts at 4.7 amperes. The finished unit weighs 15½ pounds and measures 6⅛ inches high, 12⅛ inches wide, and 9 15/16 inches deep. Total construction time in our case was approximately 28 hours.

Transistorized Mobile Power Supply

The Heathkit MP-1 transistorized power supply was designed primarily to furnish all the necessary power to the Heathkit mobile transmitter and receiver units. This supply is the usual transistor type having a feed-back winding on the power transformer to set the transistors into oscillatory switching, as has been described several times in recent issues of *QST*. However, the rectifier-filter arrangement differs from most of those previously described in using a full-wave voltage doubler circuit rather than a center-tap or bridge rectifier. This is apparently a matter of economics, primarily; the doubler circuit requires only half the number of semiconductor rectifiers that would be needed with either the center-tap or bridge circuits to deliver the same output voltages. (This is because the peak inverse voltage on each rectifier group is twice as great with either of the latter rectifier circuits.) The circuit is shown in Fig. 4. The 100-ohm resistors between the first and second filter capacitors in each leg add considerably to the ripple attenuation since they represent about 20 times the impedance of the 40-μf. output capacitance at the 800-cycle ripple frequency.

The pilot lamp across the 20-ohm resistor serves as a current indicator, lighting up to about normal brilliance at the maximum permissible current drain on the supply.

A 1000-μf. electrolytic capacitor is connected directly across the battery at the primary input side of the supply to bypass the battery circuit and prevent the 400-cycle hash from feeding back into the transmitter and receiver. There is also a self-contained control relay for turning on

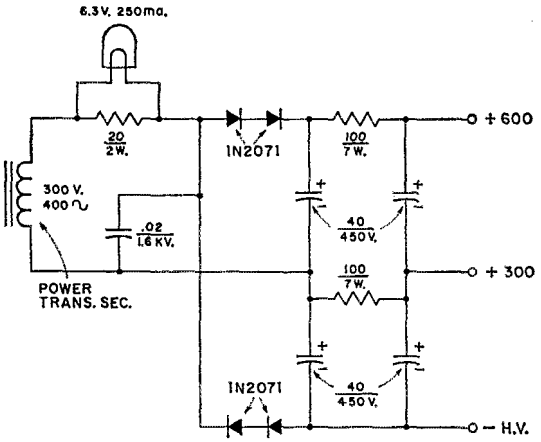


Fig. 4—Rectifier-filter circuit used in the transistorized power supply.

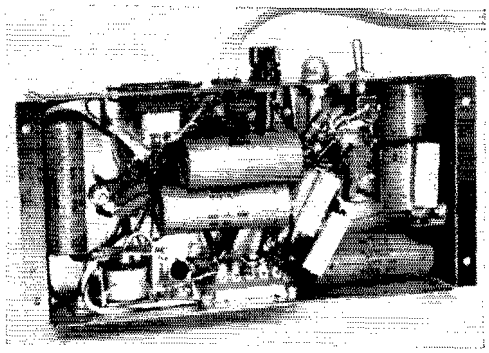
the supply, operated by the auxiliary control circuits in the mobile transmitter and receiver. A manual toggle switch on the chassis offers an alternative means for turning on the supply. The 12-volt primary circuit is protected by a 15-ampere fuse.

After constructing the power supply unit it would be wise to check the relay contacts with an ohmmeter before applying power. In the unit constructed here these contacts were covered by some type of insulating coating which had to be cleaned off before the supply would function.

Power specifications of the supply are as follows: Input voltage 12 to 14 volts; input current, 4.5 to 15 amperes (varies with load); maximum output power, 120 watts. This maximum power may be taken from either tap alone or distributed as desired between the two taps. In the transmitter-receiver combination the distribution is 90 watts from the high tap (600 volts at 150 ma.) and 30 watts from the low tap (300 volts at 100 ma.). Over-all dimensions are $9\frac{1}{16}$ by $4\frac{3}{4}$ by $5\frac{1}{16}$ inches. The total weight is 5 lb. 8 oz. Total construction time was approximately 6 hours.

Mobile Accessories

Optional accessories styled to match the receiver, transmitter and power-supply units include a 5-inch speaker (AK-7) to be used in conjunction with the receiver, and a mobile mounting base (AK-6) which is designed for mounting of the mobile transmitter and receiver on the transmission hump of the car floor. Also available is an all-band mobile antenna (RM-1). The manufacturer is the Heath Company, Benton Harbor, Michigan. — *K. C. L.*



The transistorized mobile power-supply chassis. From right to left on front (top) wall are the external power switch, output-current indicator bulb, primary fuse, primary input power cable, and power-supply output plug. The semiconductor diode rectifiers are mounted on the terminal strip at the lower center. The control relay is to the left of the terminal strip.

Strays

Hams interested in good-paying jobs with generous vacation, sick leave and retirement should investigate the civilian positions of electronic inspectors for the U. S. Navy. Write to Executive Secretary, Board of U. S. Civil Service Examiners, 17 Brief Avenue, Upper Darby, Pa., for application form 5000-AB. Applicants are graded on written examinations plus experience.

— ··· —

A couple of novel QSOs. On aurora the other night K1JWK worked K8III and W8MMM, both of whom are in Novelty, Ohio.

— ··· —

W6TKV gave a call on 80 c.w. the other night and who should answer but W7TKV from Boulder City, Nev., who said he used to be W6TKV back before World War II. The present W6TKV uses a ten-meter dipole for an antenna.

— ··· —

W9DBO's post office box number is 73!