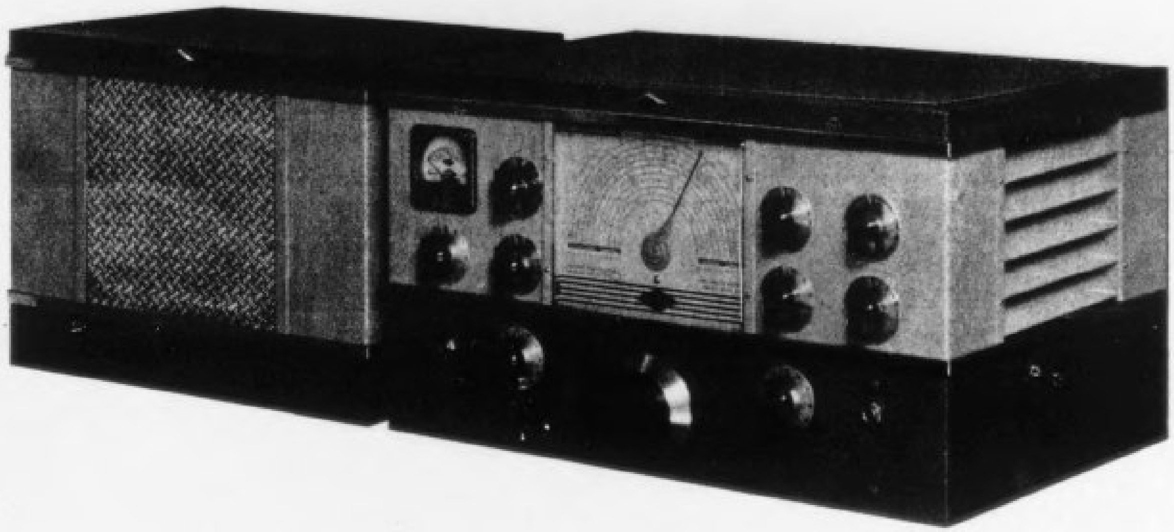
INSTRUCTION MANUAL

for

THE NATIONAL NC-200

SERIES
UNIVERSAL COMMUNICATIONS
RECEIVERS

High performance receivers of advanced design for the 490 to 30000 kilocycle range



NC–200 RECEIVER

HIGHLIGHTS . . .

- 490 to 30,000 Kilocycle Range
- 6 General Coverage Ranges
- 4 Amateur Ranges with Uniform Band-spread
- All Ranges Have Definite, Accurate Calibration
- Actual Single Dial Control
- Temperature Compensation
- Automatic Voltage Stabilization
- Series Valve Noise Limiter
- New, Flexible Crystal Filter
- Speaker in Matching Cabinet
- Phonograph or High Level Microphone Pick-up Jack.

National Company, Inc.

THE NC-200 COMMUNICATION RECEIVER

SECTION 1. DESCRIPTION

1-1. *General*

THE NC-200 RADIO RECEIVER is a twelve tube superheterodyne covering a continuous frequency range of from 490 to 30,000 kilocycles and band-spreading the 10, 20, 40 and 80 meter amateur bands. It has a number of new features not previously available in any receiver regardless of price. One of these is the stability of the high frequency circuits. A new high frequency oscillator design has been developed in the National laboratories which eliminates the exasperating detuning effect of the R.F. gain control and the even more undesirable motor-boating or fluttering which occurs in most receivers when tuning in strong high frequency signals. Perhaps the best way to prove the exceptional performance of the new circuit is in the 10-meter band where a line voltage shift from 100 to 120 volts produces less than 1000 cycles change in tuning. This is a variation of less than .003 percent. Frequency drift has been reduced to minimum through the use of temperature compensating capacitors not only in the high frequency oscillator circuits but in the R.F. and first detector circuits as well.

The sensitivity of the NC-200 is particularly high, an input signal of only 1 microvolt providing 1 watt of audio output. New R.F. coupling circuits developed in the National laboratories have made possible the maintenance of full sensitivity up to the highest frequencies covered by the receiver. Moulded polystyrene coil forms are used in all circuits, both R.F. and I.F., thus assuring the freedom from circuit losses or detuning which might otherwise be caused by humidity effects. Variable condenser insulators, tube sockets, etc., are of Isolantite.

A loud speaker mounted in a matching cabinet and an instruction manual are supplied with each receiver.

1-2. *Circuit*

The circuit employed on all ranges consists of one stage of radio frequency amplification, a separate first detector and stabilized high frequency oscillator, two intermediate frequency stages, an infinite impedance second detector, a self-balancing phase inverter and audio amplifier, and a push-pull audio output stage.

The second detector utilizes one set of elements of a dual triode; the other set of elements is utilized for a series valve noise limiter. Separate tubes are used in the automatic volume control and beat frequency oscillator circuits. The latter is coupled to the second detector for C.W. reception.

A crystal filter is connected between the first detector and first I.F. amplifier tubes.

All voltages required by the receiver circuits are supplied by a built-in power supply.

1-3. *Tube Complement*

The NC-200 is supplied complete with tubes which are tested in the receiver at the time of alignment.

The tubes employed are as follows:

R.F. Amplifier	6SK7
First Detector	6K8
H.F. Oscillator	6J5
First I.F. Amplifier	6K7
Second I.F. Amplifier	6SK7
Second Detector-Limiter	6C8G
Automatic Volume Control	6SJ7
Beat Frequency Oscillator	6SJ7
Amplifier and Phase Inverter	6F8G
Push-Pull Audio Output (2)	6V6
Rectifier	5Y3G

1-4. *Tuning System*

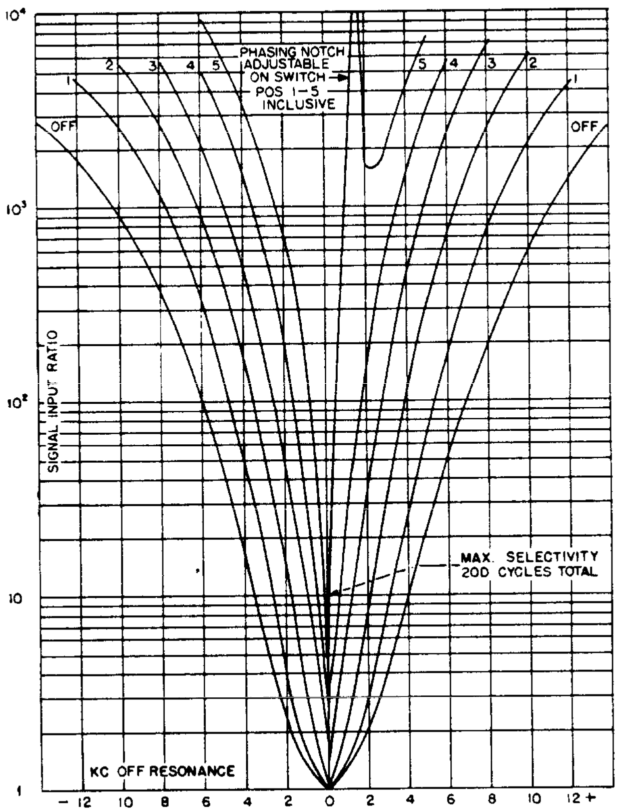
The master tuning capacitor C-1 and six sets of coils are used to tune the 490 to 30,000 kilocycle range of the receiver. By means of a newly developed band change mechanism, four of these same coil sets are made to spread the 10, 20, 40 and 80 meter amateur bands uniformly over the major portion of the tuning dial (HRO System). All ten ranges are calibrated.

All transformer coils of the R.F. amplifier, first detector and H.F. oscillator stages with their associated padder and air-dielectric trimmer capacitors are mounted in a rigid aluminum casting which slides the length of the chassis, being moved by the MAIN TUNING control. The various coil assemblies are fitted with heavy contact pins which engage spring contactors mounted immediately under the variable tuning capacitor. This system permits thorough shielding of each individual coil while, at the same time, the coils in use are moved to the best position in the chassis, giving shortest leads to the tubes and master tuning capacitor, and all other coils are completely disconnected from the circuit.

1-5. *Crystal Filter*

Undoubtedly, the most efficient, flexible crystal filter yet designed is used in the NC-200 Receiver.

Six uniform steps of selectivity, as shown in Dwg. No. 1, and a variable phasing control allow the receiver to be adjusted to almost any operating condition, a highly desirable feature for both short wave communication and broadcast band reception. The curves show that any degree of selectivity between that of full single signal operation and wide band broadcast reception is available, the ratio between the two being almost forty to one.



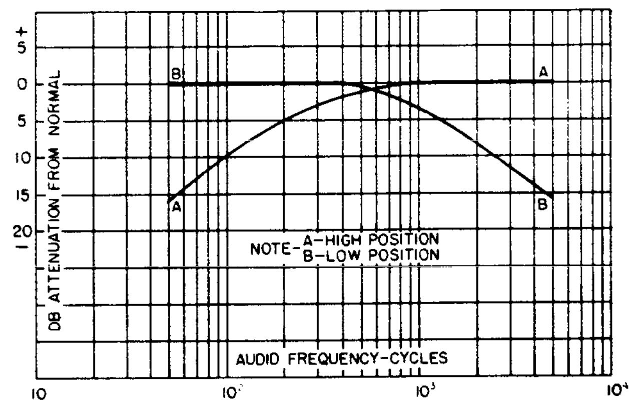
Dwg. No. 1. Typical Selectivity Characteristics

1-6. *Noise Limiter*

The noise limiter of the NC-200 Receiver is of the series valve type developed in the National laboratories. Its effectiveness and superior performance as compared to the more common types of "silencers" were proved in the NHU and modernized NC-100 receivers. A threshold control on the front panel permits adjustment of the level at which limiting action starts.

1-7. *Tone Control*

The tone control is used to vary the frequency characteristic of the audio amplifier as shown in the accompanying curves, Dwg. No. 2. The control is particularly helpful when receiving weak signals through interference, as explained in Section 3.



Dwg. No. 2. Tone Control Action

1-8. *Signal Strength Meter*

A 0 to 1 milliammeter, serving as a signal strength meter, is front panel mounted. It is fitted with a scale graduated in S-units from 1 to 9 and in db above S-9 from 0 to 40 db. The bridge circuit, in which the meter is connected, makes possible accurate signal input readings from below 1 microvolt to 1,000 microvolts.

1-9. *Antenna Input*

Antenna input terminals are located at the rear of the receiver chassis near the center. The input circuit is suitable for use with a single wire antenna, a balanced feed-line or a low impedance concentric transmission line. Average input impedance is 500 ohms.

1-10. *Audio Output*

Two audio output circuits are provided:

(1) A headphone jack is mounted on the front panel and is wired so as to silence the loud speaker when the phone plug is inserted. The correct load impedance for the headphone output is 20,000 ohms, this being the usual impedance of phones having a DC resistance of between 2000 and 3000 ohms. Maximum audio output available at the phone jack is 15 milliwatts.

(2) A five prong speaker socket (X-1) is provided at the rear of the receiver chassis. To this socket are brought the audio output leads. The proper load impedance (total) for the output circuit is 10,000 ohms. Maximum undistorted audio power output available is 8 watts.

1-11. *Power Supply*

The standard NC-200 Receiver is designed for operation from a 110 120 volt, 50 60 cycle power source. Normal power consumption is approximately

100 volt-amps. The built-in power supply delivers all voltages required by the heater and B supply circuits — 4.5 amperes at 6.3 volts and 100 milliamperes at 250 volts, respectively. One side of the AC input line is connected through a 2 ampere fuse housed in an extractor post marked "FUSE" which is mounted at the rear of the receiver chassis.

All NC-200 Receivers are equipped with a seven prong plug and socket combination to permit portable or emergency operation from batteries. See Section 2-3.

1-12. *Loud Speaker*

The loud speaker supplied with the table model NC-200 Receiver is of the permanent magnet field type having a nominal diameter of 10 inches. A coupling transformer, mounted on the loud speaker chassis, matches the voice coil to the output impedance of the receiver. A shielded three wire cable and plug is furnished for connection between the loud speaker and receiver.

A cabinet, finished to match the receiver, houses the loud speaker for table mounting. The cabinet interior is lined with sound absorbent material to avoid any undesirable mechanical resonance.

A $10\frac{1}{2}$ x 19 inch panel of 3/16 inch aluminum is used to support the ten inch loud speaker chassis in a relay rack installation.

1-13 *Pick-up Jack*

A pick-up jack mounted on the front panel of the Receiver may be used to connect auxiliary apparatus, such as a phonograph pick-up, to the audio system of the NC-200 Radio Receiver. This input circuit is high impedance and feeds into the 6F8G Audio Amplifier-Phase Inverter tube. The TONE and AF GAIN controls are operative with this connection.

SECTION 2. INSTALLATION

2-1. *Antenna Recommendations*

When using a single-wire antenna, the lead-in should be connected to one antenna input terminal and the short flexible lead, which is attached to the chassis, should be fastened to the other terminal. The dimensions of the single-wire antenna system are not critical, the recommended length, including lead-in, being from 75 to 100 feet, although any length between 25 and 200 feet may be used.

Feed-lines of doublet systems should be connected to the two input terminals. The flexible lead is not used.

The inner conductor of a concentric transmission line should be connected to one input terminal. The outer conductor and the flexible grounding lead should be connected to the other terminal.

An external ground connection to the chassis may or may not be necessary. It should be used unless it reduces signal strength.

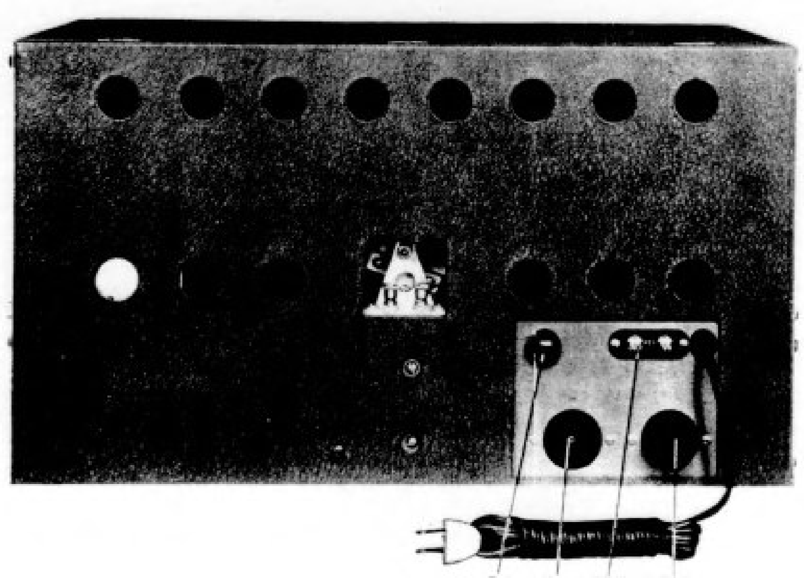


PHOTO NO. 1

2-2. *AC Operation*

After unpacking the NC-200 Receiver and loud speaker from the shipping cases, proceed as follows:

(1) Make sure tubes are firmly in their sockets.
(2) Insert the dummy connector plug P-2 in the seven prong socket X-2.
(3) Insert loud speaker plug P-1 in the five prong audio output socket X-1 of the receiver.
(4) Connect antenna feed line.
(5) Plug AC line cord in proper source of supply.
(6) Set controls as recommended in Section 3 for reception of signals.

2-3. *Battery Operation*

The NC-200 may be operated in portable or emergency service by connecting batteries to the terminals of battery connector plug P-3 and inserting it in socket X-2, in place of plug P-2. See Dwg. No. 3. For normal operation with somewhat reduced loud speaker output, a 6 volt heater supply (storage battery) should be connected to terminals 1 and 2 of plug P-3, and a 180 volt B supply should be connected to plug terminals 5 and 6. The jumper between terminals 3 and 4 (of P-3) completes the plate and screen supply circuits of the 6V6 output tubes. It may be omitted, with greater battery economy, when operation with head-phones only is desired. A suggested refinement is to connect a switch between terminals 3 and 4, thus permitting the 6V6 B supply to be opened at will. Alternatively, removal of speaker plug P-1 from socket X-1 will open the 6V6 B supply in the same manner, without harming the output tubes. A further economy of battery power may be effected by removing the 6V6 tubes from their sockets.

Do not attempt to use plug P-2 for battery connection, since the jumper between terminals 1 and 7 would be incorrect.

The recommendations of Section 3, OPERATION, apply to the battery powered NC-200.

2-4. *Loud Speaker*

If the installation is such that the loud speaker will be placed close to the receiver, the most desirable position is at the side. Placing the loud speaker on top of the receiver is not desirable since vibration from the speaker might possibly introduce microphonic noises which would not otherwise be noticeable.

SECTION 3. OPERATION

3-1. *Controls*

The MAIN TUNING control knob is located at the middle of the front panel and operates a three-gang variable capacitor C-1 through a 30 to 1 ratio reduction drive mechanism. The main dial has ten accurately calibrated scales, the scale in use being definitely indicated by band markers appearing at the scale ends. A dial pointer shows the frequency to which the receiver is tuned. The accuracy of the general coverage calibration can be relied upon to better than plus or minus 2%.

The tuning system of the NC-200 is truly single control; in fact, the MAIN TUNING control referred to above is used for range changing as well as tuning. To select either a general coverage or band-spread coil range, the MAIN TUNING control knob is pulled out about ¼ inch. When this is done, the dial and capacitor drive mechanism is disengaged and the knob is geared to the coil casting. As the knob is turned, the coil carriage is moved across the chassis until the proper coil pin contacts engage the circuit contactors, as indicated by the scale markers. Approximately one full turn of the MAIN TUNING knob is required to change from one general coverage range to an adjacent general coverage range. Approximately one-quarter turn of the knob is required to shift from a general coverage range to the associated band-spread range near the high frequency end. The knob does not turn smoothly between ranges, but only a few minutes is required to become familiar with its action. After the desired range has been selected, the tuning knob is pushed in to its original position, engaging the capacitor drive and disengaging the coil carriage rack.

The LIMITER control, at the left-hand side of the receiver panel, is used to adjust the DC potential applied to the elements of the series valve noise limiter tube. The limiter circuit is thus provided with an adjustable threshold at which limiting starts. Any audio voltages, or peaks, in excess of this threshold are prevented from reaching the audio amplifier. With the LIMITER control set at 0, the limiter circuits will pass all but the strongest audio peak voltages; when the control is set at 10, the threshold is lowered to a point where the audio signal will be distorted due to

PHOTO NO. 2

suppression of the positive peaks.

The R.F. GAIN knob is located below and to the right of the LIMITER knob. It is used to adjust the amplification of the R.F. amplifier and two I.F. amplifier tubes. Amplification increases as the control is turned clockwise towards 9. With the knob set at 10, the meter switch is closed, connecting the signal strength meter. See Section 3–4 regarding meter use.

A CONTROL SWITCH is mounted above the R.F. GAIN control knob. In the AVC position, the automatic volume control circuits are in operation; in the MVC position, automatic volume control is turned off; in the CWO position, the beat frequency oscillator is turned on and automatic volume control is turned off.

The POWER SUPPLY control knob is directly above the CONTROL SWITCH. In the counterclockwise position, OFF, the receiver is turned off, the primary circuit being opened by the AC line switch; in the mid-position, B+ OFF, the AC line switch is turned on but the B supply circuits are incomplete since the B+ switch is open; in the clockwise position, B+ ON, the B+ switch is closed, completing the B supply circuit. The B+ OFF position may thus be used for rendering the receiver inoperative, as may be required during transmission periods.

The A.F. GAIN control knob is located to the right of the MAIN TUNING control. It is used to adjust the audio amplification of the receiver. Audio amplification increases as the control is turned towards 10 on the scale.

The PHASING and SELECTIVITY controls, located above the A.F. GAIN knob, are part of the crystal filter. When the SELECTIVITY control is set at OFF, the crystal is switched out of the circuit. With the crystal switched out, the phasing control has little influence on receiver performance. With the SELECTIVITY control knob set at any point between 1 and 5, inclusive, the crystal filter is in operation, selectivity increasing as the knob is advanced to 5. See Dwg. No. 1. The PHASING control is then used to balance the crystal bridge circuit and eliminate interfering signals or heterodynes. See Sections 3–2 and 3–3.

The C.W. OSC. control knob located to the right of the PHASING control is used for varying the frequency of the beat oscillator. At 0 on the C.W. OSC. scale, the beat oscillator is tuned to the intermediate frequency. See Section 3–3.

A TONE control knob is located above the C.W. OSC. knob and is used to vary the frequency characteristic of the audio amplifier as previously described.

A BSW terminal panel is mounted at the rear of the receiver chassis. The terminals are connected in parallel with the B+ switch. If external (remote) stand-by control is desired, it can be accomplished by connecting a switch or relay to these terminals.

3-2. *Phone Reception*

After the equipment is properly installed, in accordance with Section 2, it is placed in operation by turning the POWER SUPPLY switch to B+ ON. The LIMITER control should be set at 0. The CONTROL SWITCH should be set at AVC. The PHASING knob should be set at 0; the SELECTIVITY at OFF; the TONE control should be set to give the desired audio characteristic; the R.F. GAIN control should be advanced to some point between 8 and 10, depending upon receiving conditions; the A.F. GAIN control should be set at the point providing the desired audio volume. The receiver is now adjusted for the reception of phone signals and will tune to the frequency indicated by the MAIN TUNING dial. The C.W. OSC. knob has no influence on receiver performance.

With the CONTROL SWITCH set in the AVC position, as recommended, the R.F. GAIN knob should be advanced as far as receiving conditions permit, or until background noise becomes objectionably loud. Audio output should be adjusted entirely by means of the A.F. GAIN knob. The operator must remember that automatic volume control action will be restricted unless the R.F. GAIN knob is fully advanced.

The CONTROL SWITCH may be set at MVC, in which case the operator must be careful not to advance the R.F. GAIN knob to a point where I.F. or audio amplifier overload occurs. Such overload is indicated by distortion. In general, the A.F. GAIN control may be set about halfway on, i.e., at 5 and the audio output adjusted by means of the R.F. GAIN control.

If a signal is weak and partially obscured by background noise and static, best signal-to-noise ratio will be obtained by turning the TONE control towards the LOW position. The most effective setting must be determined by trial as too much attenuation of high audio frequencies will impair the intelligibility of speech.

When a signal is accompanied by static peaks or noise pulses of high intensity and short duration, the best signal-to-noise ratio will be obtained by advancing the LIMITER control towards 10. The best setting must be determined by trial as too much limiter action will impair audio quality. If static peaks and noise pulses are extremely strong or if they are of fairly long duration, the effectiveness of the limiter will be best with the CONTROL SWITCH in the MVC position. In such cases both R.F. GAIN and LIMITER controls must be carefully adjusted for optimum signal-to-noise ratio.

The selectivity of the receiver may be adjusted by means of the crystal filter. The normal setting of the SELECTIVITY control in phone reception is at one of the positions affording broad selectivity. Positions 1 or 2 are recommended. Selectivity may be progressively increased by turning the SELECTIVITY control to positions 3, 4 and 5 although advancing the control too far will increase selectivity to a degree where phone signals become unintelligible.

The PHASING control is used to eliminate or attenuate heterodynes. The normal setting of the PHASING control in phone reception is at 0 on the scale. If, after a signal has been tuned in, an interfering signal causes a heterodyne or whistle, the PHASING control should be adjusted until the interference is reduced to a minimum. The setting of the PHASING control which provides maximum attenuation of the heterodyne will depend upon the pitch of the heterodyne whistle. If the beat note is above 1000 cycles, the optimum PHASING control setting will be near 0; if the beat note is 300 or 400 cycles, the optimum PHASING control setting will be near one end of the scale or the other, depending upon whether the interfering signal has a higher or lower frequency than the desired signal.

It is recommended that the TONE control be set in the HIGH position when using the crystal filter in phone reception. The resulting attenuation of low audio frequencies tends to compensate for the side-band cutting action of the crystal filter.

3-3. *C.W. Reception*

The initial adjustment of the receiver for C.W. reception is as described in Section 3-2, except that the CONTROL SWITCH must be in the CWO position. The C.W. OSC. control should be set at mid-scale.

The sensitivity of the receiver should be adjusted by means of the R.F. GAIN control, care being taken not to advance the control to the point where strong signals will cause I.F. or audio amplifier overload, as indicated by excessive thumping.

The action of the TONE and LIMITER controls will be similar to that described under Section 3-2. When receiving C.W. signals, it will be possible to advance both TONE and LIMITER controls considerably further than is possible in phone reception, since audio distortion is relatively unimportant.

Turning the C.W. OSC. control will change the characteristic pitch of the receiver background noise. The pitch will become higher as the beat frequency oscillator is detuned from the I.F. amplifier. With the C.W. OSC. control set at 2 or 3 (on either side of 0), the characteristic pitch of the receiver background noise will be in the neighborhood of 2000 cycles. Under these conditions, the audio beat note of any C.W. signal will show a broad peak at approximately 2000 cycles. This peak will appear on "one side of the carrier" only and the other side, where the audio beat note is around 2000 cycles, will be considerably weaker. This characteristic, known as "semi-single signal", is helpful in receiving weak signals through interference.

As stated in Section 3–2, the selectivity of the receiver may be adjusted by means of the crystal filter, the action of the SELECTIVITY and PHASING controls in C.W. reception being similar to that described. It is possible, however, to utilize the full range of crystal filter selectivity in C.W. reception. Maximum selectivity is obtained with the SELECTIVITY control set at 5. With this setting the single-signal effect, outlined above, becomes very pronounced; in other words, the audio beat note is very sharply peaked at a definite audio frequency which is determined by the setting of the C.W. OSC. control. The operator may have difficulty in finding the audio peak when first attempting to use the crystal filter. After a signal has been accurately tuned to give peak response, the R.F. GAIN control may need to be retarded in order to prevent I.F. or audio overloading. With the receiver tuned to "crystal peak", an interfering signal may be attenuated by proper setting of the PHASING knob since this control does not appreciably affect the desired signal.

3–4. *Measurement of Signal Strength*

To make a measurement of signal strength by means of the S-meter, the R.F. GAIN control must be advanced to 10, and the CONTROL SWITCH set at the AVC position. The crystal filter should be turned OFF by means of the SELECTIVITY control; the PHASING knob set at 0. The TONE, LIMITER and A.F. GAIN controls do not affect the meter reading.

Tuning the receiver to a signal will cause the meter to read, indicating the signal input in S-units or in decibels above the S-9 level.

With no R.F. input to the receiver, or with the antenna disconnected, the S-meter should read 0, plus or minus 1 S-unit. If it does not, the S-meter circuit requires adjustment. See Section 5–5.

Measurement of the signal strength of C.W. signals cannot be made with the beat frequency oscillator in operation.

SECTION 4. SERVICE AND TEST DATA

4–1. *Tube Failures*

Failure of a vacuum tube in the receiver may reduce the sensitivity, produce intermittent operation, or cause the equipment to be completely inoperative. In such cases, all tubes should be checked either in an analyzer or similar tube testing equipment, or by replacement with tubes of proven quality. All tubes should be marked as they are removed from the receiver so that they may be returned to their original sockets thereby reducing the necessity for realignment.

Individual tubes of the same type will vary slightly in their characteristics and it is well to remember this fact when replacements become necessary. Even though the circuit is designed to reduce the effect of such variations to a minimum, the high frequency oscillator and I.F. tubes should be selected with some care. A replacement high frequency oscillator should be checked in the receiver to make sure that the inter-electrode capacities are the same as those of the tube originally employed. This is easily determined by noting any change in dial calibration, particularly in the amateur band-spread ranges.

Substitution of new tubes in the I.F. amplifier may possibly alter overall gain and selectivity characteristics. Instructions for realignment are given in detail in Section 5–2.

One other point should be checked when trying the new high frequency oscillator; a fairly strong steady signal should be tuned in, preferably on some frequency above 10 mc.; the beat frequency oscillator should be turned off; jarring the receiver, or lightly tapping the tube, should not show any evidence of noise in the output.

4–2. *Circuit Failures*

Even though all component parts of the receiver have an ample factor of safety, failure may occur in individual cases. Excluding tubes, the most common failure will probably be due to some defect in a capacitor or resistor. Measurement of voltage in accordance with Section 4-4 will no doubt show where failure has occurred. A by-pass capacitor which has failed may cause overload of associated resistors. These resistors should be checked for any change in resistance. An open capacitor, often the cause of loss of sensitivity or oscillation, may be checked by temporarily connecting a good capacitor across it. Intermittently poor connections can usually be located by lightly tapping each part with a piece of insulating material.

4-3. Stage Gain Measurements

The sensitivity measurements listed below are made with the equipment set up as specified in Section 5-1. The CONTROL SWITCH should be set at MVC, the A.F. GAIN at 10, the SELECTIVITY at OFF and the PHASING at 0. The signal generator should be adjusted to deliver a test signal of 455 plus or minus 2 kc. either modulated or unmodulated. The high output lead should be attached to the grid of the tube specified in the table below and the ground lead connected to the receiver chassis.

With 1 milliwatt output at the phone jack, the test signal should be within the limits specified below.

Terminal	*Test Signal*
First Det. Grid	50 ± 10 Microvolts
First I.F. Grid	250 ± 50 Microvolts
Sec. I.F. Grid	50,000 ± 10,000 Microvolts
Sec. Det. Grid	Over 1 volt

4-4. Voltage Tabulation

All measurements of voltages should be made with the equipment connected for normal operation with AC supply of 115 volt, 50/60 cycle. Except as noted, the R.F. GAIN knob is set at 9, the LIMITER knob set at 0 and the CONTROL SWITCH knob set at MVC. A DC Voltmeter of 1000 ohms per volt sensitivity should be used. The following table must not be considered as a list of the actual operating voltages since loading effects of the measuring instrument will disturb many of the circuits and alter normal voltage distribution. All voltages are measured between specified terminal and chassis.

Tube Terminal	*DC Volts* ±15%
R.F. Amp. Grid	0
R.F. Amp. Cathode	3 A
R.F. Amp. Cathode	25 A*
R.F. Amp. Screen	80 B
R.F. Amp. Plate	230 B
First Det. Grid	0
First Det. Cathode	1 A
First Det. Screen	80 B
First Det. Plate	225 B
H.F. Osc. Grid	C
H.F. Osc. Cathode	0
H.F. Osc. Plate	90 B

Tube Terminal	*DC Volts* ±15%
First I.F. Grid	0
First I.F. Cathode	3 A
First I.F. Cathode	25 A*
First I.F. Screen	80 B
First I.F. Plate	225 B
Sec. I.F. Grid	0
Sec. I.F. Cathode	5 A
Sec. I.F. Cathode	25 A*
Sec. I.F. Screen	95 B
Sec. I.F. Plate	225 B
Sec. Det. Grid	0
Sec. Det. Cathode	8 A
Sec. Det. Plate	225 B
Limiter Grid	−3 A
Limiter Cathode	4.5 A
Limiter Cathode	0 #
Limiter Plate	0
AVC Grid	−25 A†
AVC Cathode	−45 A†
AVC Screen	0 †
AVC Plate	0 †
B.F. Osc. Grid	C
B.F. Osc. Cathode	0 §
B.F. Osc. Screen	10 A§
B.F. Osc. Plate	25 A§
Amp.-Inv. Grids	0
Amp.-Inv. Cathode	4.5 A
Amp.-Inv. Plates	115 B
Audio Grids	−20 A
Audio Cathodes	−40 A
Audio Screens	230 B
Audio Plates	215 B
B+ Common	230 B
B− Common	−50 B

A — 0 to 50 volt meter scale
B — 0 to 250 volt meter scale
C — Accurate measurement cannot be made
* — R.F. GAIN knob set at 0
# — LIMITER knob set at 10
† — CONTROL SWITCH knob set at AVC
§ — CONTROL SWITCH knob set at CWO

The Power Output Tubes used in the NC-200 Radio Receiver may be the metal type 6V6 or the glass type 6V6GT/G. It is necessary, however, to provide glass type 6V6GT/G output tubes with metal shields to avoid oscillation in the audio amplifier. The recommended shield is Goat type G1222K with type G1004 connector.

SECTION 5. ALIGNMENT DATA

5-1. *General*

All circuits are carefully aligned, before shipment, using precision crystal oscillators which insure close conformability to the dial calibration. No readjustment will be required, therefore, unless the receiver is tampered with or damaged.

To determine the necessity for realignment, the receiver should first be carefully checked against its normal performance as described in Section 3. In no case should realignment be attempted unless tests indicate that such realignment is necessary. Even then, it must be remembered that the NC-200 is a communications receiver and should not be serviced or realigned by any individual who does not have a complete understanding of the functioning of the equipment and who has not had previous experience adjusting a similar type of receiver.

The coil group which is plugged into the circuit at any time is the one directly underneath the three gang master tuning capacitor. The coil nearest the front panel of the receiver is in the H.F. oscillator circuit, the middle coil is in the first detector circuit and the coil nearest the antenna input terminal panel is in the R.F. amplifier circuit. See Photo No. 5.

All coils have individual general coverage trimmer capacitors. The H.F. oscillator circuits of broadcast ranges E & F have, also, general coverage variable series padding capacitors. All coils of ranges A, B, C and D have band-spread trimmer capacitors. Variable series padding capacitors are used in all H.F. oscillator band-spread circuits. These capacitors are identified on Photo No. 5.

Adjustment of general coverage circuits affects the alignment of the band-spread circuits. On the other hand, band-spread circuit adjustments have little effect on general coverage circuit alignment. This fact must be kept in mind when any high frequency circuit is adjusted. A screw driver having a metal shaft may be used to make adjustments in the high frequency circuits but capacity effects will be noticeable, and the shaft should not touch any part of the aluminum casting.

Before proceeding with the alignment of any circuit of the receiver, the equipment must be set up as specified in Section 2, except that the antenna lead-in or transmission line must be disconnected. An output meter having a 20,000 ohm resistive load should be connected to the phone output jack. The POWER SUPPLY knob should be set at B+ ON and the R.F. GAIN knob set at 9. The TONE control knob should be set at N and the LIMITER knob should be retarded to 0.

Alignment of the equipment may be divided into three major steps:

(1) I.F. Amplifier Alignment
(2) General Coverage Alignment
  (a) H.F. Oscillator
  (b) First Detector and R.F. Amplifier
  (c) Tracking of H.F. Circuits
(3) Band Spread Alignment
  (a) H.F. Oscillator
  (b) First Detector and R.F. Amplifier
  (c) Tracking of H.F. Circuits

The circuits *MUST* be tuned in the above order when complete alignment is necessary.

5-2. *I.F. Amplifier Alignment*

The intermediate frequency of the NC-200 Receiver is 455 kilocycles, plus or minus 2 kilocycles. The exact frequency is determined by the quartz crystal resonator Y-1.

Tuning capacitors are provided on the crystal filter and on each I.F. transformer. These capacitors are designated by symbol numbers C-39 and C-41 to C-46, inclusive, on Photo Nos. 3 and 4.

The high output lead of an accurately calibrated signal generator should be connected to the grid terminal of the first detector tube and the grounded lead to any convenient point on the chassis. The flexible lead need not be disconnected from the grid of the tube. Connection is made directly from the output jack of the signal generator, the dummy antenna being omitted. The CONTROL SWITCH of the receiver should be in the CWO position and the modulation of the signal generator turned off to provide a steady C.W. test signal. The PHASING control of the receiver should be set at 0 and the SELECTIVITY control at 5. The A.F. GAIN control should be fully advanced.

Adjust the output attenuator of the signal generator to provide a signal of approximately 100 microvolts and vary the tuning control of the signal generator slowly between the frequencies of 453 and 457 kilocycles. At some frequency between these limits the I.F. amplifier of the receiver will show a very sharply peaked response, as indicated on the output meter. The output attenuator of the signal generator should be retarded after the signal generator has been tuned to the I.F. peak in order to avoid I.F. or audio overload; the C.W. OSC. control must be set to provide an audio beat note in the middle of the audio range (between 400 and 1000 cycles).

The I.F. tuning capacitors C-39 and C-43 to C-46,

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inclusive, should each be carefully adjusted to give a maximum reading on the output meter. The order in which the adjustments are made is not important. While making I.F. amplifier adjustments, it will be necessary to retard the attenuator of the signal generator if the readjustment increases I.F. amplifier gain to the point where overload occurs.

The crystal filter SELECTIVITY knob should then be set at 1 and the signal generator detuned between 3 and 4 kilocycles either side of the crystal frequency. Capacitor C-42 should be tuned for maximum output meter reading. After this adjustment is made, the SELECTIVITY knob should be set at OFF and the signal generator retuned to *exact* crystal frequency. Compensator capacitor C-41 should then be adjusted for maximum reading on the output meter.

The performance of the I.F. amplifier and audio circuits may be checked against the stage gain data in Section 4–3 after alignment has been completed. Selectivity may be checked against the curves of Dwg. No. 1.

After alignment of the I.F. amplifier has been completed, the C.W. OSC. control should be set at 0 at which setting the CW. oscillator should be at zero beat with the test signal. If zero beat does not occur at 0, readjust capacitor C-47 of transformer T-4, as shown in Photo No. 3.

The quartz crystal resonator Y-1 may be checked at the conclusion of I.F. amplifier alignment as follows: The SELECTIVITY control should be set at 5 and the signal generator tuned to the crystal frequency. The output meter reading should be noted. When the SELECTIVITY knob is turned to OFF, the meter reading should decrease 1 to 2 db. provided the PHASING knob is at 0. An increase in meter reading can, in most cases, be traced to an improper adjustment in the I.F. amplifier, since the crystal resonator is mounted in a sealed holder, and it is rather unlikely that trouble will be had from that source.

5–3. *General Coverage Alignment*

(a) H.F. Oscillator

Alignment is effected as follows: With the coil range to be aligned connected in the circuit and with the receiver controls set as recommended in Section 5–1, the MAIN TUNING dial should be set near the high frequency end of the range. A signal generator should be connected to the antenna input terminals through a standard IRE dummy antenna and accurately tuned to deliver a signal of the same frequency as that indicated by the receiver dial setting. If, when this signal is tuned in, the dial reading is too high, the capacity of the H.F. oscillator general coverage circuit trimmer C-51 should be decreased to make correction. Conversely, low dial readings are corrected by increasing the capacity of trimmer C-51.

It is imperative that the high frequency oscillator circuits operate at a higher frequency than that of the first detector and R.F. amplifier circuits. This can be checked by tuning in the image signal, which should appear at a dial reading approximately 910 kilocycles below that of the real signal. The image signal should be considerably weaker if the R.F. amplifier is correctly aligned and a stronger test signal may be required before the image can be found. If the image does not appear at the lower frequency dial setting, the H.F. oscillator circuit is incorrectly adjusted and the capacity of the H.F. oscillator trimmer capacitor in question must be decreased until the real signal and image signal appear at the proper points on the dial.

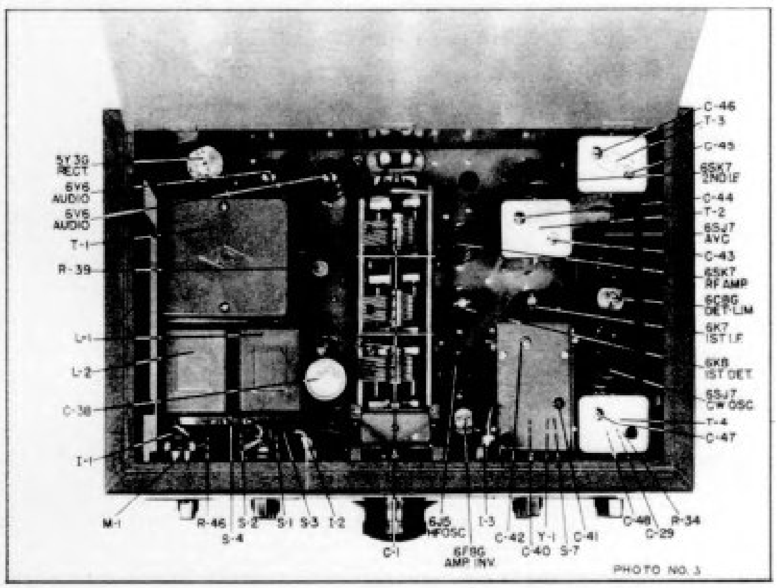


PHOTO NO. 3

(b) First Detector and R.F. Amplifier

With the signal generator adjusted to deliver a modulated signal near the high frequency limit of the range to be checked, the receiver should be tuned to give maximum output, as indicated by the output meter. The first detector and R.F. amplifier trimmer capacitors C-50 and C-49, respectively, should then be varied until the output meter reads maximum. On the highest frequency bands, adjustment of the first detector and R.F. amplifier trimmers may change the calibration of the high frequency oscillator, necessitating retuning of the MAIN TUNING dial. If these trimmers should require considerable realignment, it may be necessary to readjust the high frequency oscillator trimmer C-51 in order to maintain correct calibration.

A very simple and quick method of first detector and R.F. trimmer alignment may be used if a signal generator is not available. This method consists of setting the trimmers at the adjustment which provides maximum circuit or background noise. It will be found that trimmer settings under this method are sufficiently sharp to provide good alignment, although the adjustment must be made with care to avoid alignment to the image frequency.

(c) Tracking of H.F. Circuits

After the H.F. oscillator, first detector and R.F. amplifier trimmers have been properly set at the high frequency limit of the range, the receiver should be tuned to a frequency toward the low frequency end. Tracking at any point up to the low frequency limit may be checked by adjusting the signal generator to the proper frequency and testing the settings of the first detector and R.F. amplifier trimmers for maximum gain. Calibration may be checked also at these points. After such a test, all trimmers checked should be reset at the high frequency end of the band since their settings are most critical at this point.

Errors in tracking near the low frequency limit of the band can be caused by defects in any of three circuit elements.

(1) The tuning capacitor section.

(2) The circuit inductance.

(3) The H.F. oscillator series padding capacitor.

In order to determine if one or more sections of the master tuning capacitor C-1 are the cause of any mistracking present, it is necessary to make the check described above on two or more different bands. If the same tracking error appears on all bands, the master tuning capacitor is definitely at fault. The error should be corrected by permanently bending the rotor or stator plates to provide the proper capacity.

If the tracking error appears only in the R.F. amplifier or first detector stage and on only one band, the inductance of the tuned circuit of the stage is incorrect. Should the tracking checks indicate that the H.F. oscillator circuit of a particular band is at fault, either the inductance of the circuit, the series padding capacitor or both may be responsible.

After any change or readjustment is made to any high frequency circuit inductance or series padding capacity, it will be necessary to realign the associated trimmer at the high frequency limit of the coil range. Tracking should then be rechecked.

5-4. *Band-Spread Alignment*

(a) H.F. Oscillator

The method of adjusting the H.F. oscillator band-spread trimmer C-56 of any range is the same as that described under Section 5-3 (a) above. As stated previously (Section 5-1), the adjustment of the general coverage trimmers must not be altered at this time.

(b) First Detector and R.F. Amplifier

The method of adjusting the band-spread trimmers C-58 and C-57 of the first detector and R.F. Amplifier circuits is the same as that described under Section 5-3 (b).

(c) Tracking of H.F. Circuits

After steps (a) and (b) have been completed, the MAIN TUNING control should be turned to the low frequency band limit, and the accuracy of the dial reading checked. If the dial reading is too low, the capacity of the series padding capacitor C-60 (see Photo No. 5) should be increased until the dial reading is correct, and vice versa. The MAIN TUNING control should then be reset at the high frequency band limit, and step (a) repeated. Recheck the low frequency dial reading and repeat the whole procedure if necessary.

The detector and R.F. amplifier stages have fixed band-spread series padding capacitors. These circuits will, therefore, track properly with the H.F. oscillator stage provided that the general coverage circuits are properly aligned and that the band-spread H.F. oscillator circuits are accurately tuned.

5-5. *S-Meter Adjustment*

The S-meter balancing resistor R-39, shown in Photo No. 3, is used to obtain zero meter reading in the absence of signal input to the receiver. The adjustment is as follows: Set the R.F. GAIN control at 10, CONTROL SWITCH at MVC, and disconnect the antenna leads; adjust R-39 until the S-meter reads zero.

5-6. *Band Indicator Adjustment*

An adjustment for centering the band indicator markers in the horizontal slots of the dial face is located in back of the MAIN TUNING knob. It is recommended that the MAIN TUNING knob be pulled out to engage the band changing mechanism, and turned clockwise to the last position before the stop. The red band marker should then indicate 28 to 30 mc. (10 meter) band-spread. To make the adjustment, simply remove the tuning knob and set the ¼″ hex-head screw as may be required. The screw is self-locking.

SECTION 6. **PARTS LIST**

Symbol	*Function*	*Type*	*Rating*
	CAPACITORS		
C_{1A}	R.F. Amplifier Tuning	Air	225 mmf. max.
C_{1B}	First Detector Tuning	Air	225 mmf. max.
C_{1C}	H.F. Oscillator Tuning	Air	225 mmf. max.
C_{2}	R.F. Grid Filter	Mica	.005 mfd., 300 v. d.c. w.
C_{3}	R.F. Cathode By-pass	Paper	.1 mfd., 400 v. d.c. w.
C_{4}	R.F. Screen By-pass	Paper	.1 mfd., 400 v. d.c. w.
C_{5}	R.F. B+ By-pass	Paper	.1 mfd., 600 v. d.c. w.
C_{6}	First Det. Cathode By-pass	Paper	.1 mfd., 400 v. d.c. w.
C_{7}	First Det. Screen By-pass	Paper	.1 mfd., 400 v. d.c. w.
C_{8}	First Det. B+ By-pass	Paper	.1 mfd., 600 v. d.c. w.
C_{9}	First I.F. Grid Filter	Paper	.01 mfd., 600 v. d.c. w.
C_{10}	First I.F. Cathode By-pass	Paper	.1 mfd., 400 v. d.c. w.
C_{11}	First I.F. B+ By-pass	Paper	.1 mfd., 600 v. d.c. w.
C_{12}	Sec. I.F. Grid Filter	Paper	.01 mfd., 600 v. d.c. w.
C_{13}	Sec. I.F. Cathode By-pass	Paper	.1 mfd., 400 v. d.c. w.
C_{14}	Sec. I.F. Screen By-pass	Paper	.1 mfd., 400 v. d.c. w.
C_{15}	Sec. I.F. B+ By-pass	Paper	.1 mfd., 600 v. d.c. w.
C_{16}	Sec. Det. Plate By-pass	Paper	.01 mfd., 600 v. d.c. w.
C_{17}	Sec. Det. to Limiter Audio Coupling	Paper	1. mfd., 200 v. d.c. w.
C_{18}	Sec. Det. Cathode By-pass	Ceramic	.00025 mfd., 1,000 v. d.c. w.
C_{19}	Sec. Det. I.F. By-pass	Mica	.001 mfd., 500 v. d.c. w.
C_{20}	Limiter Output By-pass	Ceramic	.00025 mfd., 1,000 v. d.c. w.
C_{21}	Tone Control	Paper	.01 mfd., 600 v. d.c. w.
C_{22}	Limiter to Inverter-Audio Coupling	Paper	.01 mfd., 600 v. d.c. w.
C_{23}	Tone Control	Mica	.001 mfd., 500 v. d.c. w.
C_{24}	Inverter-Audio Cathode By-pass	Elec.	10 mfd., 50 v. d.c. w.
C_{25}	Inverter-Audio to Output Coupling	Paper	.1 mfd., 400 v. d.c. w.
C_{26}	Inverter-Audio to Output Coupling	Paper	.1 mfd., 400 v. d.c. w.
C_{27}	Inverter Feedback Coupling	Paper	.1 mfd., 400 v. d.c. w.
C_{28}	H.F. Oscillator Grid	Ceramic	.0001 mfd., 1,000 v. d.c. w.
C_{29}	Beat Oscillator Grid	Mica	.001 mfd., 500 v. d.c. w.
C_{30}	Beat Oscillator Screen By-pass	Paper	.1 mfd., 400 v. d.c. w.
C_{31}	Beat Osc. to Sec. Det. Coupling	Bakelite	1 mmf., 400 v. d.c. w.
C_{32}	AVC Output By-pass	Paper	.1 mfd., 400 v. d.c. w.
C_{33}	AVC Plate By-pass	Paper	.1 mfd., 400 v. d.c. w.
C_{34}	AVC Cathode By-pass	Paper	.1 mfd., 400 v. d.c. w.
C_{35}	B Minus By-pass	Elec.	8 mfd., 200 v. d.c. w.
C_{36}	AVC to Sec. Det. Coupling	Ceramic	.00005 mfd., 1,000 v. d.c. w.
C_{37}	Power Supply Filter	Paper	.1 mfd., 600 v. d.c. w.
C_{38}	Power Supply Filter	Elec.	8 and 8 mfd., 475 v. d.c. w.
C_{39}	Crystal Filter Input Tuning	Air	6 to 85 mmf.
C_{40}	Crystal Filter Phasing Control	Air	5 and 5 mmf.
C_{41}	Crystal Filter Compensating	Ceramic	2 to 6 mmf.
C_{42}	Crystal Filter Output Tuning	Air	6 to 85 mmf.
C_{43}	T-2 Primary Tuning	Air	6 to 85 mmf.
C_{44}	T-2 Secondary Tuning	Air	6 to 85 mmf.
C_{45}	T-3 Primary Tuning	Air	6 to 85 mmf.

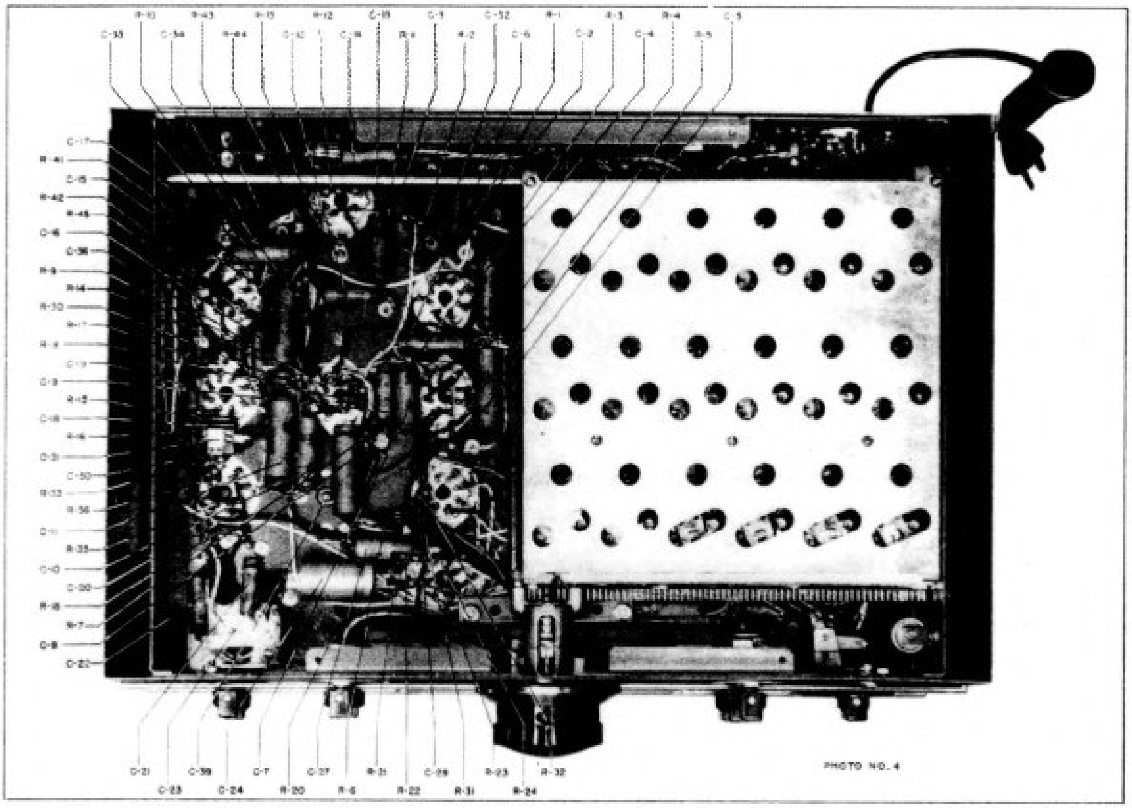


PHOTO NO. 4

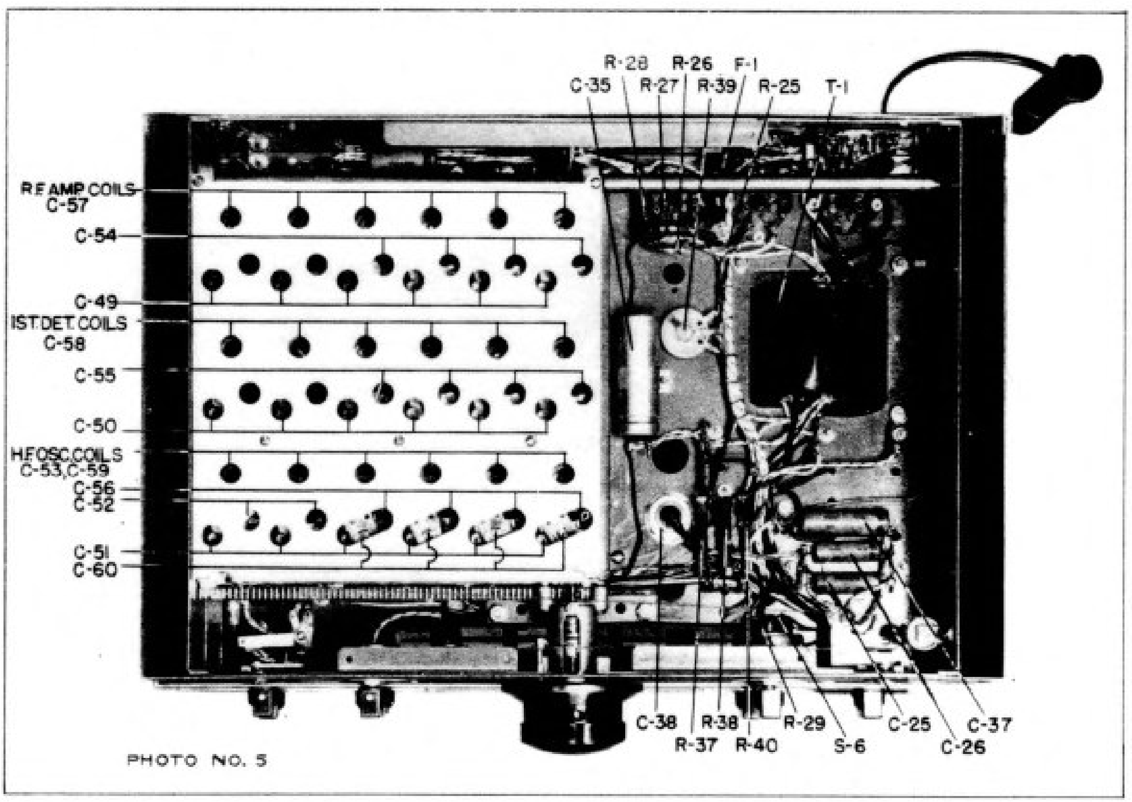


PHOTO NO. 5

The two bottom views above show the NC-200 Receiver with the coil carriage at the extreme ends of its travel. It will be noted that such construction makes all components readily accessible for test or replacement.

SECTION 6. **PARTS LIST (*Continued*)**

Symbol	*Function*	*Type*	*Rating*
	CAPACITORS (*Continued*)		
C_{46}	T-3 Secondary Tuning	Air	6 to 85 mmf.
C_{47}	T-4 Tuning	Air	6 to 85 mmf.
C_{48}	C.W. Osc. Control	Air	1 to 10 mmf.
C_{49}	Gen. Cov. R.F. Amplifier Trimmer	Air	See Note No. 1
C_{50}	Gen. Cov. 1st Det. Trimmer	Air	See Note No. 1
C_{51}	Gen. Cov. H.F. Osc. Trimmer	Air	See Note No. 1
C_{52}	Gen. Cov. H.F. Osc. Padder	Air	See Note No. 1
C_{53}	Gen. Cov. H.F. Osc. Padder	Mica	See Note No. 1
C_{54}	Band-Spread R.F. Amplifier Trimmer	Air	See Note No. 1
C_{55}	Band-Spread 1st Det. Trimmer	Air	See Note No. 1
C_{56}	Band-Spread H.F. Osc. Trimmer	Air	See Note No. 1
C_{57}	Band-Spread R.F. Amp. Padder	Ceramic	See Note No. 1
C_{58}	Band-Spread 1st Det. Padder	Ceramic	See Note No. 1
C_{59}	Band-Spread H.F. Osc. Padder	Ceramic	See Note No. 1
C_{60}	Band-Spread H.F. Osc. Padder	Ceramic	2 to 6 mmf.
	RESISTORS		
R_1	R.F. Grid Filter	Fixed	500,000 Ohm, ½ w.
R_2	R.F. Cathode Bias	Fixed	500 Ohm, ½ w.
R_3	First Det. Cathode Bias	Fixed	250 Ohm, ½ w.
R_4	First Det. Screen Bleeder	Fixed	100,000 Ohm, ½ w.
R_5	First Det. Screen Dropping	Fixed	50,000 Ohm, ½ w.
R_6	First Det. Plate Filter	Fixed	2,000 Ohm, ½ w.
R_7	First I.F. Grid Filter	Fixed	20,000 Ohm, ½ w.
R_8	First I.F. Cathode Bias	Fixed	See Note No, 2, ½ w.
R_9	First I.F. Plate Filter	Fixed	2,000 Ohm, ½ w.
R_{10}	Sec. I.F. Grid Filter	Fixed	500,000 Ohm, ½ w.
R_{11}	Sec. I.F. Cathode Bias	Fixed	See Note No, 2, ½ w.
R_{12}	Sec. I.F. Screen Bleeder	Fixed	100,000 Ohm, ½ w.
R_{13}	Sec. I.F. Screen Dropping	Fixed	70,000 Ohm, ½ w.
R_{14}	Sec. Det. Plate Filter	Fixed	2,000 Ohm, ½ w.
R_{15}	Sec. Det. I.F. Filter	Fixed	5,000 Ohm, ½ w.
R_{16}	Sec. Det. Load	Fixed	25,000 Ohm, ½ w.
R_{17}	Limiter Input	Fixed	50,000 Ohm, ½ w.
R_{18}	Limiter Output	Fixed	50,000 Ohm, ½ w.
R_{19}	Tone Control	Comp. Var.	500,000 Ohm, 1 w.
R_{20}	A.F. Gain Control	Comp. Var.	500,000 Ohm, 1 w.
R_{21}	Inverter-Audio Cathode Bias	Fixed	1,000 Ohm, ½ w.
R_{22}	Inverter Grid	Fixed	500,000 Ohm, ½ w.
R_{23}	First Audio Plate	Fixed	50,000 Ohm, ½ w.
R_{24}	First Audio Plate	Fixed	50,000 Ohm, ½ w.
R_{25}	Output Grid	Fixed	250,000 Ohm, ½ w.
R_{26}	Output Grid	Fixed	250,000 Ohm, ½ w.
R_{27}	Inverter Feedback Coupling	Fixed	250,000 Ohm, ½ w.
R_{28}	Output Cathode Bias	Fixed	200 Ohm, 2 w.
R_{29}	R.F. Gain Control With Switch	W. W. Var.	10,000 Ohm, 1½ w.
R_{30}	R.F. Gain Bleeder	Fixed	50,000 Ohm, ½ w.

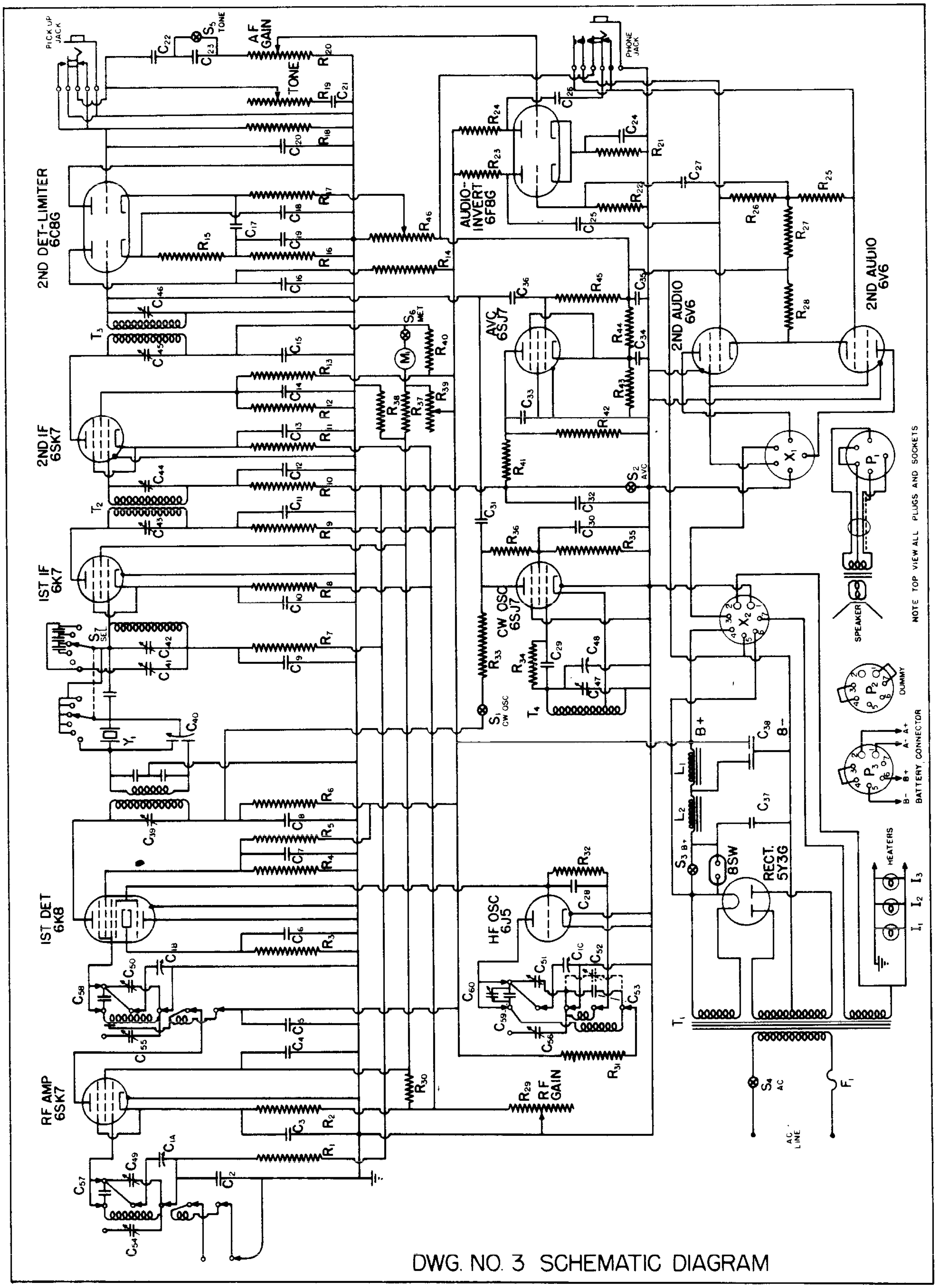
SECTION 6. **PARTS LIST (*Continued*)**

Symbol	Function	Type	Rating
	RESISTORS (*Continued*)		
R_{31}	H.F. Osc. B+ Dropping	Fixed	50,000 Ohm, 1 w.
R_{32}	H.F. Osc. Grid	Fixed	50,000 Ohm, ½ w.
R_{33}	Beat Osc. Plate Filter	Fixed	250,000 Ohm, ½ w.
R_{34}	Beat Osc. Grid	Fixed	50,000 Ohm, ½ w.
R_{35}	Beat Osc. Screen Bleeder	Fixed	100,000 Ohm, ½ w.
R_{36}	Beat Osc. Screen Dropping	Fixed	100,000 Ohm, ½ w.
R_{37}	B+ Voltage Divider	Fixed	20,000 Ohm, 2 w.
R_{38}	B+ Voltage Divider	Fixed	20,000 Ohm, 2 w.
R_{39}	S-Meter Adjustment	W. W. Var.	1,000 Ohm, 1 w.
R_{40}	S-Meter Bridge	Fixed	1,000 Ohm, ½ w.
R_{41}	AVC Plate Filter	Fixed	500,000 Ohm, ½ w.
R_{42}	AVC Plate	Fixed	500,000 Ohm, ½ w.
R_{43}	AVC Voltage Divider	Fixed	1,500 Ohm, 2 w.
R_{44}	AVC Cathode Bias	Fixed	500 Ohm, 2 w.
R_{45}	AVC Grid	Fixed	5,000,000 Ohm, ½ w.
R_{46}	Limiter Control	W. W. Var.	10,000 Ohm, 1½ w.
	MISCELLANEOUS		
F_1	AC Line Fuse	Glass Encl.	2 Amp.
I_1	S-Meter Lamp	No. 40	6 v., .15 a.
I_2	Dial Lamp	No. 47	6 v., .15 a.
I_3	Dial Lamp	No. 47	6 v., .15 a.
L_1	Power Supply Filter Choke	Potted	17 h., 100 ma.
L_2	Power Supply Filter Choke	Potted	17 h., 100 ma.
M_1	Signal Strength Meter	"S" Scale	0 to 1 ma.
P_1	Loud Speaker Connector Plug	Molded	5 Prong
P_2	Dummy Plug for AC Operation	Molded	7 Prong
P_3	Battery Connector Plug	Molded	7 Prong
S_1 S_2	Control Switch	Two Gang	SPST 250 v., 1 a.
S_3 S_4	Power Supply Switch	Two Gang	SPST 250 v., 1 a.
S_5	Tone Control Switch	Part of R-19	SPST
S_6	S-Meter Switch	Part of R-29	SPST
S_7	Selectivity Control Switch	Rotary	2 Section, Ganged
T_1	Power Transformer	150 Watt	115 Volt, 60 Cycle
T_2	I.F. Transformer	Air Tuned	455 kc.
T_3	I.F. Transformer	Air Tuned	455 kc.
T_4	Beat Osc. Transformer	Air Tuned	455 kc.
X_1	Audio Output Socket	Bakelite	5 Prong
X_2	Battery Connector Socket	Bakelite	7 Prong
Y_1	Crystal Resonator	Quartz	455 kc.

Note No. 1. Capacitor rating is different in each coil range and is individually adjusted as circuit conditions may require. Definite rating cannot be listed. C-52 used in E and F ranges only. C-54 to C-60, inclusive, used in A, B, C and D ranges only.

Note No. 2. Resistors R-8 and R-11 may have values between 300 and 5,000 ohms since they are chosen to meet the circuit requirements of the particular receiver. The resistance values are determined after careful laboratory test and cannot be changed without impairing performance.

NOTICE:—Due to the exigencies of the War Program, the manufacturer may have found it necessary to employ substitute, interchangeable parts in certain receivers. Such parts do not impair performance in any way, but should replacement become necessary it is suggested that the type indicated in the Parts List be obtained, if possible.



DWG. NO. 3 SCHEMATIC DIAGRAM