



73 Test the Heath HX-20

Robert Buas K6KGS

Heath Company calls their new HX-20 a MOBILE SSB TRANSMITTER. All this it is, and more. Compactly packaged is a complete filter SSB transmitter/exciter for mobile, portable, or fixed use. Advanced mechanical and electrical design make the HX-20 a real performer. Modern styling and "ease-of-operation" make this unit a natural mobile transmitter. It is the opinion of the author that Heath has come out on top AGAIN.

The HX-20 sports an 11 tube circuit (not to mention the 7 diodes and 2 gas voltage regulators) that emits 100 watts PEP of USB, LSB, and CW. Associated circuits provide VOX, ANTI-TRIP, ALC, receiver muting, and antenna switching. Provision is made to "spot" the VFO either by "talking it on frequency" or by inserting carrier and zero-beating.

The HX-20 was designed to be used with the HR-20 in a mobile installation. Simply connect the two together, add a power source (such as the Heath HP-10), microphone, speaker, and an antenna, and you're on the air. In the mobile lash-up, total power draw

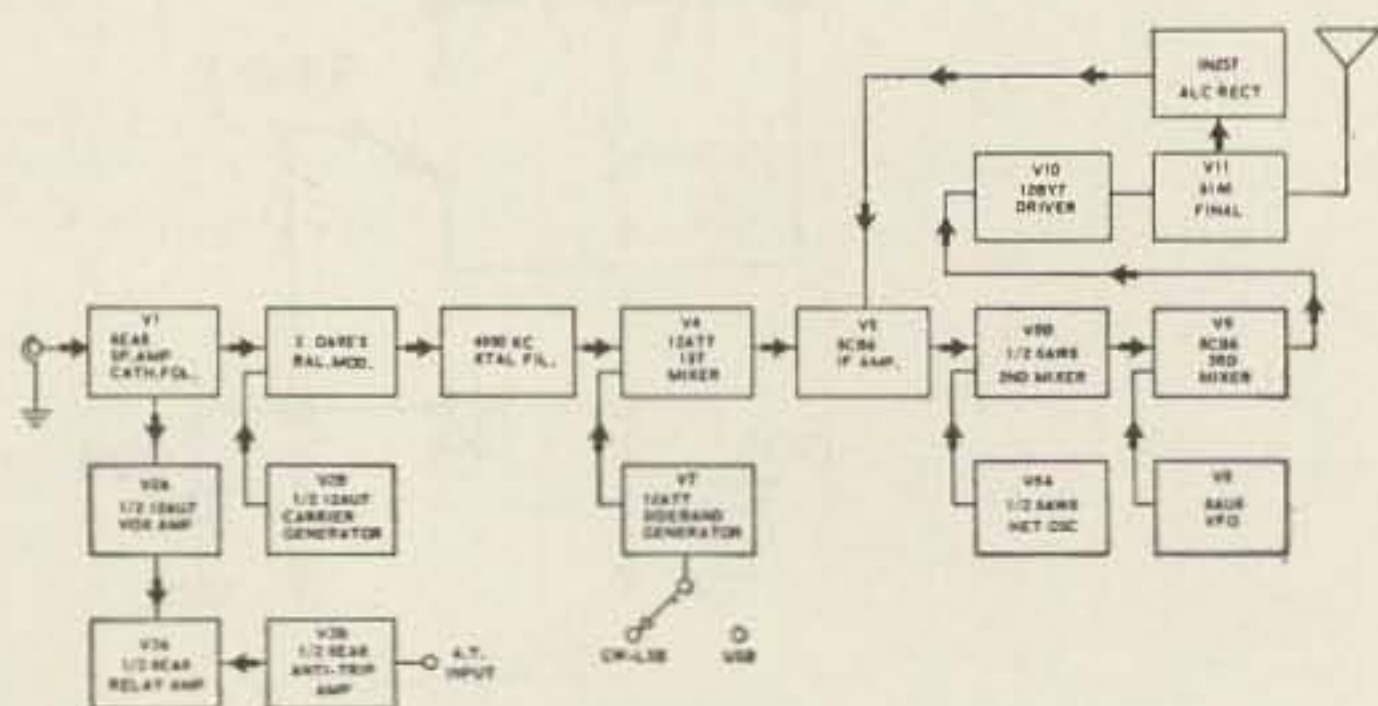
on the battery on voice peaks is 150 watts, from a 12 volt dc source. Receiving power is 80 watts. All oscillators in the HX-20 run continuously, accounting for the additional power drain.

For fixed use, the HX-20 may be used to excite a 1 KW linear amplifier (such as the Heath HA-10) or may be operated "barefoot." The 6146 power amplifier develops up to 50 watts average output on all bands. Hetrodyne circuitry and temperature compensation of the VFO are used to obtain maximum frequency stability and image rejection.

A block diagram of the HX-20 is shown in Fig. 1. As one might imagine, the schematic is very involved, thus it was omitted here. A triple-conversion hetrodyne circuit is used to obtain SSB at the desired output frequency. All oscillators are crystal controlled, with the exception of the VFO, of course.

Audio from a high-impedience microphone is amplified in the pentode section of a 6EA8. The triode section of the same tube acts as a cathode follower to provide the proper match for the crystal filter. A sample of this audio is amplified in $\frac{1}{2}$ a 12AU7, the VOX amp. This VOX audio is rectified and used to control the relay amp, the triode half of a 6EA8. The other half of the 12AU7 is used as a carrier generator for the crystal filter, the frequency being crystal controlled at 4990 kc. Output of this stage is coupled to the Balanced Modulator, two matched germanium diodes. A path for inserting carrier is provided for tune-up and CW operation.

The lower sideband of the DSB suppressed-



BLOCK DIAGRAM

USB or LSB may be selected directly. Another 12AT7 is used for two crystal oscillators so that the sum or difference frequencies of the USB signal at 4990 kc and the crystal oscillator selected will produce a 9000 kc USB or LSB signal respectively. Thus, the xtal freqs. are 4010 and 13990 kc. Provision is made for tuning the USB and LSB carrier freqs. to the same frequency. The output of the first-mixer is tuned to 9 mc in a Hi-Q double-tuned *if* transformer.

A single 6CB6 increases the 9 mc SSB signal to a usable level. The plate circuit is again a Hi-Q transformer. ALC voltage is used to bias this stage to keep from driving the final amplifier into the non-linear region. In the CW mode of operation, the "Drive" control on the front panel allows the operator to set the amount of cw output. This feature is an asset in tuning up the rig "on-the-air" without hetrodyne QRM.

Nine mc SSB is coupled to the second-mixer, the pentode section of a 6AW8. The triode section of this tube is used as a xtal controlled heterodyne oscillator, providing the second mixer with injection voltage. The output of the 6AW8 mixer is tuned 5 mc higher than the output frequency selected by the bandswitch. Hi-Q slug tuned circuits and traps are used. SSB from the second mixer is fed to the third-mixer, a 6CB6.

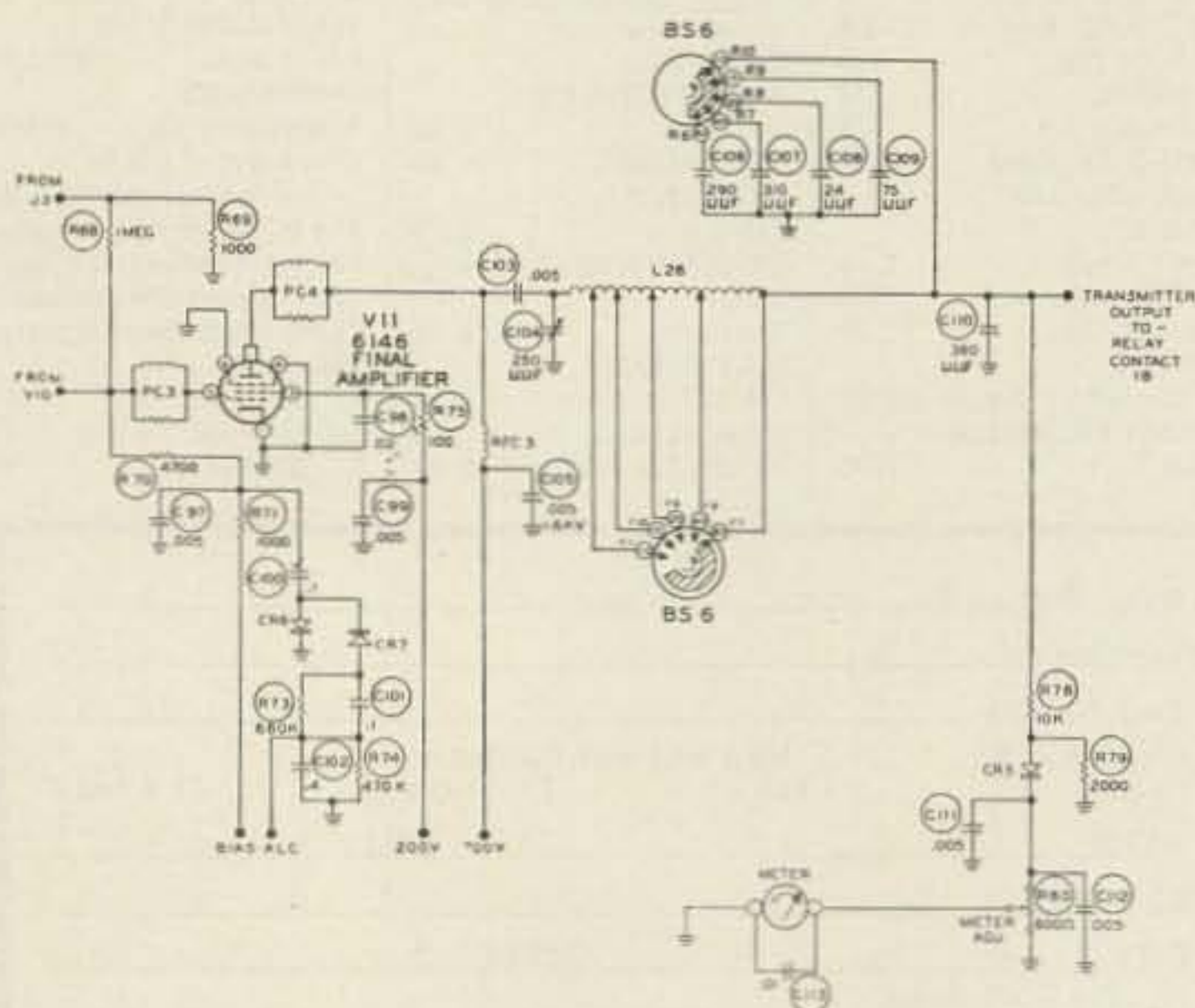
Injection voltage for the third mixer comes from the VFO, an electron coupled series tuned Colpitts oscillator. Plate and screen voltages are regulated by an OA2 gas regulator

The difference frequencies found at the plate of the third mixer are selected with Hi-Q slug tuned circuits, connected in the plate circuit by the bandswitch. These tanks are tuned to the output frequency, one for each band. Output of the 6CB6 is amplified in the 12BY7 driver, which is again resonated to the output frequency in the plate circuit. The third mixer and driver plate tanks are "gang-tuned" to reduce the number of front panel controls and to simplify tune-up. This control is labeled "Driver" on the front panel.

Blocking bias is connected to the control grids of the third mixer and driver stages, rendering them inoperative during standby periods. The output freq. is "spotted" by un-biasing these stages. Grid-block keying is used in CW, providing no key clicks or chirp.

The plate of the 12BY7 driver is capacity coupled to the 6146 Final Amplifier. Control grid bias is regulated at -50 v by an OC2 voltage regulator and resistance voltage divider. Screen voltage is regulated at 200 v by a tap on the voltage divider supplying the VFO OA2 voltage regulator. A fixed loaded pi-network is used in the final amp. plate circuit. The input of the pi-net is resonated to the output frequency with a 250 mmfd variable capacitor labeled "Final" on the front panel. The output impedance is fixed, chosen to match a 50 ohm non-reactive load. An rf "sniffer" samples a small amount of the output. This signal is rectified and displayed on the relative output meter on the front panel.

An interesting feature of the HX-20 is the ALC circuit. Fig. 2 shows a schematic diagram of the final amp and the ALC. ALC voltage is applied to the 9 mc *if* amplifier control grid in the form of negative bias. When the final draws no grid current through R71, the 1K grid resistor, no ALC voltage is developed and the *if* amp operates at maximum gain. When grid current starts to flow, a voltage drop appears across the 1K resistor, the waveform of which is that of the input speech peaks. This voltage is coupled by C100, a .1 mfd capacitor, to a voltage doubler circuit, CR1 and CR2. The ALC voltage decreases the gain of the *if* amp., reducing the drive, thus bringing the final back into linear operation. A sample of the rf drive at the final grid is returned to the receiver for spotting the



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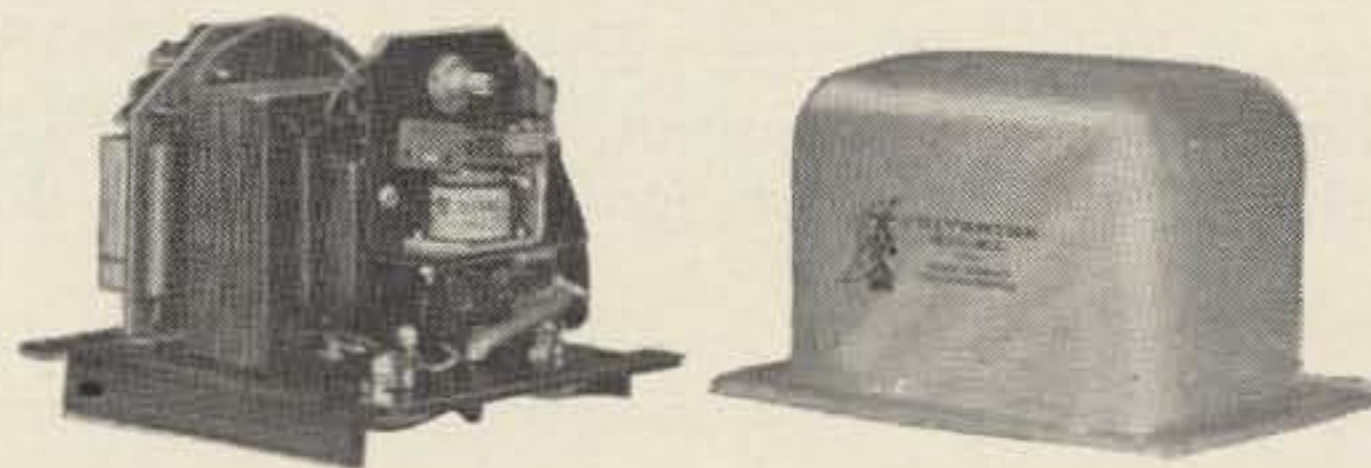
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VFO. The "sniffer" circuit is also shown in Fig. 2.

Anti-trip audio from the receiver is amplified in the pentode half of a 6EA8 and rectified to provide negative bias to compensate for receiver pick-up in the microphone. This negative anti-trip voltage is applied to grid of the VOX relay amp along with the VOX voltage.

Some hold-up in production must have existed at Heath when the author ordered his HX-20 because it was back-ordered two weeks. The kit was well packed; no damage was found on unpacking. Even the cardboard box survived the 2500 mile trek in one piece. All the components are of highest quality, as in the HR-20. All tube sockets are ceramic. The output coil is wound on a 2" ceramic form. Parasitic suppressors are used in the Driver and Final Amplified stages. All leads at rf ground are well by-passed. Twenty-two heavily plated steel brackets make up the HX-20 chassis and internal shields. When bolted together, these parts make an extremely rugged framework. VFO drive gears are spring loaded to eliminate backlash. This rugged construction and spring loading contribute greatly to the excellent stability of the VFO. Although the HX-20 is well shielded, it is not difficult to build. Heath says that approximately 45 hours of construction time is required. The amount of time required varies with the experience of the builder. This figure represents the time required of a relatively inexperienced constructor. Patience is of the essence in the building of this kit. In places, components are wired 4 and 5 layers thick. A very professional job of wiring can be achieved

if the builder carefully studies the instruction manual previous to picking up the screwdriver and pliers.

Upon completion of wiring, the HX-20 was given a thorough resistance check before power was applied. Finding no errors, power was turned on; no smoke resulted. Alignment is straight forward, and no re-peaking was required. A VOM will not work when one is tuning up the heterodyne oscillator. An 11 meg input VTVM must be used. Even then, grid voltage was found to be a little below specified on 10 meters.

Since the author dislikes the use of RCA phono connectors at RF, BNC type UHF connectors were used in place of the connectors supplied. The phono connectors would, no doubt, work well, but the authors HX-20 and HR-20 are moved from the rack in the mobile regularly, placing undue wear on the coax cables. It was found that straight through operation of the 6AW8 second mixer on 75 meters did not supply enough drive to the 6CB6. Thus, the 2.7K resistor, R38, was changed to 4.7K, 1 watt. This solved the problem.

The specification sheet states that carrier suppression is 50 db while suppression of the unwanted sideband is 55 db. The proof of the pudding was the "on-the-air" test. Excellent reports were received, on both quality and signal strength. Frequency stability is remarkable. The HX-20 was clamped in a paint mixer and allowed 30 minutes to warm up. After warmup, the output frequency was heterodyned with a 10 meter harmonic of the 100 kc frequency standard. After 15 minutes

of vigorous mixing, the HX-20 had moved only 1500 cps. Someone try this test on a 32S1. No one has volunteered the use of one here, yet!

Other than the stability test, the HX-20 was compared with a KWM-2. The HX-20 lacks the frequency "re-setability" that the KWM-2 possesses. Careful interpolation can bring the HX-20 within 1.5 kc, whereas the M-2 can come within 200 cps. There is only 3 db difference in power output. VOX, ANTI-TRIP, and ALC tied for first. As far as size goes, the

KWM-2 is a transceiver and the HX-20 is a transmitter. No valid comparison can be made. Note gents that the HX-20 is just a tad smaller than the 32S1.

For the money, it will be extremely hard to do better than the HX-20. It is the opinion of the author that the HX-20 and HR-20 make one of the best rigs on the air today—with the added consolation that one does not have to sacrifice one of his gold fillings.

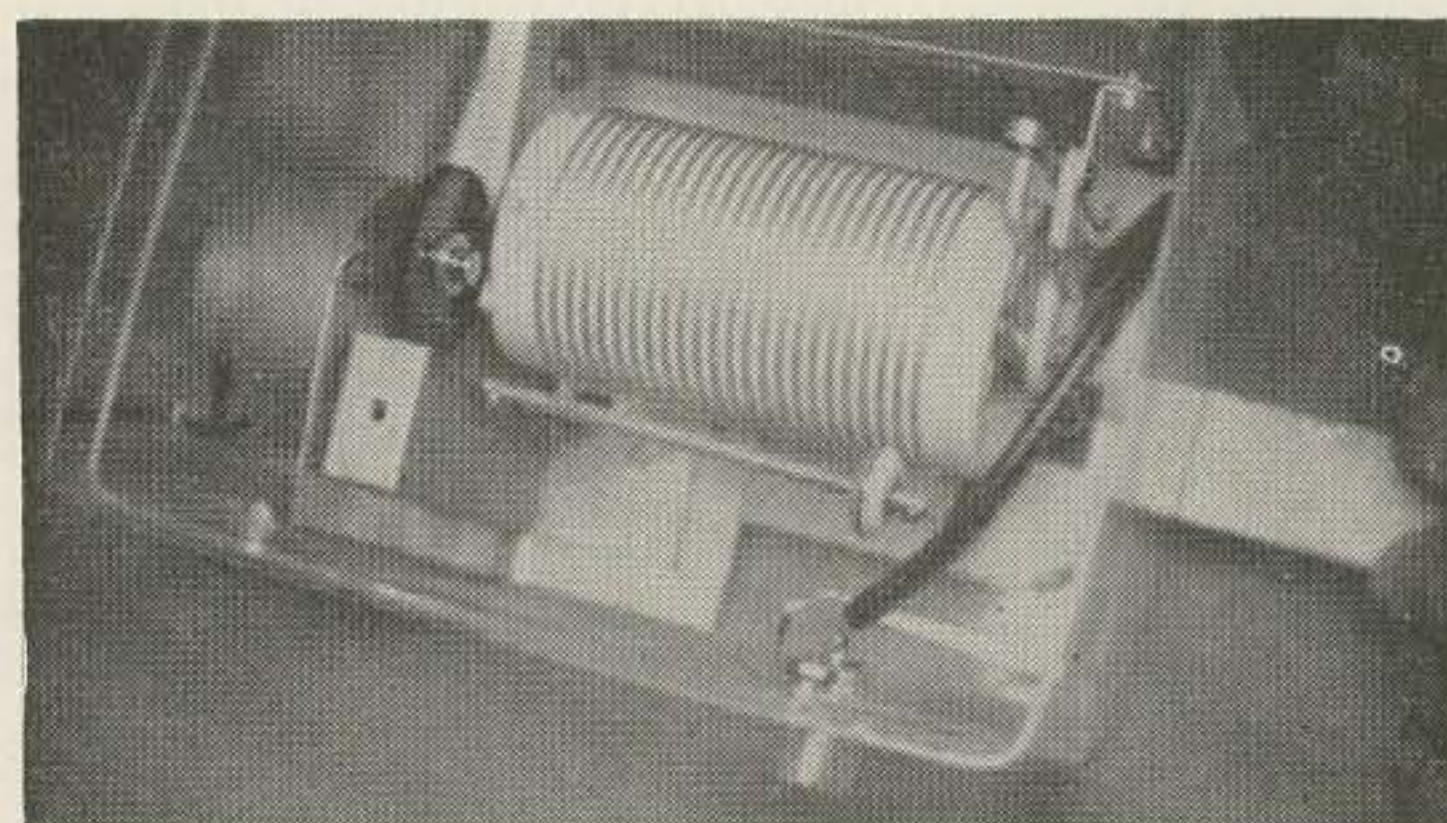
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Remotely Controlled Variable Inductor

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I faced the problem of changing antenna inductance in relation to ground potential. When I decided to become sophisticated and raise my 32' vertical plus coil from 40' (roof-top) to a height of 71'. Although the physical transfer of the antenna to its new position was made without difficulty, when my bridge and dipper were placed on the line, I was shocked to note the resonance change. Since I am somewhat inhibited about climbing to the tops of swaying towers, some remote means of altering inductance was needed. A system controlled from the shack was the answer.

Since I am new to amateur radio I had originally turned to the Command series of transmitters for a first rig. My original purchase was an 80 meter BC-696. The variable inductor (to resonate long wires) had been removed and thrown into the junk box. After meditating for a long period of time, this piece of valuable equipment was exhumed from the maze of wires, tubes, shoes and other choice bits of equipment that make up the average ham



shack. This undistinguished bit of equipment was to provide the solution to this quasi-intricate dilemma. I realized that variable inductance, controlled remotely was feasible and extremely inexpensive.

The parts required are:

- 1 5" x 7½" x 4" plastic food container & cover
- 1 female co-ax connector
- 1 1-5 rpm motor (Barry's Elect. NYC, \$1.59)
- 2 right angle fittings constructed from scrap
 - a. 6 x 3 x 2¼"
 - b. 3½ x 2 x 1¾"

The right angle supporting the variable inductor is cut and tapped as per Fig. 1.

The small right angle is cut from scrap metal to provide the mounting for the motor. The dimensions are as per Fig. 2. In my case the
(Turn to page 58)

