

HAMMARLUND

HQ-120-X

COMMUNICATIONS RECEIVER

CRYSTAL MODEL



For example, the same degree of efficiency is maintained in the 10 meter band as in the 80 meter band

With the type construction employed in the "HQ-120-X," the inclusion of the broadcast band in no way jeopardizes the efficiency of the receiver at higher frequencies. Although this requires special tuning condenser design, it is the only satisfactory solution. The band-spread condenser is a 9-section affair, while the main tuning condenser has 6 sections.

Every feature essential to perfect short wave reception, whether for amateur or commercial use, has been incorporated in this new receiver.

There are three necessary qualities which go to make up a good communications receiver. They are: sensitivity, selectivity, and stability. The "HQ-120-X" excels in all of these qualities. Its sensitivity is so great that it actually goes below the noise level in even the most perfect locations. Its selectivity is really remarkable for it is variable from the narrowest band width, generally used for "single-signal" code reception, right through to the band width necessary for good quality musical reproduction. This exceptional band expansion is accomplished by the unique crystal filter used. This filter is an original HAMMARLUND development and will be found only in the "HQ-120-X." There are six available band widths scientifically arranged to progressively broaden and cover all possible needs, including code reception, voice reception, or reception of musical programs.

Stability was a prime consideration in designing the "HQ-120-X." Every effort was made to provide maximum stability so that the calibrated dials read accurately even at the very high frequencies. Special oscillator circuit, together with automatic voltage regulation in the receiver, account for its remarkable stability.

The "HQ-120-X" has a new type of signal strength meter which is designed for accurate measurement of signal strength. The new set has also been equipped with a noise limiter. The limiter (controllable directly from the panel with a simple on-and-off switch) is extremely valuable in removing all noise, interference and similar disturbances. This is a great aid, especially in the high frequency bands where such disturbances usually override the incoming signal. The noise limiter operates so as to remove the noise without materially altering the quality of the incoming signal.

To further complete this receiver, there is a special antenna compensating device. This goes a long way toward overcoming the difficulties experienced when certain types of antennas are used. In other words, you can be assured of peak performance insofar as image rejection, signal-to-noise ratio, and sensitivity are concerned.

impossible to maintain fixed circuit alignment when antennas are frequently changed. Also, because the selectivity is thus improved and the gain considerably increased.

permanent regardless of the rejector control setting. These five steps include 1, 2, and 3 for phone reception, varying from broad to fairly sharp, in convenient steps. The fourth and fifth are for CW or code reception. Four, being moderately selective and "five" the maximum selectivity of the crystal filter. The crystal can also be cut out for general use, by the sixth contact on the switch; see diagram in Fig. 2. Various curves showing

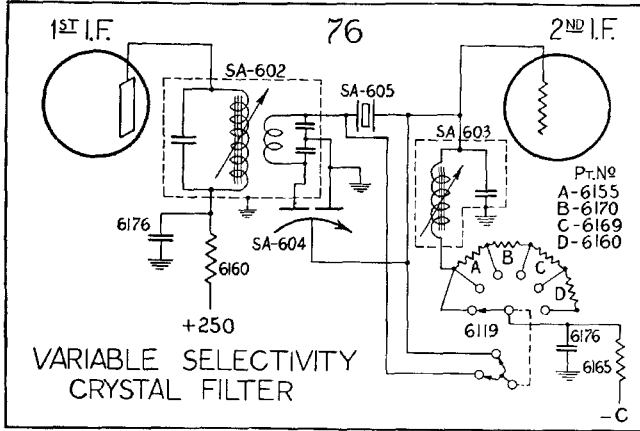
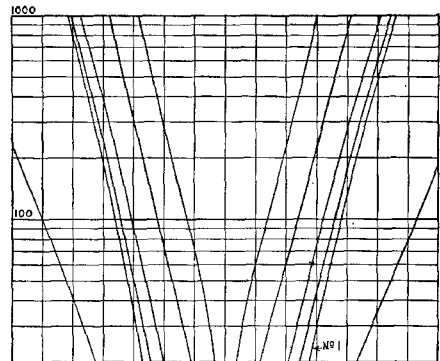


FIG. 2—Diagram of outstanding variable selectivity crystal filter. This original Hammarlund development opens a new field in radiophone communication.

the selectivity for these settings of the selectivity control are indicated in Fig. 3. There is absolutely no interlocking of the controls in this crystal filter. The rejector or phasing control can be set to eliminate a heterodyne of some particular frequency within its range, and will not require re-adjustment when the selectivity control of the filter is changed. Also, the output, or overall gain, of the receiver is not noticeably affected by changes in selectivity of the filter. This feature is extremely desirable, especially from the standpoint of accurately determining the strength of incoming signals. It is not necessary to make allowances for usual attenuation in the crystal filter, should it be necessary to change the selectivity in order to eliminate interference. Complete unit shown in Fig. 9.

I. F. AMPLIFIER: The intermediate frequency amplifier consists of three stages



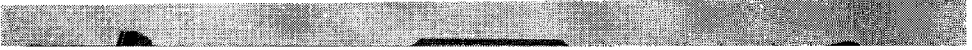
either on or off and is so arranged that its operation does not affect the intelligibility of the received signal by altering the audio form. Its effect on modulation is negligible. There is also a switch on the panel for cutting out the noise limiter when it is not required, although it can be left in the circuit permanently without ill effects.

"S" METER: The "S" meter is calibrated to read in "S" units from 1 to 9. "S-1" corresponds to approximately .39 microvolts input at the antenna terminals. "S-9" corresponds to 100 microvolts. The meter is also calibrated up to 40 DB. above "S-9." "S-8" equals 50 M.V., "S-7"—25, "S-6"—12.5, etc. Special compensating controls for the meter are provided so that, regardless of particular local conditions, corrections can always be made for irregularities. These controls and the adjustment of them are thoroughly discussed under "Operation."

BEAT FREQUENCY OSCILLATOR: The beat frequency oscillator circuit is designed to effectively heterodyne signals of varied signal level. This oscillator is so isolated that it has no material effect on the operation of the I.F. amplifier. The variable control on the panel provides a wide selection of beat frequencies. A switch is also provided for cutting the oscillator off.

A. F. AMPLIFIER: The A.F. amplifier consists of a 6V6 tube with an output of approximately 4 watts. A manual gain control is provided in this stage in order that the operator may choose the proper amount of amplification. The output impedance is 6 ohms, and the output terminals connect directly to the voice coil of a permanent-magnet dynamic speaker.

POWER SUPPLY: Special care has been exercised in the design of this part of the receiver. Components used have a very large safety factor in order to insure satis-



main tuning condenser and to the left is the band-spread condenser. The small condenser in the center with the extended shaft, is the antenna compensator. The special pure inlaid silver contacts can also be seen along the rotor shafts of the two variable condensers.

The band-spread condenser has three main units and each of these is divided into three individual sections. This represents 9 individual condensers in the band-spread assembly. This arrangement makes it possible to employ the most suitable capacity for the particular wave range in which the condenser is operated. The main tuning condenser is also of this design and maintains the proper L/C ratio in each band, regardless of the range in which the receiver is operated. For the broadcast band, the condensers are of the usual capacity. These, however, would ordinarily be too large for proper circuit values at the higher frequencies. Here, too, we have sectionalized the condensers with the result that the usual difficulties encountered in a receiver covering both the short wave and broadcast bands are eliminated. In other words, the proper size condensers are always employed in all bands. The high frequency performance in the receiver is in no way jeopardized by the incorporation of the broadcast band. This condenser unit is not a compromise with a regular broadcast tuning condenser. It is especially designed as the photograph reveals. These two multi-sectional condensers are built into a large sturdy frame which can not change shape and thus impair the stability of the receiver under the most adverse conditions. The plates are of heavy brass, cadmium plated and soldered to the rotor shaft. The stators are also of the same material and soldered to the bars which support them on the Isolantite base. The rotor units are suspended on two ball bearings—one at the front and one at the rear, thus assuring smooth operation at all times.

There are three sets of dual silver-to-silver contacts making six for each unit. These contacts are distributed along the rotor shaft to maintain symmetry and insure perfect electrical contact without noise. These contacts are not silver plated—they are solid inlaid silver.

The tuning condensers are driven by a special dial arrangement having over 310 degrees spread, and tuning is further simplified by a 9 to 1 ratio knob. Behind the panel, on the knob shaft, there is a heavy flywheel which is an extreme aid in tuning. It is only necessary to give the dial a twist in order to make it coast a considerable distance across the scale. It will be noticed, by referring to the photograph, that the

bulbs can be readily replaced in case of failure without dismantling the receiver in any way.

Construction of the receiver is such that the panel plays no part in supporting any of the critical components. Therefore, any pressure that may be exerted on the panel during operation, will in no way affect the adjustment of the receiver, nor is there any detuning effect.

The precision wound inductance coils for the various bands in this receiver are mounted underneath the chassis and employ both the inductive as well as capacitive method of trimming in order to insure perfect circuit alignment.

Thorough shielding and proper placement of the various components in the receiver assure perfect stability and no interlocking of circuits.

The cabinet may be removed from the chassis and panel by removing the screws along the outer edges of the panel and the four screws on each side of the cabinet, as well as the three screws along the rear edge of the cabinet.

OPERATION

After unpacking the receiver check the chassis carefully to determine that all tubes are properly fitted into their respective sockets. Also, be certain that all grid clips are in place on the tops of the tubes. It is possible that the grid clips or tubes may have been dislodged during transportation.

This receiver, unless it is a special model, operates on 105 to 125 volts AC at 50 to 60 cycles. If you are uncertain as to the type of power available for operating the receiver, check with your local power company office. An attempt to operate the set on other types of power is liable to ruin it. Next, connect the speaker to the receiver. Two wires from the permanent magnetic dynamic speaker connect to the two terminals on the rear edge of the chassis marked "speaker." The main power supply switch that turns the receiver on and off is operated in conjunction with the "audio gain" control. When this control is in the "off" position, the receiver is completely inoperative. So, the next operation is to turn this control on slightly and wait for the tubes to heat up to their operating temperature. In the meantime, set the band selector switch in the .54-1.32 megacycle position; this is the major part of the standard broadcast band, the remainder is covered in the 1.32 to 3.2 mc. band. Also, set the control marked "MAN-AVC.-BFO." in the AVC position. The crystal selectivity control knob should be set in the "off" position. This is the broadest setting. The control in the lower left-hand corner of the panel should be set in the "REC" position. This latter control turns the receiver on and off for stand-by and transmitting periods during communication, but does not disconnect the receiver from the power line thus leaving the tubes heated and ready for instant use. By this time, the receiver is in operation—tubes having had ample time to heat up. We can now tune in broadcast stations by turning the sensitivity control full on and advancing the audio gain control to the point permitting the desired volume. All tuning in the broadcast band is done with the "main tuning" control. The band-spread control does not operate in the first two ranges. For accurate tuning, it will be necessary to watch the "S" meter. At this point it might be well to mention that it is possible that the meter may not be operating properly and may require adjustment. Along the rear edge of the chassis we find two screw driver adjustments (see Fig. 11) marked "A" and "B." These are for aligning the meter so that it operates properly. First, with the receiver turned off the indicator on the meter should rest to the extreme left, at the beginning of the scale to the left of the

Time -

7.38

After the meter circuit has been properly aligned and the antenna system connected to the receiver (see chapter on antenna requirements) the main tuning control should be adjusted for maximum reading of the meter on any particular station. The antenna compensating control is the final tuning adjustment. This should be set also for maximum meter reading. If, for any reason, automatic volume control is not desired, the switch so marked should be set in the "MAN" (or manual) position. In this case, sensitivity is controlled with the control thus marked and then the audio control should be turned all the way on.

A jack is provided in the lower right-hand corner of the panel for those who desire to use head-phones. This jack cuts the speaker out of the circuit. On the rear of the chassis, will be found terminals marked "relay." These pin jacks are in parallel with the "send-receive" switch and can be connected to a send-receive relay for break-in operation.

Operation on the remaining high frequency bands is essentially the same, except that the band spread dial comes into use. There are five scales on the band-spread dial. The 0-200 scale is for general coverage and is an arbitrary scale for accurately logging in any one of the various short wave broadcast bands. The other scales are for each of the amateur bands from 80 to 10 meters inclusive, and are calibrated in megacycles. The main tuning dial is also calibrated in megacycles and this calibration holds true when the band-spread dial is set at 200 on the arbitrary scale.

In order to make full use of the high degree of accuracy available with the calibrated band-spread dial, it is necessary to have available an oscillator of known frequency within or very close to the edge of the amateur band being used.

Assuming, that we have a signal of known frequency, set the band-spread dial exactly to this frequency. Then adjust the main tuning control to zero beat signal. You will find that the setting of the main dial will be slightly off frequency according to the scale. This is as it should be because the band-spread control is designed to tune beyond the legal limits of the band at either end. The ability to tune beyond the limits of the bands has many advantages, especially if "marker" stations are used as calibration references. As an example, in a typical case, the main tuning dial was set at 4.015 mc. for the 80 meter band, 7.32 mc. for the 40 meter band, 14.47 for the 20 meter band, and 30.04 for the 10 meter band. These figures will not hold exactly true for all receivers. However, they will serve as a guide in setting the main dial where no signal of known frequency is available.

In short wave reception of either amateur or short wave broadcast stations, other features of the receiver are brought into use. For instance, the beat frequency oscillator is used for CW code reception and also for logging weak phone stations. This oscillator is only available without the AVC action and, when turned on, brings the main sensitivity control into operation. The beat oscillator tuning control provides wide variety of tones—the selection of which will depend upon the operator. Also in short wave reception we may need the noise limiter. There is a switch on the panel which provides this feature. The noise limiter operates independent of the setting of any of the other controls on the panel. Its purpose is to limit the interference caused by automobile ignition and similar disturbances.

The next important feature is the crystal filter. Detailed description and diagram can be found under "Circuit Arrangement." The variable feature permits the operator to select the band width that best suits receiving conditions. Normally, the phasing control should be set at the arrow in the center of its scale. Adjustment of this control will cut out interference from stations on either side of the desired signal in any of the five selectivity ranges of the crystal filter. When using the crystal filter, select the band width that provides the greatest fidelity with a minimum of interference. The selectivity of the filter increases as the switch is rotated clockwise. The first three positions of the selectivity control are intended for phone reception, although they can also be used for code in cases where interference is not too severe. The remaining positions are, of course, for single signal code reception in extremely crowded bands.

ANTENNA REQUIREMENTS

The input of the "HQ-120" is arranged so that various types of antennas may be employed. The average input impedance is 400 to 600 ohms. The most common

type of antenna used generally by the amateur and short wave listener is the Marconi, consisting of a single wire and ground connection. In most rural locations, this type of antenna provides satisfactory results. The length of this type of antenna is not really important. Seventy-five feet or over will be quite satisfactory. In connecting this type of antenna system to the receiver it is necessary to put a jumper between the ground terminal and the nearest terminal marked "A." The antenna lead in connects

uous absence of high audio frequencies. The correct setting can be checked by means of the tuning dial, by slowly turning it back and forth across resonance. When the upper screw is properly adjusted, the signal will tune in and out smoothly and there will be no peaks or loudspots as the dial is turned. In fact, the signal should tune in and out just as *smoothly* as with the Crystal "off" except that the band width will be noticeably *narrower*.

R. F. AND H. F. OSCILLATOR: Before attempting to realign these circuits the following instructions should be read through very carefully. As in the case of the I. F. amplifier, these circuits have also been accurately aligned during final inspection and great care has been taken in their design to insure stability and permanence of adjustment. Therefore, they should not be disturbed unless it is absolutely certain that readjustment is necessary. Even in that case, only very slight alterations will be necessary to restore the receiver to its original efficiency. In general, a small fraction of a turn on either inductance adjuster or trimmer condenser will suffice. These adjustments, together with their respective test frequencies, are clearly shown on the chart below (Fig. 10). On the bands from 3.2 mc. to 31 mc. it is extremely important to have the band spread dial set at 200, since that is the setting at which the main dial has been calibrated. Naturally, the alignment of the receiver cannot be more accurate than the source of the test signal. The aligning during final inspection at the factory is accomplished with special test oscillators which are frequently compared with standard frequency crystals. The front row of adjustments shown on the chart in Fig. 10, control the high frequency oscillator circuits and consequently the dial calibration. These adjustments should be disturbed *only* if the calibration of the main dial (with band spread dial at 200) is known to be off. As clearly indicated in the diagram, the inductance should be adjusted at the low test frequency in each band and the trimmer capacitor at the high frequency end. These adjustments mutually affect each other, therefore, if any considerable change is made at one end of a band the other end of the same band must be readjusted. This procedure must be repeated until no further readjustment at either end is necessary.

The adjustments in the middle row control the first detector input circuits. No great accuracy of test signal is required to check their correctness. Set the oscillator approximately to the frequency shown on the chart and tune in on the receiver (using the output meter). Then adjust for peak meter reading by means of the inductance adjuster at the low test frequency and the trimmer capacitor at the high frequency end. At 30 mc. there is a certain amount of interlock between the detector and H. F.

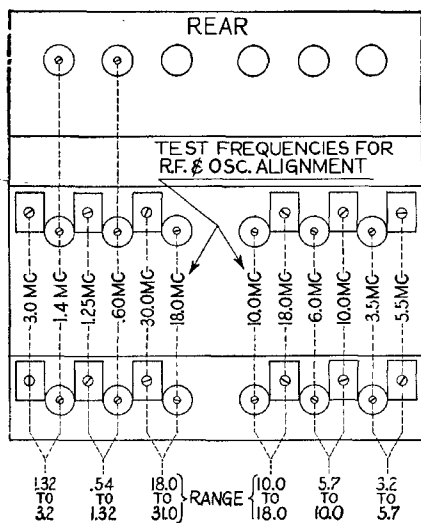


FIG. 10—Chart for R.F. alignment.

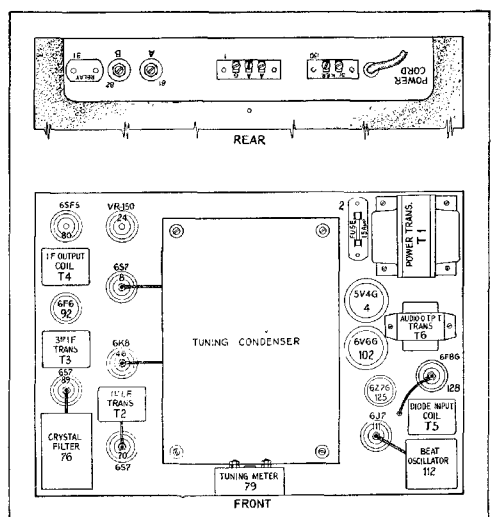


FIG. 11—Chassis layout and meter adjustments "A" and "B."

oscillator, so in order to avoid a false setting of the trimmer capacitor in this range, it will be necessary to rock the tuning condenser back and forth while the test is being made.

MAINTENANCE

In the course of manufacturing and designing the "HQ-120-X," HAMMARLUND engineers have maintained a very wide margin of safety throughout the entire receiver. ~~When given treatment such as any precision instrument should receive, the "HQ-120-X"~~

HQ-120-X PARTS LIST

DIAGRAM	DESCRIPTION	PART NO.
L-1	Antenna coil .54-1.32 mc. range.....	6007
L-2	Antenna coil 1.32-3.2 mc. range.....	6010
L-3	Antenna coil 3.2-5.7 mc. range.....	6012

HO-129-X PARTS LIST-Cont.

DIAGRAM	DESCRIPTION	PART NO.
31	Relay pin jack.....	6142
32	Det. grid tap and osc. plate switch wafers.....	6064
34-35-36-37-	} Special MEX trimmer cond.....	6055
38-39-53-54-		
55-60-61-62		
42-49-	} 50,000 ohm resistor (1/2 W.).....	6075
110-191		

10 1/2

27
28



10 - ~~5.84~~ 1.23

85 - 4.03 - 7 1/5
(21)

15 - 17.00 (25) art
(to 73.5) top
scal

2 14.5 - 2 25.00

3.00



K4XL's BAMA

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