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THE HAMMARLUND CB-23
CITIZENS BAND TRANSCEIVER

SERVICE MANUAL

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OPERATING CONTROLS

The CB-23 Citizens Band Transceiver has six operating controls, five on the front panel, and one on the microphone. To put the unit in operation, turn VOLUME knob (See Diagram Page 2) clockwise about one half turn. The channel indicator should be illuminated by the internal pilot lamp to indicate that electric power is being applied. Allow about one minute of warm-up time before proceeding further.

RECEIVING

Set the unit to the desired channel with the SECTOR knob and the CHANNEL knob as described below:

<u>SECTOR knob setting</u>	<u>CHANNEL knob settings</u>
Extreme left	Channels 1, 2, 3, 4, 5, 6, 7 or 8
Mid position	Channels 9, 10, 11, 12, 13, 14, 15 or 16
Extreme right	Channels 17, 18, 19, 20, 21, 22 or 23

Squelch Setting

Turn the SQUELCH knob clockwise just beyond the point that background noise from the speaker is silenced -- when a radio signal is "not" being received. If you hear a radio transmission, wait until the channel is clear and then set the SQUELCH control as above.

Volume Setting

When you hear a radio transmission adjust the VOLUME knob until the sound level suits your needs.

Tune Setting

When you hear a radio transmission, rotate the TUNE knob for maximum sound clarity and for maximum reading on the meter. This knob does "not" affect transmitter frequency, but helps you fine-tune incoming signals. At the extreme clockwise and counter-clockwise positions of the TUNE knob you may hear strong, undesired adjacent channel stations. An on-channel station should be received best with this knob set at some point between the two extremes.

Sensitivity Control

The ability of the CB-23 to pick up weak signals depends upon the setting of the SQUELCH knob and TUNE knob. The SQUELCH knob adjusts the threshold at which your receiver will accept signals. If turned to the extreme clockwise

position, only strong signals will be heard. Thus, you can cut out unwanted weak (and noisy) transmissions from distant stations. When turned to the extreme counter-clockwise position, but not far enough to click the ANL OFF switch (controlled by the same knob), the loud-speaker will be live at all times and all stations within range will be heard. If turned farther so that the ANL OFF switch clicks, the Automatic Noise Limiter will be cut out and maximum sensitivity will be achieved. The optimum position of the SQUELCH knob is the point where background noise is silenced between incoming transmissions, and the stations you want to receive can be heard.

TRANSMITTING

To transmit, adjust the CB-23 to receive on the desired channel as described above. Listen to make sure the channel is not in use, hold the microphone not less than three inches from the lips and, when the channel is clear, press the microphone push button and talk. That's all there is to it.

As soon as you have transmitted your message, **release** the microphone push button so you can hear the reply. The microphone push button converts your transceiver into a transmitter when it is pressed, and converts the transceiver back into a receiver when the push button is released.

To transmit and receive on another channel, select the desired channel with SECTOR knob and CHANNEL knob. Adjust TUNE knob, VOLUME knob and SQUELCH knob as described above. Before transmitting, by pressing microphone push button, "listen" to make sure the channel is not in use.

WARNING A valid radio station license is required in order to use the CB-23 as a transmitter. Severe penalties can be imposed if you operate a radio transmitter without a radio station license. You may not use someone else's license. However, you may use the CB-23 as a receiver only without, or until you get, a license.

OPERATING PROCEDURES

You and other Citizens Band users will get more satisfaction from the use of your Citizens Radio if you and they employ proper operating procedures.

RECEIVING

Check the operating controls to make certain they are set properly for receiving on the selected channel. The number of the channel you have selected will appear at channel indicator window. You may listen on any channel by selecting the desired channel with SECTOR knob and CHANNEL knob, and adjusting for optimum operation with the VOLUME, SQUELCH and TUNE knobs. The relative strength of a received signal is indicated by the meter.

TRANSMITTING

The effectiveness of your transmissions depends upon the channel being clear and upon the way you use the microphone. Hold the microphone close to the lips. If you hold it too far away, your transmitter's effective range and loudness will be impaired. Talk in a normal speaking voice when transmitting, enunciate clearly and don't shout or speak too softly.

INITIATING CALLS

To call a station of another licensee, press the microphone push button and announce your call letters and the call letters of the station you are calling in the following manner "KRT-794 calling KRO-242". Release the microphone push button and listen for a reply. When a reply is heard, adjust TUNE knob for best reception.

To call a mobile unit or base station covered by your own station license, announce your call letters and unit number and the unit number of the station being called in the following manner "KRT-794 Unit One calling Unit Two". Release the microphone push button and listen for a reply.

RESPONDING TO CALLS

When you hear someone calling you, wait until the caller has stopped transmitting. Then pick up your microphone, press the microphone push button and acknowledge the call in the following manner "KRT-794 back to KRO-242, over". Release the microphone push button (8) and listen for the message. If the call is from one of your own units reply like this "KRT-794 Unit One back to Unit Two".

CONCLUDING TRANSMISSIONS

Two-way radio communication is maintained by alternately pressing the microphone push button to transmit and releasing it to listen. At the conclusion of a conversation announce your station call letters and sign off in the following manner "KRT-794 out".

ON-THE-AIR COURTESY

Since others may want to use the channel on which you are operating, keep all transmissions as short as possible, make no unnecessary transmissions and don't transmit when your channel is in use. To avoid loss of your license, or possible fine or imprisonment or both, by inadvertent or deliberate violation of the law, read and comply with F.C.C. (or D.O.T. in Canada) regulations. Get a copy of Volume VI, F.C.C. Rules and Regulations, which contains Part 19, from your CB-23 dealer, a field office of the U.S. Department of Commerce, or from the U.S. Government Printing Office, Washington 25, D. C.

COMMUNICATING RANGE

Intercommunication by Citizens Radio Stations operating in the 26.96-27.23 Mc/s band are limited by law to 150 miles. This range is seldom achieved. The purpose of Citizens Radio is to provide short-range personal and business communications facilities. Communicating distance is determined by "effective antenna elevation", noise, receiver sensitivity, effective radiated transmitter power and the way you use your microphone. Range may vary from one mile or so to 20 miles or more, depending upon many factors.

EFFECTIVE ANTENNA ELEVATION, which is not the same as antenna height, is the "effective elevation" of the antenna above surrounding objects and those intervening in the radio transmission path. In general, the greater the effective antenna elevation, the greater the range you will enjoy.

The "height" of your antenna is specifically limited by F.C.C. regulation. Refer to Volume VI, F.C.C. Rules and Regulations.

NOISE

Your CB-23 is a very sensitive receiver. If there were no "noise" to contend with, your receiving range would be greatly extended. Its receiving range, which cannot be increased by making the receiver more sensitive, can be extended by reducing noise pick-up. This can be done by installing the antenna where it will pick up less noise and more signal, and by suppressing the noises at their source.

Noise generated by the ignition systems of automobiles is the worst offender. It is a "popping" noise, much of which is eliminated or reduced by the Automatic Noise Limiter (ANL) built into your CB-23.

Noise is a form of radio signal which is generated by sparking electrical contacts, such as the brushes and commutator of a sewing machine motor, the vibrating contacts of an electric shaver, etc.

Information about suppression of ignition interference is contained elsewhere in this manual. Techniques for locating and suppressing other man-made electrical interference are described in several books on the subject which are available at radio parts stores and technical book shops.

You can do something about the noise generated by your own automobile or boat and in your home. But, there is little you can do about noise generated by other cars.

VEHICULAR INSTALLATIONS

The CB-23 is designed to be installed under the dashboard of a car or truck by means of the mounting plate furnished. Since the CB-23 is compact, it can be installed at any convenient location.

Under-dash Mount

Using the mounting bracket as a template, find the best location under the dash of the vehicle, taking into consideration handles, controls and the glove compartment. Bolt the mounting frame securely in place. Find a convenient location for the microphone mounting clip and fasten it securely, taking into consideration that the microphone cord might hamper the driver if the microphone mounting clip is not correctly placed.

Power Cable

Route the DC power cable so that its leads will reach the power take-off point. This can be at the ignition key, the ammeter or the storage battery, the red lead secured to the ungrounded line and the black lead secured to the vehicle frame. The best way is to connect the red lead directly to the ungrounded battery terminal and the black lead to the grounded battery terminal.

Antenna

You have a wide choice of mobile antennas. Install your antenna and connect the antenna end of the coaxial cable as instructed in the directions furnished with the antenna. Make sure the ground contact of the antenna base makes excellent contact with the car body. If you use a bumper mount, ground the bumper to the car frame with a short piece of flat metal braid.

Route the coaxial cable to the CB-23 location. The set end of the coaxial cable must be terminated in a PL-259 UHF connector.

Attach the antenna plug to the antenna receptacle at the back of the CB-23, and insert the coaxial socket at the set end of the DC power cable into the octal power connector, also at the back of the CB-23. Turn VOLUME knob clockwise. The pilot lamp behind the channel number window should now light. If your power take-off point is at the ignition switch, turn the ignition switch on if the pilot lamp doesn't glow.

After a minute or so, you should be able to hear CB stations by setting the CB-23 to various channels. You are now ready to receive and transmit (if you have a license).

Antenna Tune-Up

Your CB-23 has been adjusted for optimum output into a 50 ohm dummy antenna at Channel 12. Since channel 12 is approximately the center of the range of the 23 channels, it is suggested that all antenna tune-up adjustments be made on this channel. This is especially true if all 23 channels are to be utilized. The antenna tune-up procedure, which follows, should only be employed to check the antenna system or when it is desirable to favor one particular channel or group of channels or in the event that an antenna system deviating from 50 ohms impedance is employed. In all cases, it is advisable not to make the antenna tune-up adjustment unless you are experienced and have the necessary equipment to do this job properly.

To get maximum capability from your transmitter you should tune your CB-23 to the antenna system. To do so, you need a field strength meter (Lafayette TM-14, Monarch FS-1) or a thru-line type RF power meter (Seco 520, Cesco CB-52C, Lafayette TM-58).

If you use a field strength meter, place it a few feet from the antenna, but where you can see it. Turn the CB-23 on its side to expose the two alignment holes in the bottom. Set the CB-23 to Channel 12 and insert the tuning tool (General Cement Co., No. 8606) into hole A (see diagram) so that the tool engages the core of the transmitter tank coil (L106). When the channel is clear, press the microphone push button and turn the core for maximum field strength meter reading. Release the microphone push button and insert an insulated screw driver in hole B so that it engages with the screw of the antenna trimmer (C152). Press the microphone push button when the channel is clear, and turn the screw for maximum reading on the field strength meter. Release the microphone push button and re-insert the special tuning tool into hole A. When the channel is clear, again press the microphone push button and readjust the core (L106) for maximum field strength meter reading.

If you use a thru-line RF power meter, disconnect the antenna plug from the CB-23 and connect it to the output receptacle of the RF power meter. Using a coaxial jumper (with plugs at both ends), connect the input terminal of the RF power meter to the CB-23 antenna receptacle. Set the RF power meter switch to measure "power output" or "incident power". Tune L106 and C152 as described in the above paragraph for maximum meter reading. Set the RF power meter to measure "reflected" power. Retune L106 and C152, if necessary, until there is a maximum difference between "reflected" (low reading) and "incident" (high reading) meter indications.

Whenever making these adjustments, announce the station call letters at the beginning and end of a series of test transmissions.

If you do not have a field strength meter or RF power meter, have the antenna tune-up performed by a competent technician.

BOAT INSTALLATIONS

Fasten the mounting plate, furnished with your CB-23, at a convenient location, preferably at a distance from the engine to reduce ignition noise pick-up. Route the DC power cable, extending it, if necessary, to the boat's battery. The battery must be a 12-volt lead - acid type storage battery. If it is an Edison battery, measure the voltage across it while the engine is running. The voltage must not exceed 14.5 volts.

On a non-metallic boat, a coaxial antenna will probably be most effective since it is like a mast (18 feet tall) and has no horizontal ground radials. You can use a base-loaded whip or a full-length (9-foot) whip if you also install a ground plane (sheet metal or screening) at the base of the antenna. Connect one end of the coaxial cable to the antenna as instructed in the directions furnished with the antenna.

The other end of the coaxial cable must be terminated in a PL-259 UHF connector which is inserted in the SO-239 antenna connector at the rear of your CB-23.

When the antenna and power connectors have been properly connected to your CB-23, turn VOLUME knob clockwise. The channel indicator window should be illuminated. After a minute or so, you should be able to hear CB stations on one or more channels. You are now ready to receive and transmit (if you have received your license).

To get maximum transmission capability, tune the CB-23 to the antenna as described under ANTENNA TUNE-UP, or have this done for you by a competent technician.

FIXED INSTALLATIONS

To use the CB-23 at a fixed location, you must also have a suitable antenna system and a source of electric power at 115 volts (nominal), 60-cycle AC or 12 volts DC (where utility power is not available). To operate the CB-23 from a 220-volt AC source, an external step-down transformer is required. Where only 24-, 32-, 36- or 110-volt DC power is available, a suitable DC-to-AC inverter is required.

Insert the octal socket of the AC power cable into the octal plug at the rear of the CB-23 and the two-prong plug at the other end of the cable into an AC outlet. If operation from a 12-volt DC source is required, use the DC power cable and connect its leads to the battery of other DC source. Turn VOLUME knob clockwise. The pilot lamp behind the channel number window should glow.

The antenna may be one of the many types now available which are designed to operate in the 27-mc band and to be fed through a 50-ohm coaxial cable. Install the antenna, and connect the coaxial cable to the antenna as instructed in the directions furnished with the antenna.

The other end of the coaxial cable must be terminated in a PL-259 UHF connector in order to mate with the SO-239 connector at the rear of your CB-23. If you have had no experience with attaching a connector to coaxial cable, have this work performed by a competent technician, or buy a piece of coaxial cable of sufficient length which is already equipped with a PL-259 connector.

Never splice coaxial cable. If the coaxial cable is only a few feet longer than required, don't cut it; instead use it as it is, the excess coiled up if necessary. For runs of less than 50 feet, you can use RG-58/U coaxial cable. Better, for any length requirement is the lower loss RG-8/U coaxial cable, Foamflex, balloon or other type of low-loss coaxial cable of 50-ohm impedance. If you are not technically qualified to select coaxial cable, consult your CB-23 dealer.

To provide lightning protection, consult your CB-23 dealer about a coaxial-type lightning arrester and install it as instructed. Or, ground the antenna support pipe or bracket through a straight-as-possible length of No. 12 or larger wire to a cold water pipe or ground rod driven into moist earth, using a ground clamp to make a secure ground connection. Or connect a flexible wire from one of the screws at the back of your CB-23 to a cold water pipe or ground rod.

After you have connected your CB-23 to the antenna system and to a suitable power source, you are ready to use the CB-23 as a receiver. If you have a station license, or when you receive it, you are ready to transmit. To get maximum capability from your transmitter, tune the transmitter to your antenna system, as described under Antenna Tune-Up, or have a competent technician do it for you.

IGNITION NOISE SUPPRESSION

You can do something about noise generated by your own car, truck or boat, but you cannot do anything about stopping the radiation of noise generated by other nearby vehicles.

The typical modern automobile is equipped at the factory for suppression of noise that will interfere with the operation of AM broadcast band receivers. But, this treatment may not be adequate for Citizens Band reception.

Noise suppression kits are made by several manufacturers (SPRAGUE, HALLETT, ESTES, G-C ELECTRONICS) which are designed specifically for suppressing noise at Citizens Band frequencies.

To determine if your car, truck or boat is the source of noise, turn on your CB-23 and turn SQUELCH knob fully counter clockwise (beyond the click). Listen to the background noise with the engine off. Then start the engine and listen for an increase in noise. Vary the speed of the engine. If there is a change in the rate at which the popping noise occurs, your engine is the culprit. If you hear a whining noise, which changes in pitch as you accelerate the engine, it is again your engine that is at fault.

It would require an entire book of this size to explain the how, why and what-to-do of noise problems. If you are plagued with this problem, you can get informative advice from a booklet entitled "Giving Two-Way Radio Its Voice" which is available from Automotive Technical Service Dept., Champion Spark Plug Co., Inc., Toledo 1, Ohio.

TROUBLE SHOOTING

The CB-23 was designed for long life and to give reliable service. It contains many resistors, capacitors and other components which were carefully selected by the manufacturer. Even so, a component in any piece of electronic equipment may fail or change in characteristics, necessitating replacement. The tubes, vibrator and pilot lamp can wear out and may require periodic replacement. These can be replaced by the user, if he wishes to do so, preferably by a competent technician.

TUBES

You can test the tubes yourself if you have a tube tester, or with a do-it-yourself tube tester in a neighborhood store, or by taking the tubes to a radio shop for testing. Replace all weak, shorted or burned out tubes with new tubes of identical type. When you remove the tubes for testing, note which tube belongs in which socket. Sometimes, a tube which checks OK on a tube tester may not function properly in your set because all tube testers are not sufficiently critical.

VIBRATOR

The vibrator, which is active only when you operate your CB-23 on a 12-volt battery, is a plug-in device similar in appearance to a metal can. To replace it, pull the vibrator out of its socket and install a new one of identical type. If replacement of defective tubes and the vibrator does not restore operation, re-install the original vibrator and have your CB-23 checked by a competent technician.

NOTE: If your CB-23 should be totally inoperative, or if smoke or a burning odor is noticed, turn it off immediately and have it checked by a competent technician. Continued operation under such circumstances can cause additional damage.

WARNING

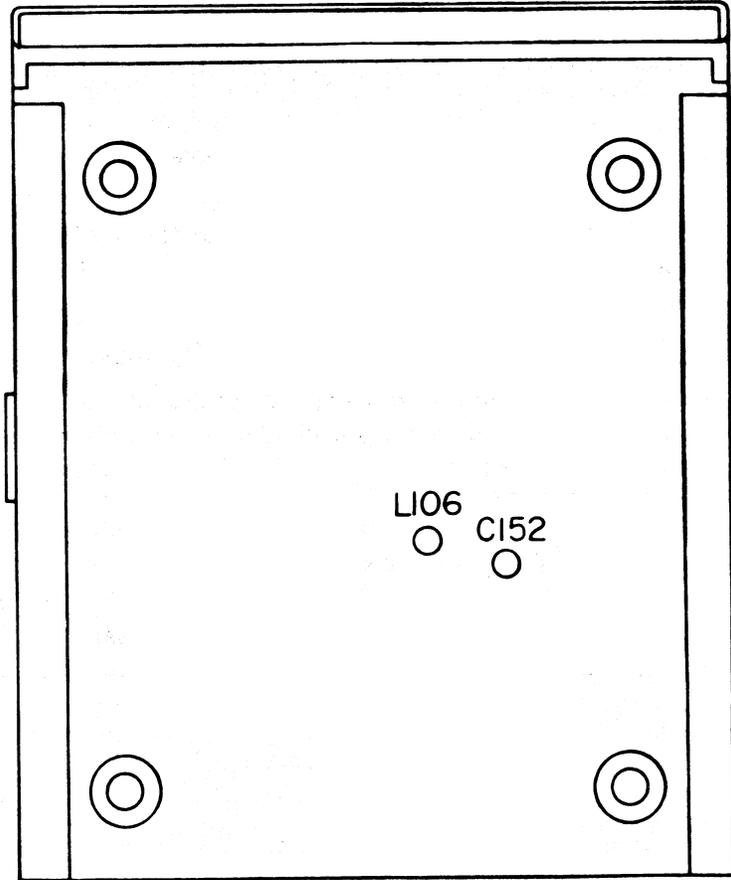
Certain repairs and adjustments to the CB-23 may be made legally only by a person, or working under the direct supervision of a person, possessing a valid First Class or Second Class F.C.C. Radiotelephone Operator License (or equivalent in Canada). This particularly pertains to those repairs or adjustments, such as replacement of crystals and transmitter oscillator components, which might affect the transmitter's ability to comply with government regulations.

GETTING A LICENSE

The CB-23 may not be operated as a transmitter except when covered by a valid Class D Citizens Radio Station license in the United States or a General Radio Service license in Canada. Any U. S. citizen (in Canada a landed immigrant is eligible) over 18 years of age may apply for such a radio station license.

The license application consists of F.C.C. form 505, which when completed, must be submitted to the Federal Communications Commission. These forms are available from your CB-23 dealer, your nearest F.C.C. field office or the Federal Communications Commissions, Washington 25, D.C. Instructions for completing the license application are furnished with the forms.

After you have filed your license application, you may have to wait several weeks for your license. But, you may not legally operate your transmitter until after your license has been granted and is in your possession.



BOTTOM VIEW OF CABINET

Antenna Tune-Up

Your CB-23 has been adjusted for optimum output into a 50 ohm dummy antenna at Channel 12. Since channel 12 is approximately the center of the range of the 23 channels, it is suggested that all antenna tune-up adjustments be made on this channel. This is especially true if all 23 channels are to be utilized. The antenna tune-up procedure, which follows, should only be employed to check the antenna system or when it is desirable to favor one particular channel or group of channels or in the event that an antenna system deviating from 50 ohms impedance is employed. In all cases, it is advisable not to make the antenna tune-up adjustment unless you are experienced and have the necessary equipment to do this job properly.

CB-23 CIRCUIT DESCRIPTION

Many transmitter or receiver troubles can frequently be resolved simply by testing and changing tubes and by making a few minor adjustments, but in order to properly service this set, it is important to be able to diagnose obscure troubles through an understanding of the circuits involved. It is for this purpose that this section is provided. A transceiver of this type contains several special circuits that are not usual in the normal transmitter or receiver commonly available. While not difficult to understand or service, the best operation is obtained when the set is adjusted in accordance with these instructions.

The complete circuit of the CB-23 is shown in the schematic diagram included at the end of this book. To help in understanding this diagram, a block version is presented on the next page. While reading the text, follow both the block and schematic diagrams -- one will illustrate the overall scheme, while the other will provide all of the connection details.

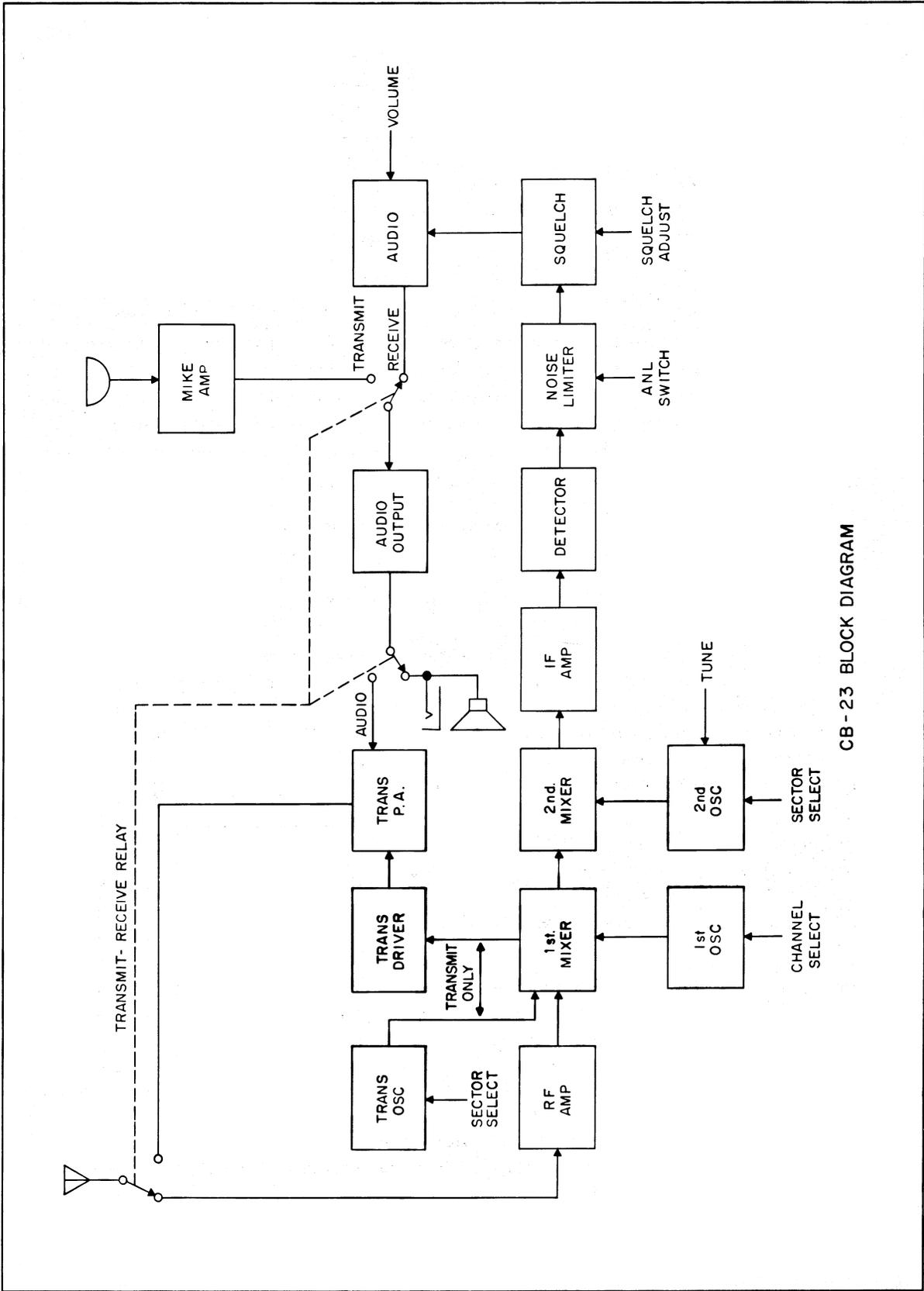
RECEIVER GENERAL CIRCUITRY

The receiver is a sensitive double superheterodyne using a crystal controlled first oscillator, and a temperature compensated second oscillator that is capable of sufficient front panel tuning control to compensate for slight frequency differences of received transmissions. A diode detector, an automatic noise limiter and an adjustable squelch system are included, and an efficient audio amplifier circuit provides ample power for the self-contained loudspeaker.

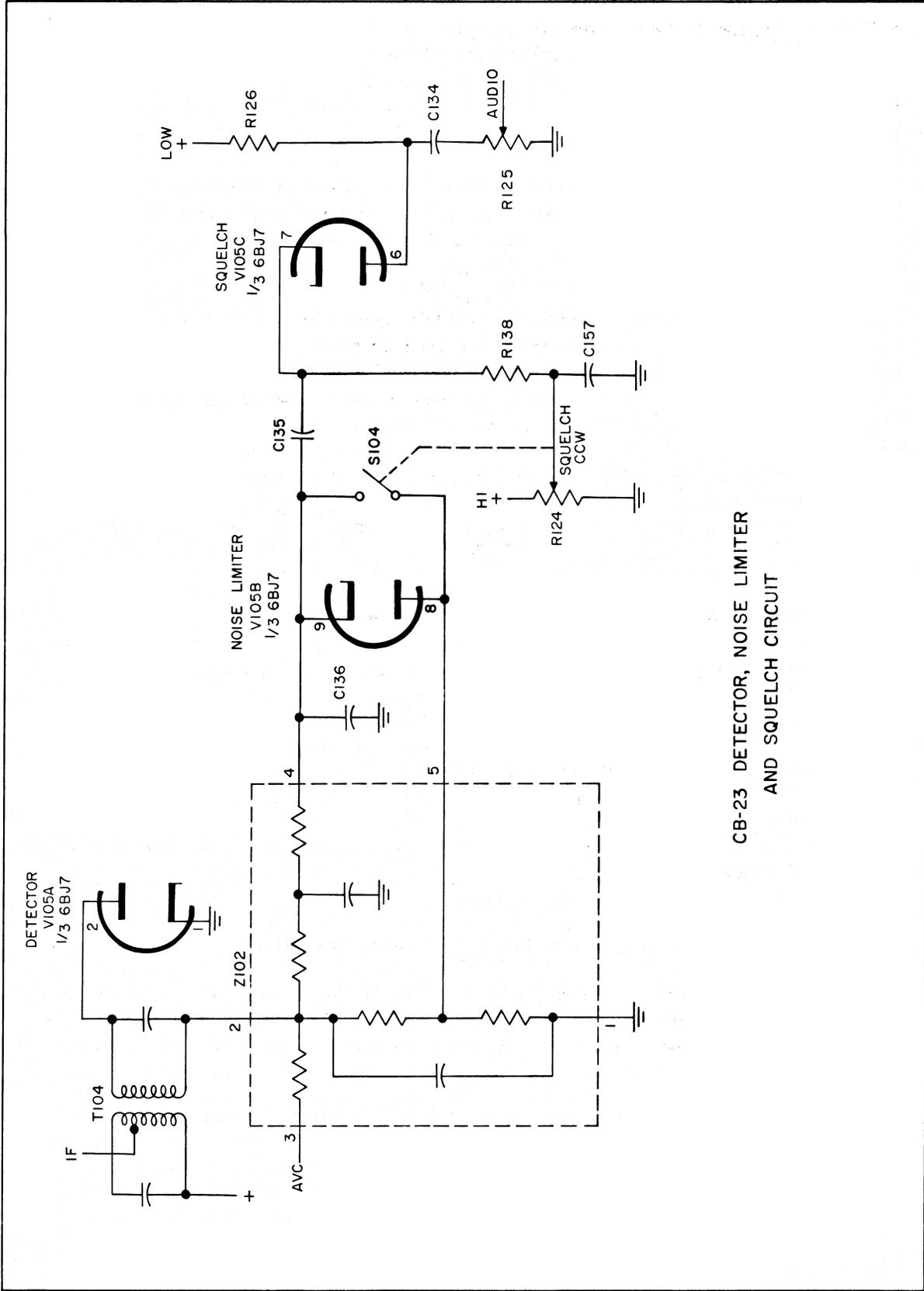
The received signal is applied to the RF stage through the transmit-receive relay contacts. Frequency conversion occurs in the first mixer to produce the first intermediate frequency (IF). The second mixer follows to produce the second IF. The second IF amplifier applies 262 KCS to the detector for the development of the audio signal.

The recovered audio is then applied to the noise limiter and squelch circuits as shown in the accompanying detailed diagram of this area. Assuming the squelch control turned fully counterclockwise and the ANL off, the audio is applied through the squelch tube to the volume control. The squelch tube is conducting at this time because V105 is conducting and clamps the grid and cathode return of V107 providing normal bias.

The automatic noise limiter is activated when the switch S104 is opened by turning the squelch control clockwise past the switch. The diode now opens the audio path when high noise signals such as ignition or similar pulse types are received. This audio discontinuity is momentary and does not effect intelligibility of the signal. Note that only the elimination of such noise at its source will provide the complete answer to ignition noise problems.



CB - 23 BLOCK DIAGRAM



CB-23 DETECTOR, NOISE LIMITER
AND SQUELCH CIRCUIT

Turning the squelch control clockwise applies a positive voltage to the cathode of the squelch tube. This voltage results in a high negative bias applied to the grid, effectively cutting off conduction. When no signal is being received, no audio in the form of set or atmospheric noise is permitted to pass. When a signal is received, the signal produced counteracts the squelch control voltage until the cathode and grid returns are clamped and conduction occurs. The received audio is then passed to the volume control. From the above it is seen that the signal produced must be great enough to overcome the squelch control voltage. For this reason the correct setting of the squelch control is to turn it clockwise with no signal being received, until the background noise just disappears. Now when a signal is received, the squelch is overcome, and audio is heard.

A conventional audio amplifying circuit, consisting of V107A and B applies audio to the loudspeaker. The carrier level meter is in a bridge arrangement and is balanced between the cathode voltage of the second IF tube and the cathode voltage of the audio output tube. With no signal received the meter is set to zero by R128. When a signal is received, AVC is produced, and the second IF is biased to reduce plate current, unbalancing the meter circuit to cause the meter to read. The AVC is proportional to the strength of the received signal so that the meter reading will increase accordingly.

TRANSMITTER GENERAL CIRCUITRY

When the microphone button is depressed, the transmit-receive relay operates to mute the receiver and to turn on the transmitter. This occurs through the removal of B+ from the screens of the receiver RF and second mixer stages, transferring it to the transmitter oscillator and driver.

Transmitter modulation is developed by applying the microphone audio through the microphone amplifier and the audio output stage of V107B. The audio output transformer T107 acts in this case as the modulation transformer to produce plate modulation of the transmitter power output tube. The resulting modulated RF is applied to the antenna through the contacts of the transmit-receive relay. Antenna loading and tuning are accomplished by the adjustments of L106 and C152.

23-CHANNEL CRYSTAL SELECTION SYSTEM (Refer to Channel-Frequency Chart.)

While the receiver and transmitter electronic circuits are quite straight forward, the crystal oscillator arrangements to cover all 23 channels using a minimum of crystals is novel. This system is shown on the diagram, and the list of frequencies illustrates the method of obtaining the final IF for the receiver, and the RF output for the transmitter.

The design of the receiver, using crystals, is made possible by the fact that the spacing between channels is repeated in groups of four: 10 KCS spacing between channels 1 and 2, and between channels 2 and 3; 20 KCS spacing between channels 3 and 4. This pattern is repeated up to channel 23 except that the 23rd frequency is