3.1.3 VOLUME CONTROL AND ON-OFF SWITCH

This control turns the power ON and OFF and adjusts the loudness of received signals.

3.1.4 POWER ON INDICATOR

This indicator is a red light which is turned on when the ON-OFF is in the ON position and remains illuminated at all times when your DIRECTOR 23 unit is transmitting or receiving.

3.1.5 TRANSMIT INDICATOR

This indicator is a white light which is turned on when you press the Push-to-Talk button on the microphone which indicates your DIRECTOR 23 is in the transmit mode. The light will fluctuate in brilliance when the transmitter is modulated.

3.1.6 S-METER

The S-Meter gives an indication of the received signal strength. A change of one S unit indicates a change of 6 db in signal level. The metering circuit is calibrated so that for 100 microvolts, the S-meter will read S9.

3.1.7 TONE CONTROL

The tone control serves as a treble attenuator which may be set for the best clarity or the most pleasing tone. However, the tone control serves another purpose. In a mobile installation, it may be set for the best clarity and the suppression of ignition noise.

3.2 OPERATING THE DIRECTOR

> CAUTION
>
> DO NOT PUSH TRANSMIT SWITCH WITHOUT FIRST CONNECTING A 52-OHM ANTENNA OR DUMMY LOAD.

3.2.1 Rotate SQUELCH CONTROL fully counterclockwise.

3.2.2 Rotate the VOLUME CONTROL clockwise, to apply power, and advance the VOLUME CONTROL until noise or signal is heard in the speaker. (Since your DIRECTOR 23 uses all transistors, no warmup time is required.)

3.2.3 With no signal present, rotate the SQUELCH CONTROL clockwise to a position in which no noise is heard. Advance this control only far enough to prevent noise from being heard. Advancing it too far may result in a weak station being unable to open the squelch. Since the squelch has been adjusted, with no signal present, then when a station transmits on the channel to which your DIRECTOR 23 is tuned, the squelch circuit will open and the station will be heard. When the station stops transmitting and no signal is received, the squelch gate will be closed and all sound will be "Turned Off". Sometimes noise will build up as a result of a passing truck, etc. If this happens, the SQUELCH CONTROL should be advanced just far enough to keep the circuit closed during these noise peaks.

3.2.4 Rotate the CHANNEL SELECTOR to the desired channel.

3.2.5 Adjust the volume as desired for the station you are listening to.

3.2.6 Adjust the tone control for the best clarity and tone.

3.2.7 To transmit, hold the microphone 2 to 3 inches from your mouth. Normally, it is best to hold it so that you talk across it rather than directly into it. This will prevent the sound of your breathing being transmitted. Hold the Push-to-Talk button on the microphone in, and speak in a normal conversational level.

3.2.8 When your transmission is completed, release the button on the microphone and listen for your reply.

3.3 OPERATING PROCEDURE

Since the Citizens Band channels are used on a shared and equal basis, standard radio operating procedure and courtesies should be observed at all times so that full use of the service can be realized by everyone. Some points to remember are:

3.3.1 Monitor your channel before transmitting.

3.3.2 Do not transmit if you hear other stations using the channel. Wait for them to clear the air.

3.3.3 Limit your transmission to the minimum possible time required to complete your business or transaction. Under no circumstances, exceed the time period as outlined within the FCC Rules and Regulations pertaining to the Citizens Radio Service.

3.3.4 State the call sign of your station at the beginning and end of each communication (not each transmission). This procedure is required by the FCC and can be performed simply.

3.3.5 Correct operating procedures, use of call signs, signing off, etc. will be found in the FCC Rules and Regulations, or can be explained by your PEARCE-SIMPSON dealer.

SECTION IV

MAINTENANCE & SERVICING

4.1 CIRCUIT DESCRIPTION

Your DIRECTOR 23 consists of the following circuits: the PEARCE-SIMPSON HetroSync[R] circuit, which provides the receiver injection frequencies and the transmitter carrier frequency; a dual conversion superheterodyne receiver; and an AM-modulated transmitter. It is powered from a positive 12.6VDC source. (See Block Diagram, Figure 4.1 and schematic.)

4.1.1 HETROSYNC[R] CIRCUIT

PEARCE-SIMPSON's method of frequency synthesis makes use of 14 crystals to provide crystal-controlled, 23 channel coverage on both transmit and receive functions. The circuit is composed of a 33.000 to 33.250 mc master oscillator (Q11), a 6.490 mc receive oscillator (Q101), a 5.995 to 6.035 mc transmit oscillator (Q101) and a transmit mixer (Q12). In the transmit function, the output of the master oscillator (Q11) and the transmit oscillator (Q101) are fed into the transmit mixer (Q12). The two fundamental frequencies are combined in the mixer, whose output will contain the two frequencies fed in, plus the sum of the two and the difference of the two, as well as combinations of the harmonics of the input. We use only the difference frequency. Let us take Channel 9 as an example. The two input frequencies are 33.100 mc and 6.035 mc. The mixer outputs are 33.100 mc, 6.035 mc, 39.135 mc and 27.065 mc. The other frequencies present at much lower levels are the harmonics of the two input frequencies such as 12.070 mc, 18.105 mc, 24.140 mc, etc. In addition to these, will be the sum and difference frequencies from the mixing of the various harmonic and fundamental frequencies. Of all these frequencies, only one falls within the passband of the transmitter. This is 27.065 mc which is the carrier frequency for Channel 9. The nearest unwanted frequency to the carrier frequency is at least 3.0 mc away and outside of the transmitter passband is adequately suppressed. "Crystal Frequency Chart", Figure 4.2, shows the crystal frequencies used, from the HetroSync[R] circuit, for receiver injections for each of the 23 channels.

4.1.2 TRANSMITTER CIRCUIT

The transmitter circuit makes use of the carrier frequency signal output of the transmit mixer (Q12), which is part of the HetroSync^R circuit. The signal is amplified by the buffer (Q13), which is a voltage amplifier, whose output is fed to the driver (Q14). Band-pass transformers T10 and T11 provide the selectivity to select the desired carrier frequency from the mixer (Q12) output. The driver is a low level Class C power amplifier which supplies the necessary RF power at the carrier frequency to drive the final power amplifier (Q15). The final supplies RF power to the antenna through a double pi-matching network. The primary purpose of a transmitter is to transmit intelligence from one plate to another. The function of the modulator is to put the intelligence on the carrier. To do this, the microphone changes sound (mechanical energy) to electrical energy which is an audio frequency signal. Mic amplifier (Q9) and transmit audio amplifier (Q10) amplify this signal and drive the audio power amplifier (Q8). This audio power amplifier varies the supply voltage fed to the driver and final at an audio rate. This variation of the supply voltage varies the amplitude of the carrier output thus producing amplitude modulation.

4.1.3 RECEIVER CIRCUIT

The receiver in the DIRECTOR 23 is a dual conversion superheterodyne circuit. Channel 9 (27.065 mc) will be used as an example to show how the receiver circuit works. A signal at 27.065 mc is received at the antenna and amplified by RF amplifier (Q1) and fed into 1st receiver mixer (Q2). The 27.065 mc signal is mixed with 33.100 mc injection from the HetroSync^R circuit. The 6.035 mc 1st IF output from the 1st receiver mixer is fed into the 2nd receiver mixer (Q3) along with the 6.490 mc injection from the HetroSync^R circuit. The 455 kc 2nd IF output from the 2nd receiver mixer is amplified by the IF amplifiers Q4 and Q5. Then, the signal is detected by detector diode CR1 to remove the audio from the IF carrier. The audio is coupled from the detector through the automatic noise limiter network to the 1st receiver audio amplifier (Q6). This amplifier also acts as a squelch gate. If the squelch control has been properly adjusted, this amplifier is biased off and will not allow any noise to be passed. When a signal is received, the amplifier is biased on and audio is allowed to be passed on to the 2nd receiver amplifier (Q7). Q7 in turn, feeds the audio to the audio power amplifier (Q8) which drives the speaker.

4.2 CABINET REMOVAL

4.2.1 TOP COVER

Remove the two screws located near the rear edge of the top cover. Now raise the rear edges slightly and slide the cover back at least 1/4 inch. This clears the clips holding the cover to the front panel and the cover can be lifted off the unit. This allows you access to the following:

A. Transistors
B. Receive & Transmit 6 mc Oscillators & Crystals
C. Tuning Adjustments
D. AGC and Squelch Circuits
E. Relay
F. Master Oscillator Crystals

4.2.2 BOTTOM COVER

Remove two screws near edge of bottom cover and follow same procedure as for top cover. This allows you access to the following:

A. Components
B. Collector Current Test Jack
C. Tuning Adjustments

4.3 HETROSYNC^{R} SERVICING

4.3.1 TEST EQUIPMENT REQUIRED

A. Hewlett-Packard 524C Frequency Counter with H.P. 525A Head, or any accurate means of frequency measuring.
B. VTVM, Heath Model IM-13 or equivalent
C. AC VTVM, Heath Model AV-3 or equivalent

4.3.2 ADJUSTMENTS

There is one adjustment in the HetroSync^{R} circuit which is C32 in the master oscillator circuit. This adjustment affects the transmitter frequency and as a result must be made only by the holder of a Second Class Radio Telephone License or higher.

> NOTE
>
> THIS ADJUSTMENT HAS BEEN PROPERLY SET AND SEALED AT THE FACTORY. NO CHANGE SHOULD BE MADE IN THIS SETTING, UNLESS, AFTER CRYSTAL REPLACEMENT, A FREQUENCY CHECK SHOWS IT TO BE NECESSARY.

A. Turn the unit onto receive and remove the receiver oscillator transistor (Q101).
B. Hold a pickup loop, which is connected to the frequency counter, near the 33 mc master oscillator.
C. Measure the frequency of each of the 33 mc master oscillator crystals, and record the readings.
D. Determine the variations, above or below the frequency stamped on the case, for each crystal.
E. Select the two that exhibit the most plus variation and minus variation from correct frequency. If all are on the same side, select highest and lowest in variation.
F. Add these two figures together and divide by two.
G. Take this figure and add it to the center frequency of the crystal with the most plug variation.
H. Switch this crystal into the master oscillator circuit and adjust C32 for the new frequency read on the frequency counter.
I. This will shift the frequency of all the master oscillator crystals so that they will group around the center frequency.

4.3.3 TROUBLE-SHOOTING THE HETROSYNC^{R} CIRCUIT

The "Crystal Frequency Chart", Figure 4.2, will be useful in locating a defective crystal or switch contact. In case of a malfunction in this circuit, proceed as follows:

A. Determine if the failure affects either transmit or receive functions, or both.
B. If the unit is inoperative on both transmit and receive, for the channel(s) involved, the problem may be a crystal or contact in the master oscillator circuit.

C. If only the receiver function is affected, one of the receiver crystals or switch contacts will be suspected.

D. If only transmit function is affected, the transmit crystals or switch contacts will be suspected.

E. Next, determine the channels on which the set will not operate. Consult the chart to determine the crystal in use for these channels. This test will verify the results of the first observation.

F. If every fourth channel is affected, one of the transmit or receive crystals or contacts is probably at fault.

G. If four adjacent channels are inoperative, the master oscillator crystal or switch is at fault.

> NOTE
>
> IF IT BECOMES NECESSARY TO REMOVE ONE OF THE 33 MC MASTER OSCILLATOR CRYSTALS, A HEAT SINK SHOULD BE USED WHILE SOLDERING AND UNSOLDERING IT. EXCESSIVE HEAT CONDUCTED FROM THE LEADS TO THE CRYSTAL MAY DAMAGE IT INTERNALLY.

H. Troubles encountered in the oscillators of the HetroSync[R] circuit, other than those described above, may be dealt with using conventional trouble-shooting methods.

I. For component location see Figure 4.3, "Component Layout". For typical voltage values see Figure 4.4, "Voltage Chart".

4.4 RECEIVER SERVICING

4.4.1 TEST EQUIPMENT REQUIRED

A. Hex-type Alignment Tool for IF Cans
B. RF Generator, H.P. 606A or equivalent
C. VTVM, Heath Model IM-13 or equivalent
D. Power Supply, 13.8VDC, 3 Amps Minimum, Regulated
E. AC VTVM, Heath Model AV-3 or equivalent

4.4.2 ALIGNMENT

A. Connect a 13.8 VDC source to the power cord.

B. Set Squelch Control fully counterclockwise.

C. Rotate volume clockwise to apply power and advance about 1/2 turn.

D. Set channel selector to Channel 13.

E. With a VTVM, measure the +11 volt regulated line (any point on the 912 wire). It should read within $\pm$5% of the 11 volts.

F. Connect VTVM set to 5-volt range between junction of R14, C17, R16 and R19. This point provides a better indication of correct tuning than is possible with the AGC line.

G. With no signal applied to the receiver, adjust R75 (AGC Trimmer) to produce +6 volts DC at the collector of Q16 (AGC amplifier).

H. Connect a signal generator, set to 455 kc, through a .01 Mfd capacitor to base of Q3.

I. Adjust top slug of T7 to top of can. Adjust bottom slug of T7 and top and bottom slugs of T4, T5 and T6 for maximum indication on the meter connected to the detector output as indicated in Paragraph F.

J. Decrease the input level of the 455 kc signal as the IF's are tuned. Do final peaking with no more than 1.5 volts at the detector.

K. Now, connect the signal generator to the DIRECTOR 23 antenna terminal and set to Channel 13 frequency (27.115 mc). Adjust the level just high enough to be measurable at the detector.

L. Adjust the top and bottom slugs of T2, T3 for maximum reading. on the meter. Adjust T1 slug to bottom of can, then return to first peak and adjust for maximum reading on the meter.

M. After the receiver has been aligned, adjust R75 (AGC Trimmer) for 1.5 volts of detected voltage for one microvolt input.

N. Increase the signal level to 100 microvolts input and set R71 (S-Meter calibration) for S9 reading on the S-Meter.

O. Increase the signal level to 300 microvolts and advance the squelch control fully CW.

P. Set R76 (Squelch Trimmer) so that the 300 microvolt signal is just squelched.

Q. Connect an AC VTVM to the speaker terminal and adjust the volume to a good measurable level on the meter.

R. Note the reading on the meter and then remove the modulation on the generator and again note the meter reading. The difference in these two readings in db is your S+N/N ratio. It should be in the order of 12 db or more. If it is less than 8 db, a re-check of the receiver alignment should be made.

4.4.3 TROUBLE-SHOOTING

Since the receiver is a conventional dual conversion, the trouble-shooting procedure is also fairly conventional. If you do find your receiver inoperative, the following hints may be of aid to you:

A. Audio Circuit - Rotate the squelch control fully counterclockwise. Turn on the power. With an audio generator, feed a signal into the noise limiter at the junction of CR1, R14 and R13. This will allow you to determine if the audio circuit is operating properly. If it is inoperative, standard audio trouble-shooting procedure may be used.

B. If the audio is functioning properly, then go to the next step. Now, apply a 455 kc signal, modulated 30% with 1000 cps, through a .01 uf capacitor to the base of Q3. The 1000 cps tone should be heard clearly with a signal level of approximately 100 microvolts. Then use standard trouble-shooting techniques in finding the loss in gain. A burned out AGC amplifier (Q16) or misadjusted AGC may be at fault.

C. If the 455 kc IF is operating properly, then you must check the mixers (Q2 & Q3) and the RF amplifier (Q1). Set the channel selector to Channel 13.

D. Feed a 6.035 mc modulated signal into the base of Q2. If you do not hear the tone in the speaker, you may find either of the mixers are bad or you have lost the 6.490 mc injection from the HetroSync^R circuit.

E. If the 2nd Receiver mixer appears to be operating correctly, then feed a 27.115 mc (Channel 13) modulated signal into the antenna connector. You should hear a fairly clear tone with one microvolt signal. If no tone is heard, trouble-shoot the 1st receiver mixer (Q2), the RF amplifier and determine if there is any 33.150 mc injection from the HetroSync^R circuit.

F. If you are able to get a signal through the receiver, but require a high signal level and the above-mentioned circuits appear to be operating correctly, then re-check the AGC circuit.

G. Connect the DC probe of the VTVM to the (9) wire connecting AGC to the base of Q1 through R2. For one microvolt signal, this should be about 8 VDC and should increase, as you increase signal level, to a maximum of about 10.5 VDC. The components most likely to fail are CR1 (delayed AGC gate