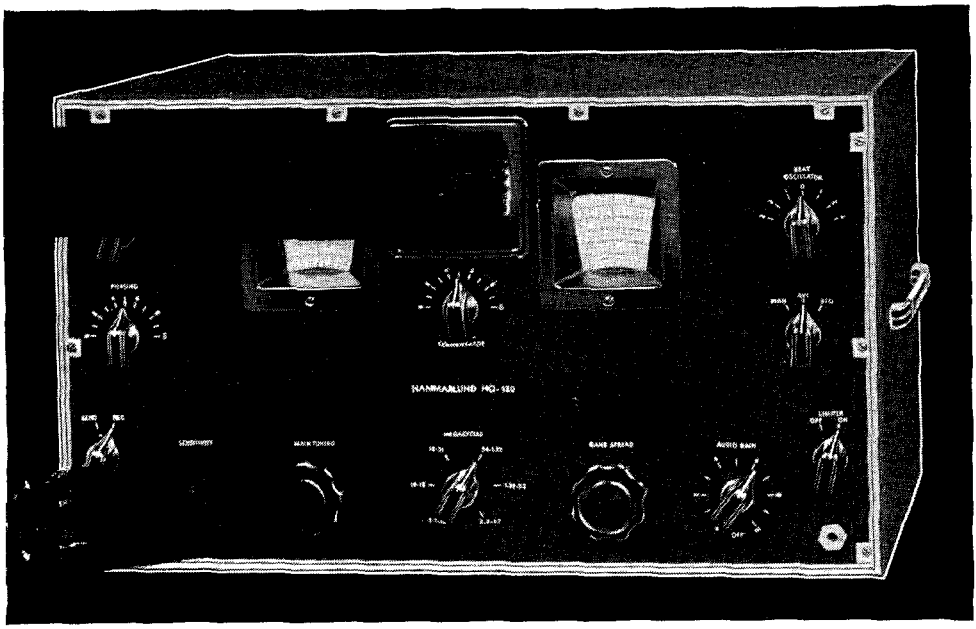
HAMMARLUND
HQ-120-X

COMMUNICATIONS RECEIVER

CRYSTAL MODEL



THE new "HQ-120-X" is *designed* to meet the most critical demands of both the amateur and professional operator. HAMMARLUND engineers have *gone* far beyond ordinary practice in this new communications receiver. This ultra-modern 12-tube superheterodyne covers a *continuous* range of from 31 to .54 mc. (9.7 to 555 meters) in 6 steps, thus taking in all important communication, amateur and broadcast bands. The "HQ-120-X" is not to be confused with modified broadcast receivers, to which have been added the short wave bands, *beat oscillator*, etc., in order that they may be called "communications" receivers. It took two years to develop the "HQ-120-X." It is a special receiver *with* especially designed parts throughout. Every wave range in this receiver is individual, that is, each range has its own individual coil and tuning condensers. These individual tuning circuits for each band, with their proper circuit values, strike a new high in *performance* throughout the entire range of the receiver.

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. This 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 [illegible] 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 radio, and sensitivity are concerned, with almost any of the popular antennas now in use. Another very important feature is the exceptional band-spread available. Due to special tuning condenser and dial construction, there is a spread of 310 degrees for each of the amateur bands from 80 to 10 meters, inclusive. The band-spread dial has five scales, four of which are directly calibrated in each of the above amateur bands. The fifth scale is the arbitrary 0-200 scale for calibration at other frequencies. This special band-spread feature, together with the calibrated band-spread dial, is exceptionally valuable in view of the new government regulations as regards monitoring of amateur stations. The main tuning dial of the receiver also has six bands, and these in turn are calibrated in megacycles. In addition to the features already mentioned, the receiver has a beat oscillator, AVC, send-receive switch (which also has relay connections) and headphone jack. Further technical details, of the various features outlined above, will be found in the following discussion.

CIRCUIT ARRANGEMENT

PRE-SELECTION: The pre-selector stage in this receiver is extremely high in gain due to its tuned grid and tuned plate circuits. An additional feature has been included in this stage in order to compensate for various types of antennas which may be used with the receiver. The adjustable compensating control which appears on the panel, directly underneath the meter, provides an external adjustment for perfectly aligning the circuits with any given antenna system. This is highly desirable for it is almost

impossible to maintain fixed circuit alignment when antennas are frequently changed. Also, because the selectivity is thus improved and the gain considerably increased, this feature affords maximum signal-to-noise ratio and maximum image rejection. See Fig. 1.

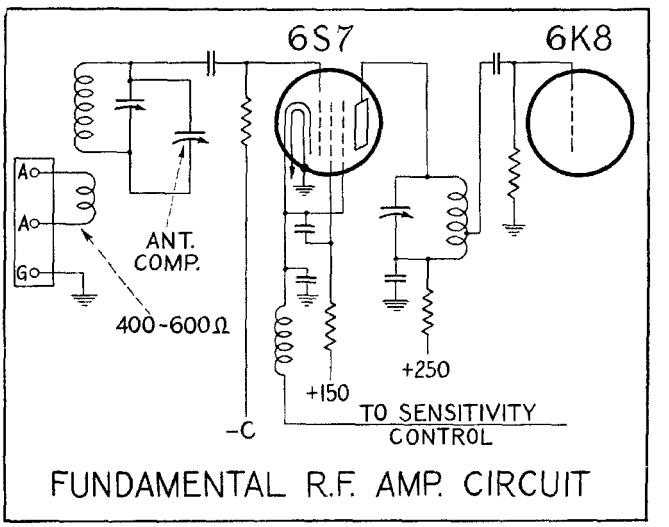


FIG. 1 — Fundamental R.F. amplifier diagram showing antenna compensating condenser.

BAND SPREAD: Much of the detail as to the band-spread arrangement has been covered in the introduction of this book. The band-spread control has five scales. The first is an arbitrary scale reading 0 to 200 for calibration in any of the bands covered by the receiver. This dial also includes four other scales calibrated in megacycles for the 80, 40, 20, and 10 meter amateur bands. It is rather unusual to find a band-spread dial calibrated directly in megacycles. However, due to the excellent stability of the receiver in general, and the outstanding design of the tuning condenser assembly, this has proved absolutely practical and, to say the least, most convenient.

CONVERTER STAGE: The converter stage uses the newly developed 6K8 tube which, incidentally, becomes more efficient as the frequency increases. The converter stage in this receiver has been treated in such a manner that the overall RF gain is relatively constant not only from one end of a particular amateur band to the other, but also from one band to the other. This is done because it can be readily seen that if the RF gain is not relatively uniform throughout each band and from one band to the other, the "S" meter reading will not be a true indication of signal strength. In some bands it would require a stronger signal to indicate "S-8" on the meter than in others. This has for a long time been a common ailment in receivers and a barrier to true meter readings. However, in the case of the "HQ-120-X" circuit adjustment has been made to permit accurate meter readings.

In order to increase stability, the oscillator is operated from a controlled voltage circuit employing the VR 150 voltage regulator tube. It is a well-known fact that fluctuations in power line voltage in many cases induce a frequency change in the high frequency oscillator stage. The use of the voltage regulator tube in a very effective circuit eliminates all danger from this source because the voltage applied to the oscillator portion of the converter remains constant regardless of power line changes. Also, the calibration of the receiver is maintained more accurately.

CRYSTAL FILTER: The crystal filter included in the "HQ-120-X" is an outstanding HAMMARLUND development. Unlike most other crystal filters, this one has five ranges of selectivity. These five degrees of selectivity are controllable directly from the panel by operation of a rotary switch. And, these degrees of selectivity remain

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

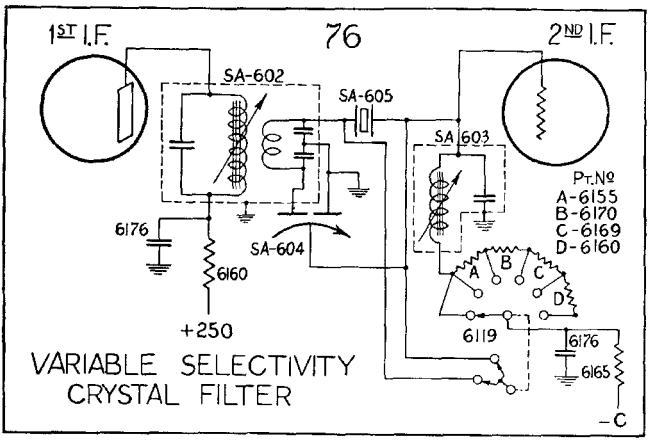


FIG. 2—Diagram of outstanding variable selectivity crystal filter. This original Hammarlund development opens a new field in radiophone communication.

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 is unit shown in Fig. 9.

I. F. AMPLIFIER: The intermediate frequency amplifier consists of three stages employing iron core permeability-tuned transformers. The intermediate frequency is 455 kc. which has now become the R.M.A. standard. Overall selectivity curves for the I. F. amplifier with crystal filter are shown in Fig. 3. The A.V.C. arrangement in this amplifier provides remarkably smooth operation. There is a switch for cutting out the A.V.C. and providing manual control of volume or sensitivity.

NOISE LIMITER: The automatic noise limiter faithfully follows the carrier signal strength. It is intended to eliminate automobile-ignition interference and other similar disturbances. It works with the A.V.C.

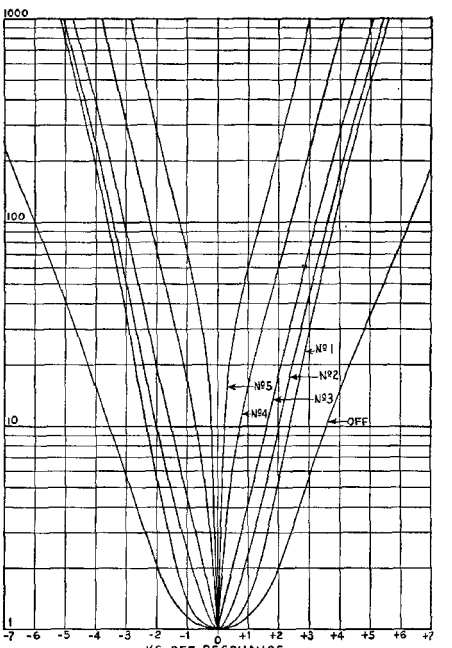


FIG. 3—Overall selectivity curves for 455 kc. I.F. amplifier and crystal filter. Labeling of the curves corresponds to the markings on the panel.

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 satisfactory operation over a long period of time. A two-section filter is employed with a total inductance of 40 henries, and a total capacity of 40 microfarads. This heavy duty filter provides humless operation.

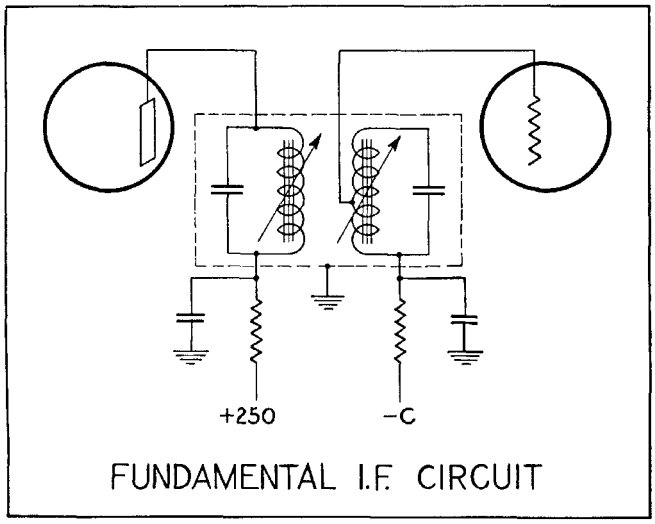


FIG. 4—Typical I.F. amplifier circuit showing permeability tuned transformers with silvered-mica padders.

CONSTRUCTIONAL DETAILS

In designing the "HQ-120-X," HAMMARLUND engineers have gone to considerable length in order to turn out a receiver that will stand up under various types of service and give years of satisfactory performance. A wide margin of safety has been employed in every case, making it suitable for even the most gruelling commercial or governmental service where 24-hour-a-day operation is required.

In Figs. 6 and 7, we have the top and bottom views of the receiver showing general construction and parts layout. The model illustrated is for table mounting. Special brackets are available for mounting the receiver in a relay rack. Fig. 8 is the top view with the cover of the tuning condenser assembly removed. To the right is the

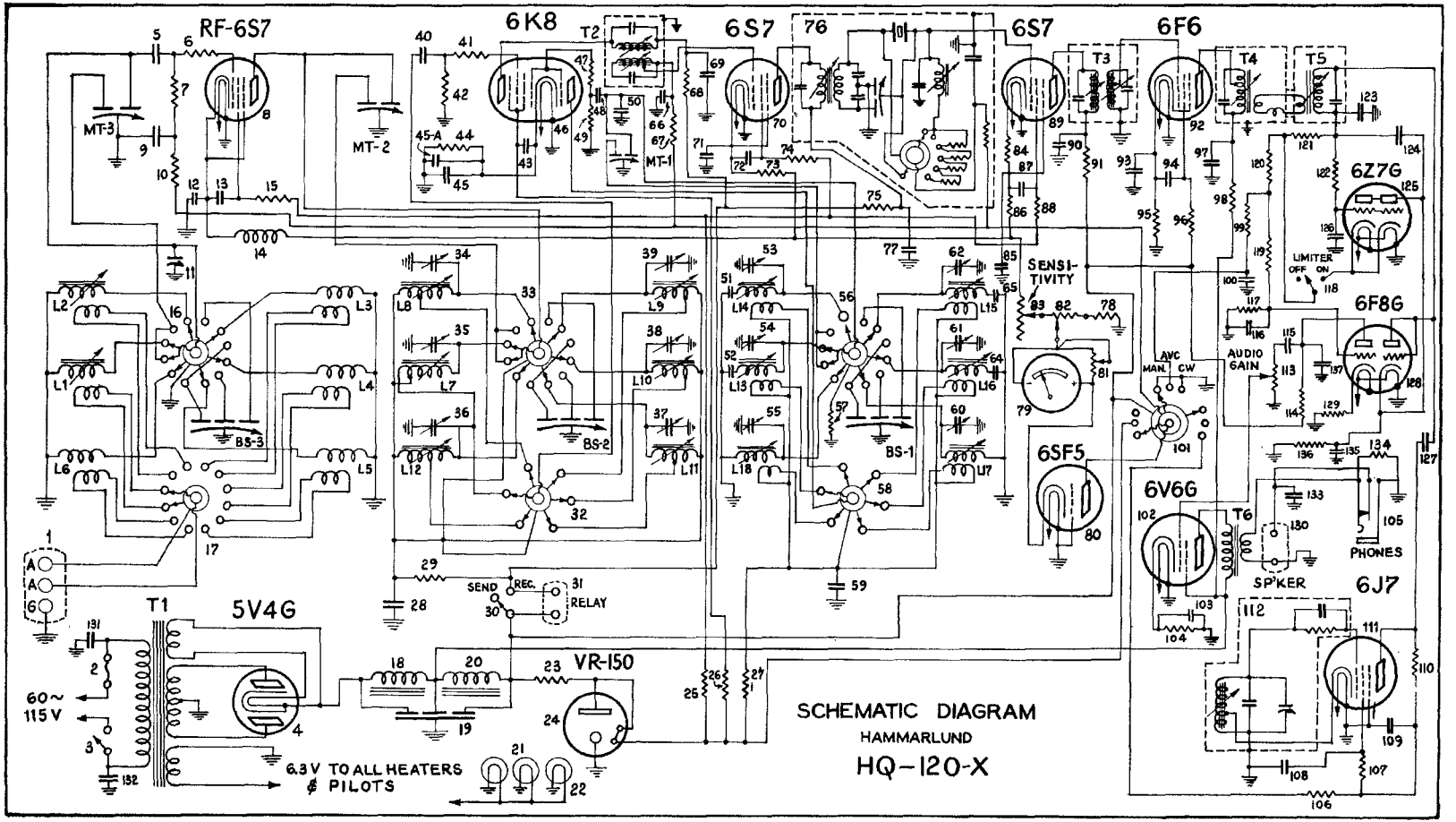


FIG. 5—Complete circuit diagram of "HQ-120-X"

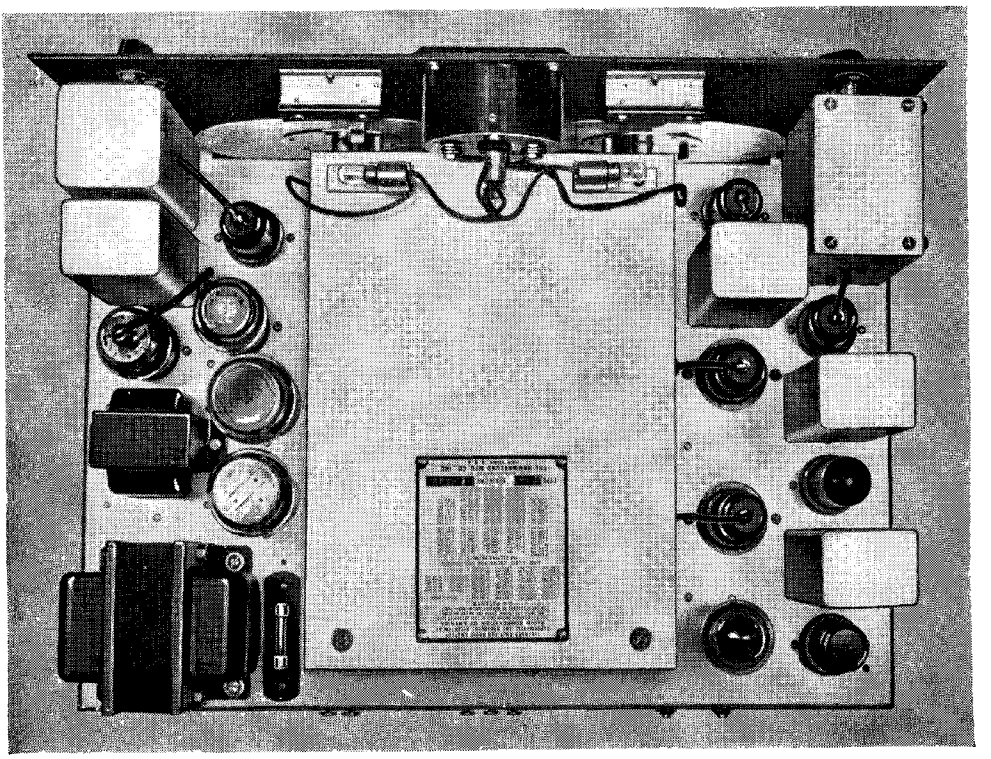


FIG. 6—Top view of "HQ-120-X," chassis.

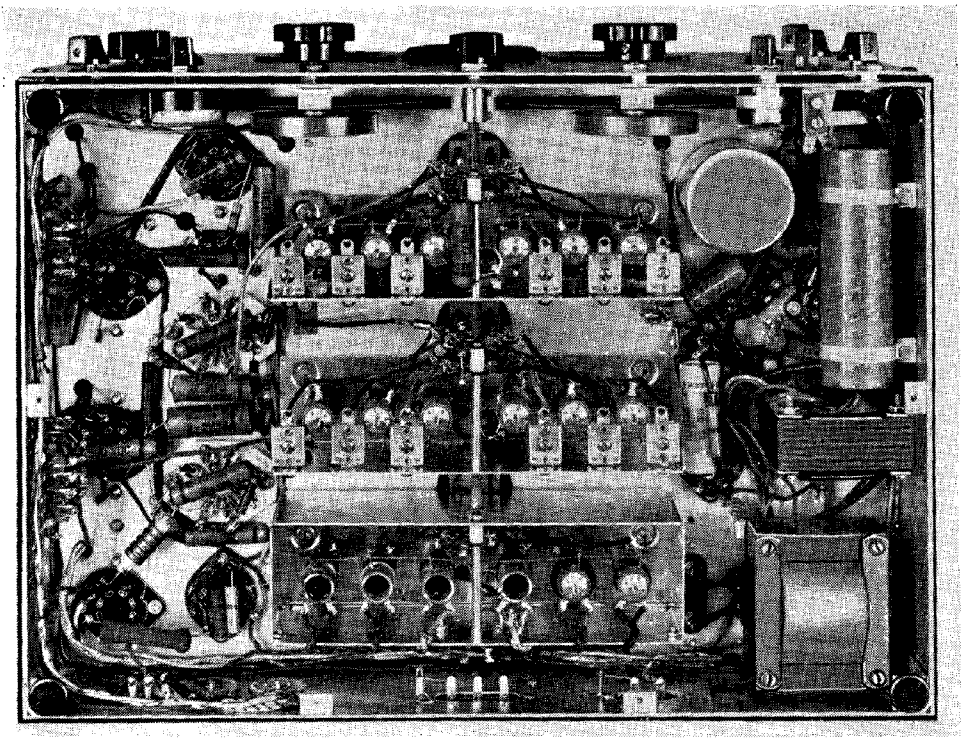


FIG. 7—Bottom view of "HQ-120-X" chassis showing the 18 individual coils.

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 dial mechanism fastens to the shaft of the condenser on the inside of the bearing with a series of gears. These gears are of the split type with take-up springs to eliminate backlash. The dial is operated with a friction drive. Three pilot lights conveniently illuminate the two tuning dials, as well as the "S" meter. These are placed so that the

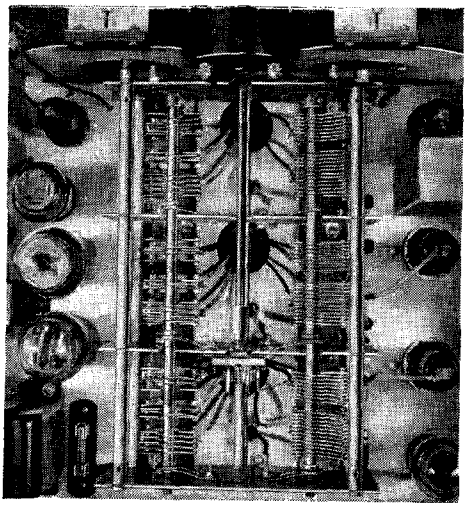


FIG. 8—Tuning condenser assembly.

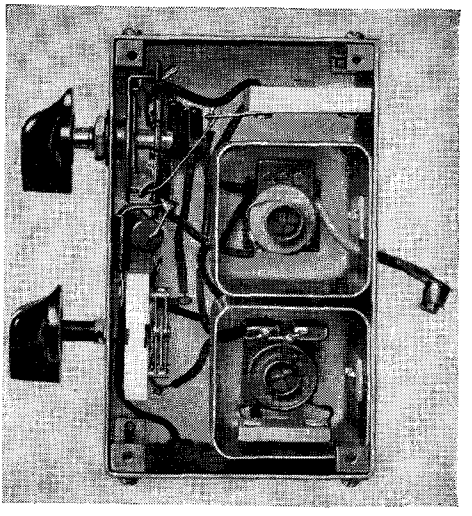


FIG. 9—Crystal filter unit.

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 commnnication, but does not disconnect the receiver from the power line thns 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 first arrow. If not, the zero adjustment on the meter (the small screw in the lower central portion) should be adjusted and the receiver turned on again. Connect a wire jumper between the 6K8 grid cap and the metal chassis when making the following meter adjustments, in order to eliminate signal and noise pickup. With the receiver in the AVC position and the sensitivity control set on zero, the screw driver adjustment "A" on the rear of the chassis should be adjusted so that the indicating needle of the meter is opposite the arrow at the extreme right of the scale. With the "sensitivity" control turned to 10, adjust "B" so that the meter needle is opposite the small arrow at the left of the scale. This should be rechecked because there is a slight interlocking of these controls. It may be necessary to repeat the operation two or three times.

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 to the remaining terminal.

In cases where the noise level is relatively high, some sort of noise reducing antenna is desirable. Many of these are available on the open market. Those special antennas having two-wire spaced lead-ins can be connected directly to the two "A" terminals. Antennas having the familiar twisted pair lead-ins should employ a coupling transformer at the receiver. In many cases, however, it will be found that the transformer can be omitted without greatly impairing sensitivity. This receiver is not critical as to the type of antenna employed because of the antenna compensating control. No matter what type of antenna is used, the receiver can be adjusted to make the best of the situation. While it is true that almost any type of antenna will work fairly well, it is also true that extra care used in the selection and installation of an antenna will pay big dividends.

REALIGNMENT PROCEDURE

I. F. AMPLIFIER: The "HQ-120-X" receiver is aligned by the usual oscillographic method during final inspection. Its I. F. circuits are of an extremely stable type employing high grade silver-plated mica fixed condensers which are practically unaffected by even extreme changes in temperature or humidity. Accurate circuit alignment is accomplished by adjusting the position of the iron dust cores in the I. F. coils by means of the slotted screws protruding from the sides of the I. F. transformers T2, T3, T4, and T5 and the crystal filter shield 76. This construction results in tuned circuits that hold their adjustment regardless of mechanical shocks or atmospheric conditions. For these reasons it is extremely unlikely that realignment will be necessary and it should not be attempted unless there is very good reason to suspect trouble in the I. F. end of the receiver. Slight misalignment of transformers T2 and T3 will have the most marked effect on sensitivity and selectivity and their adjustment can be checked as follows:

Connect an output meter across the speaker voice coil leads. A low reading copper-oxide rectifier meter is quite suitable for this purpose. Connect a test oscillator (modulated) to the input terminals of the receiver. The frequency of this test oscillator may be anything within the range of the receiver, but its output must be steady. Then tune in its signal on the receiver with the crystal selectivity switch set on No. 1 (phasing control at centerscale) and adjust sensitivity (MAN) until a reading of approximately 1 volt is obtained on the output meter. It will now be found that the output meter reading is very sensitive to slight changes in tuning. After adjusting the tuning dial for peak output meter reading, check each adjusting screw on I. F. transformers T2 and T3. If any great change occurs readjust the tuning dial and again check the four I. F. adjustments. When no further improvement can be made T2 and T3 will be perfectly aligned. The lower, or plate circuit adjusting screw of the Crystal Filter transformer 76 may be checked at the same time and in the same manner.

To *perfectly* align the upper, or grid circuit of the crystal filter 76 an oscillograph and sweep oscillator are required. When such equipment is available the Crystal Selectivity switch may be set on No. 3 or No. 4 and the sweep frequency oscillator adjusted to coincide with the quartz crystal resonant frequency (phasing control at centerscale). Then, with Crystal Selectivity switch on No. 1, adjust the upper screw of Crystal Filter 76 for symmetrical pattern on the oscillograph screen. When such visual aligning equipment is not available a fairly satisfactory setting of this upper screw may be made as follows: After checking the alignment of T2, T3 and the lower screw of Crystal Filter 76 with the output meter as previously outlined, leave the Crystal Selectivity switch on No. 1 and tune in a broadcast station. Then adjust the upper screw in Crystal Filter 76 for best quality of reproduction of speech and music. In making this adjustment no attention should be paid to loudness. On either side of the correct setting, the speech and music will sound low and drummy, with a conspic-

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 test frequency. 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 amouut of interlock between the detector and H. F.

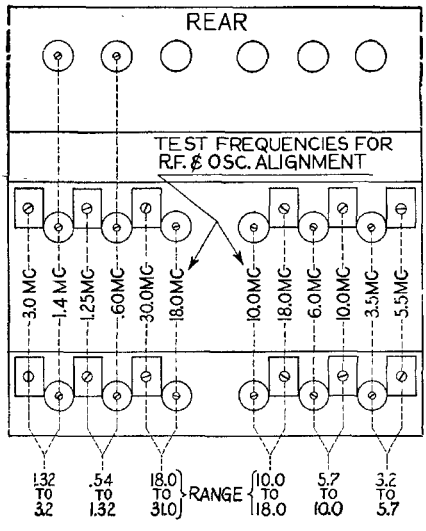


FIG. 10—Chart for R.F. alignment.

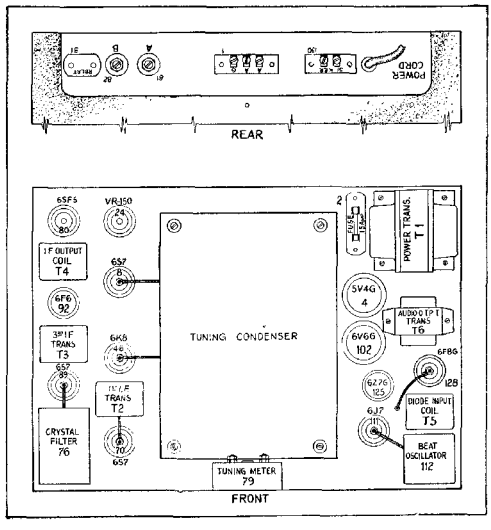


FIG. 11—Chassis layout and meter adjustments "A" and "B."

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" will provide years of satisfactory service, and there should be no need for the owner or servicemen to tamper with the receiver. In case of serious trouble, of course, it is recommended that the owner contact the factory service department. Although great strides have been made by tube manufacturers, the first source of trouble is most likely to be the tubes. Therefore, in case of failure, the tubes should be carefully checked by a reliable technician. The second source of trouble will invariably be found in the large assortment of small resistors and by-pass condensers. A defective resistor or condenser can be located by employing the well-known point-to-point continuity test. To expedite this check, the chart below should be consulted. This chart provides information as to the various voltages which will appear between certain tube socket prongs and the ground or B-negative side of the circuit. A slight explanation of the chart might be in order. As an example, when checking the R.F. tube (6S7) we find that the reading from pin 3 to ground should be 200 volts if read on a 0–250 scale meter. The scale that should be used for making the check is contained in the parentheses below the voltage. In the course of making this check it may be found that the voltage will vary slightly in some cases. This, of course, will be due to varying line voltage conditions in the particular location where the receiver is being tested. The voltage values indicated should be found in cases where the line voltage is exactly 117 volts. A meter having a resistance of 1000 ohms per volt with scales approximately as indicated can be used for the checking. In compiling the parts lists on pages 14 and 15, an endeavor has been made to indicate all values of parts readily obtainable in the open market. For instance, such common items as .02 mf. paper condensers with 500 volt ratings and 10,000 ohm ½w. resistors are standard items. Other parts whose values are not standard should be obtained by writing to the factory. Such parts as 5.5 mmf. silver mica condenser, of course, are not readily obtainable. However, in many cases these special items are located in parts of the circuit where it is almost impossible for them to become defective through ordinary operation of the receiver.

	SWITCH ON MAN. NO SIGNAL								SWITCH ON CW AVC	
TUBE	RF 6S7	Conv. 6K8	1–IF 6S7	2–IF 6S7	3–IF 6F6	Audio 6V6-G	REG VR150	6F8-G	B.O. 6J7	Meter 6F5
Pin 3 to ground	200 (250)	215 (250)	215 (250)	210 (250)	270 (500)	260 (500)	...	170 (250)	35. (250)	...
Pin 4 to ground	115 (250)	105 (250)	115 (250)	115 (250)	122 (250)	275 (500)	...	2.5 (10)	75. (250)	...
Pin 5 to ground	...	...	...	...	...	...	150 (250)	...	...	150 (250)
Pin 6 to ground	...	115 (250)	...	...	...	...	...	...	...	...
Pin 8 to ground	3.2 (10)	3.2 (10)	6.2 (10)	6.2 (10)	9.3 (10)	16. (100)	...	...	...	1.8 (10)

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	6013
L-4	Antenna coil 5.7–10 mc. range	6016
L-5	Antenna coil 10–18 mc. range	6019
L-6	Antenna coil 18–31 mc. range	6022
L-7	R.F. coil .54–1.32 mc. range	6008
L-8	R.F. coil 1.32–3.2 mc. range	6011
L-9	R.F. coil 3.2–5.7 mc. range	6014
L-10	R.F. coil 5.7–10 mc. range	6017
L-11	R.F. coil 10–18 mc. range	6020
L-12	R.F. coil 18–31 mc. range	6023
L-13	H.F. osc. coil .54–1.32 mc. range	6009
L-14	H.F. osc. coil 1.32–3.2 mc. range	6012
L-15	H.F. osc. coil 3.2–5.7 mc. range	6015
L-16	H.F. osc. coil 5.7–10 mc. range	6018
L-17	H.F. osc. coil 10–18 mc. range	6021
L-18	H.F. osc. coil 18–31 mc. range	6024
T-1	Power transformer 50–60 cycle, 115 V	6082
T-2	First I.F. transformer	6116
T-3	Third I.F. transformer	6118
T-4	I.F. output coil assembly	SA-660
T-5	Diode input coil	SA-670
T-6	Audio output transformer 6 ohm	6086
1	Antenna terminal strip	6088
2	Fuse block (1.5A fuse Pt. No. 6065)	3859
3	Power switch (comb. with audio gain control), 500,000 ohm	6095
4	Rectifier tube socket 5V4-G	6114
5-40-116	600 mmf. mica condensers	6073
6-41	25. ohm resistor (½ W.)	6155
7	500,000 ohm resistor (½ W.)	6076
8	Tube socket 6S7-RF (iso.)	6107
9-12-13-43-59-66-69-72-77-87-90-97	.02 mf. paper cond. (500 V.)	6176
10-67-106	10,000 ohm resistor (½ W.)	6165
11	Antenna compensating condenser	SA-617
14	R.F. choke	CHX
15-29-68-74-75-88-91-98	2000 ohm resistor (½ W.)	6160
16-33	R.F. and detector grid switch wafer	6063
17	Antenna switch wafer	6062
18	First filter choke	6083
19	Filter condenser	6085
20	Second filter choke	6084
21	.15 amp. pilot lamps (6-8 V.)	6036
22	Dial and meter lamps socket assembly	6045
23	3000 ohm resistor (10 W. wire wound)	6161
24	Tube socket VR-150	6115
25	6000 ohm resistor (1 W.)	6163
26	7000 ohm resistor (1 W.)	6164
27-114	10,000 ohm resistor (1 W.)	6162
28	.005 mf. mica condenser	6056
30-118	Send-Receive and Limiter switches	6098

HQ-129-X PARTS LIST—Cont.

DIAGRAM	DESCRIPTION	PART NO.
31	Relay pin jack	6142
32	Det. grid tap and osc. plate switch wafers	6064
34-35-36-37-38-39-53-54-55-60-61-62	Special MEX trimmer cond.	6055
42-49-119-121	50,000 ohm resistor (½ W.)	6075
44-129	230 ohm resistor (½ W.)	6156
126-131-132-133-45-71-85-94-100-108-109	.05 mf. condenser (500 V.)	6174
45A	.005 mf. mica condenser	6194
46	Tube socket 6K8-Conv. (iso.)	6107
47	15 ohm resistor (½ W.)	6154
48	50. mmf. condenser (silver)	6074
50-127	5.5 mmf. condenser (silver)	6151
51	673 mmf. condenser (silver)	6061
52	300 mmf. condenser (silver)	6060
56	H.F. osc. grid switch wafer	6132
57	10. ohm resistor (½ W.)	6089
64	.0015 mf. mica condenser	6058
65	[illegible] mf. mica condenser	6059
[illegible]	Tube socket 6[illegible]	6109
[illegible]	[illegible] ohm resistor (½ W.)	6159
76	Crystal filter	SA-600
78	50. ohm resistor ½ (W.)	6170
79	Tuning meter	6139
80	Tube socket 6SF-5	6106
81-82	80. ohm meter circ. potentiometers	6140
83	Sensitivity control 10,000 ohms	6096
84	400 ohm resistor (½ W.)	6168
86	300. ohm resistor (½ W.)	6169
92	Tube socket 6F6	6108
93	.1 mf. condenser (500 V.)	6173
95	600 ohm resistor (½ W.)	6158
96	50,000 ohm resistor 1 watt	6166
99-122	1-meg. resistor (½ W.)	6167
101	AVC-MAN-BFO switch	6097
102	Tube socket 6V6G—Audio	6113
103	40 mf. electrolytic condenser	6171
104	350. ohm resistor (1 W.)	6157
105	Phone jack	6087
136-107-110	100,000 ohm resistor (½ W.)	6135
111	Tube socket 6J7	6112
112	Beat oscillator	SA-680
113	Audio gain control (500,000 ohm combined with power switch)	6095
115	.01 mf. condenser (500 V.)	6175
117	20,000 ohm resistor (½ W.)	6197
120	25,000 ohm resistor (½ W.)	6198
123-124-135	50. mmf. mica condenser	6199
137	1000. mmf. mica condenser	6177
125	Tube socket 6Z7-G	6201
128	Tube socket 6F8-G	6200
130	Speaker terminal strip	3843
134	25 ohm resistor (1 W.)	6196

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