For reception of other type signals, the "T" or "L" antenna used for transmission is satisfactory.

TRAILING WIRE

A trailing wire antenna will not normally be specified for use with this equipment, but may be used if necessary. A length of wire may be used for transmission ranging from about 15 feet at 9.1 MC to 60 feet at 2.1 MC, or the tuning equivalent of these in lengths several times greater. The length is not critical for the receivers.

LOOP

No provision is made for loop reception in any of the receivers of this equipment, but in an emergency, the leads from a loop may be connected to the antenna and ground terminals of the 190-550 KC or 520-1500 KC receiver. The input circuit should be realigned after connection of the loop in order to obtain maximum receiver gain.

FINAL ADJUSTMENTS

The final adjustments to the equipment prior to normal use are: (a) antenna circuit alignment of the receivers; (b) tuning the transmitters. *Before making these adjustments read Chapter III, "Operation", so that the functions of the controls will be well understood.*

ANTENNA CIRCUIT ALIGNMENT OF THE RECEIVERS

(*All receivers must be connected to the antenna or antennas with which they are to be used.*)

(1) Set the "CW-OFF-MCW" power switch controlling the first receiver to "CW".

(2) Set the "A TEL-B TEL" switch of the same control box section to "A TEL".

(3) Connect the headset into any "A TEL" jack.

(4) Set the gain control knob to maximum gain position.

(5) Tune the receiver to the highest frequency.

(6) Align the antenna input circuit for maximum background noise using the "ALIGN INPUT" knob on the front of the receiver.

(7) Switch this receiver "OFF".

(8) Perform a similar operation to each of the other receivers in turn.

(9) It is good practice to repeat the alignment operation on all receivers for optimum results, even though the improvement may seem small.

TUNING THE TRANSMITTERS

There are three controls on the front of each transmitter: (1) the frequency control knob in the lower right corner marked "FREQUENCY". When calibrated, the frequency emitted by a transmitter is within .04% of the frequency indicated by the dial, (2) the antenna tuning inductance control in the upper right section marked "ANT. INDUCTANCE," and (3) the coupling control in the middle left section marked "ANT. COUPLING." All receivers and transmitters should be connected as shown in Fig. 28 or Fig. 30 before the transmitters are tuned.

Transmitters must be tuned with the emission switch of the transmitter control box in the "CW" position, and must not be readjusted in any way after switching to "TONE" or "VOICE". Such retrimming would result in greater antenna current in this position, but the transmitter would then be incapable of being modulated properly.

To tune a transmitter:

(1) Set "FREQUENCY" control dial to the desired transmitting frequency. If the calibration accuracy of this transmitter has not been checked, read step 17 of this chapter before continuing.

(2) Set "ANT. COUPLING" control to about 3 on its scale.

(3) Throw toggle switch on antenna relay unit to "LOCAL".

(4) Set transmitter control box emission switch to "CW".

(5) Set transmitter control box transmitter selector switch to #1 or #2 depending on whether the left or right transmitter is being tuned.

(6) After making sure that neither the microphone button nor the key is closed, set "TRANS. POWER" switch to "ON". The transmitter dynamotor should start.

(7) Allow 15 seconds for tubes to heat up.

(8) Lock the "built-in" key on top of the transmitter control box by screwing it clockwise as far as it will go.

(9) Resonate the antenna circuit by adjusting the "ANT. INDUCTANCE" for maximum antenna current. (Maximum series inductance is in circuit when the contact button behind the transparent window is in the extreme right hand position.) *This adjustment should be made with the "ANT. COUPLING" at a lower setting than that which gives highest antenna current.*

(1.) Vary the "ANT. COUPLING" until maximum "CW" current is indicated on the meter of the antenna relay unit. This setting must be carefully made.

(11) Retrim the "ANT. INDUCTANCE" tuning for maximum "CW" antenna current.

(12) Observe the antenna current on "VOICE" and "TONE". Antenna current

readings will vary widely with the antenna and the choice of frequency. For a short "built-on" fore and aft antenna the reading on "CW" will probably be greater than half scale. On "VOICE" it will be considerably less than for "CW", and for "TONE" will be between the values for "CW" and "VOICE".

(13) The second transmitter should be tuned up following the same routine as for the first. It is then good practice to return to the first transmitter and retrim the "ANT. INDUCTANCE" control on "CW".

(14) Lock the three controls of each transmitter by rotating the "LOCK" knobs one-half turn clockwise to a stop, in which position the engraving "LOCK" on the knob will read right side up.

(15) Leave the toggle switch on the antenna relay unit on "LOCAL". The "REMOTE" position is provided for a remote indication of antenna current in the pilot's or radioman's cockpit. A remote indicating meter is not provided as part of this contract.

(16) If desired, mark the frequency to which each transmitter has been tuned, in soft pencil, in the appropriate blank space on the plate above the "TRANSMITTER SELECTION" switch. Record the transmitter data on the "write-in" plate on the front of each transmitter.

(17) Each transmitter is supplied with a special frequency checking circuit which includes a plug-in quartz-crystal *resonator. This crystal circuit is used for checking the frequency at one point on the dial; it does not control the frequency and it is not necessary for the operation of the equipment.* The frequencies of the crystals supplied with the different transmitters are as follows:

Transmitter	**Crystal Frequency*
2.1-3 MC	2.5 MC
3-4 MC	3.5 MC
4-5.3 MC	4.6 MC
5.3-7 MC	6.2 MC
7-9.1 MC	8.0 MC

*Other crystal frequencies may be specified at a later date for these transmitters, hence it is essential to note the nominal frequency of the crystal before checking the calibration accuracy of the dial of a transmitter.

The Type 1629 tube in each transmitter is used as an indicator of resonance between the crystal and the transmitting frequency. When a transmitter is operated at or near the frequency of the crystal which is in that transmitter, a dark three-cornered shadow appears in the round spot of green light on the screen. This shadow increases in size as the transmitting frequency passes through the frequency of the crystal; operation at exact resonance with the crystal frequency is indicated by a sharp *maximum* in the width of the shadow.

When a transmitter is first placed in service the frequency calibration should be checked by the following steps:

(1) Open hinged cover (at top rear of transmitter) to such an angle that the reflection of the entire resonance indicator screen may be seen.

(2) Tune the transmitter to the LOWEST frequency which will open the shadow on the resonance indicator.

Spurious responses will usually be observed, but they will always be higher than the nominal frequency of the crystal.

The indicator dial frequency should now correspond with that of the crystal. If it does not, set the dial exactly on the nominal frequency of the crystal and trim the master-oscillator capacitor to make it so. This trimmer may be adjusted with a small metal screw driver inserted through the hole in the top of the transmitter. The hole is covered with a metal slide. A clockwise rotation of this trimming control lowers the transmitter frequency. Adjust the "FREQUENCY" control again to make certain that the crystal is resonating at its *lowest* frequency—so that no opening of the resonance indicator is observed for any indicated dial frequency below that corresponding to the value shown on the crystal holder. The calibration accuracy over the remainder of the dial should be better than .04%.

Always recheck the frequency calibration as described above after any tube is replaced in the transmitter; this is particularly important when a new master-oscillator tube is installed.

III. OPERATION

Operation of this equipment involves the use of High Voltages which are dangerous to life. Operating personnel must at all times observe all safety regulations. See safety notice on page 2 of this book.

OPERATION OF THE RECEIVERS

The 1-unit, 2-unit, and 3-unit receiver control boxes are designed for the complete remote control of any one, two, or three of the receivers. Accessories for local control of receivers are not supplied on this contract.

Each receiver control box contains one or more of the following groups of controls: (1) "CW-OFF-MCW" switch, (2) "TUNING" control, (3) "INCREASE OUTPUT" control (gain), (4) "TEL" line selector switch. Each group of controls is used to operate and control one receiver independent of the other receivers and independent of the other groups of controls.

The "CW-OFF-MCW" switch is a combination primary power supply and CW heterodyne oscillator switch. All power is off the receiver in the "OFF" position. In the "CW" position the primary power and the CW heterodyne oscillator are both on for the reception of CW signals. In the "MCW" position the primary power is switched on but the receiver is capable of receiving only amplitude-modulated (MCW) signals. For pilot-operation on VOICE this switch should be left on "MCW" throughout the flight.

Remote "TUNING" is accomplished by a flexible mechanical linkage. Remote tuner dials are directly calibrated in kilocycles (KC) or megacycles (MC) and should be installed so as to indicate precisely the same frequency as the corresponding receiver dial. Operators must be careful not to attempt to tune beyond the stop at the ends of the calibration because of the possibility of damage to the equipment if an unreasonable force is applied.

The "INCREASE OUTPUT" control is a manually adjustable gain control. It must not be left in a retarded position or weak signals may be lost. If left in the maximum gain position, strong signals may appear to be uncomfortably loud in the early part of a flight but not so after the first half hour or so. Some pilots recommend the use of cotton in the ears as an aid to ear-comfort and radio reception particularly on long flights. It is urged that this be tried.

FOR RECEPTION OF AIRWAYS RADIO RANGE SIGNALS THE "INCREASE OUTPUT" CONTROL MUST ALWAYS BE KEPT RETARDED TO A POINT WELL BELOW THE LEVEL OF MAXIMUM AUDIO OUTPUT OR COURSE DISTORTION WILL RESULT.

The "TEL" line selector switch in each control section is a single-pole-double-throw switch by means of which the output from a receiver may be switched to the "A" or the "B" line, or to neither if left in the center position. All receivers may be switched to either or neither line in any desired combination. See functional diagram in Fig. 2.

The "TEL" line selector switch, when left in the center position, acts as a "stand-by" switch for the receiver to which it is connected. By throwing this switch to the center position the output from that receiver is eliminated without the necessity of turning off the power, detuning, or retarding the gain control. The gain control of a receiver may be used to "fade" the output of one receiver with respect to the others as for example, the output from the receiver used for reception of radio range signals may be "faded" down to bare audibility without affecting the output from the remaining receiver or receivers.

RECEPTION OF AIRWAYS SIMULTANEOUS RADIO RANGE—VOICE SIGNALS

Reception of radio range *or* voice signals from the airways simultaneous radio range-voice transmitters may be improved by favoring one or the other while tuning the signal. This operation is not necessary if a special filter for the purpose is installed with the necessary control switch.

OPERATION OF THE TRANSMITTERS

Accessories are provided for the operation of two transmitters as a part of this radio set. One transmitter is preset on one frequency and the other is preset on another frequency. Transmission is possible on either one or the other preset frequencies, but not both at once. The operator has a choice of "TONE", "CW" or "VOICE" types of emission on either of the two frequencies. All transmitter controls are associated with the transmitter control box. Assuming that the equipment has been installed, tested, and tuned according to instructions, the operator need learn only the following directions:

(1) Set the "TRANSMITTER SELECTION" switch to the desired preset transmitting frequency, indicated on the "write-in" plate.

(2) Set the emission switch to "TONE", "CW", or "VOICE" as required.

(3) Set "TRANS. POWER" toggle switch to "ON" and wait 15 seconds before further action. This warms up all the transmitter tubes.

(4) If switch S-50 is on "VOICE", press the "press-to-talk" button on the microphone, and talk clearly and distinctly into the microphone. In the "VOICE" position the transmitting dynamotor will not start until the "press-to-talk" button has been closed. Sidetone should be heard distinctly whenever transmitting.

NOTE: When transmitting "VOICE" with a microphone which does not have a keying switch, the equipment *must be switched between "RECEIVE" and "TRANSMIT" by means of the key on the control box, or a remote switch plugged into the KEY jack.*

(5) The "TRANS. POWER" toggle switch should be left "ON", throughout the flight in order to avoid repetition of the 15 second warming up time.

(6) To transmit on "TONE" or "CW" turn the emission switch to the appropriate position. The transmitter dynamotor will start and continue to run as long as this switch is in either of these positions, but the transmitter will not be "on the air" until either the built-in key or the external key is pressed. Antenna current will be indicated by a reading on the local antenna current indicator on the antenna relay unit if the switch S-54 is on "LOCAL". A side tone of approximately 1000 cycles per second should be heard while transmitting on either "TONE" or "CW".

To reduce battery drain and to increase dynamotor life, the emission selector switch should be left on "VOICE", unless continued use on "TONE" or "CW" is expected.

PRECAUTIONS

VOLTAGES GENERATED IN THIS EQUIPMENT ARE DANGEROUS. READ THE SAFETY NOTICE ON PAGE 2 OF THIS BOOK

INPUT VOLTAGE LIMITS

The equipment should not be operated when the primary source voltage is outside the limits of 22-30 volts. Lower voltages will result in improper functioning of the circuit components such as improper sensitivity of the receivers and improper modulation of the transmitters, or even failure to oscillate on the part of the RF and CW oscillators of the receivers and of the master-oscillator of the transmitter. Higher voltages may cause damage to the tubes or dynamotors, or may cause RF voltage breakdowns within the equipment.

CURRENT DRAIN FROM AUXILIARY OUTLET ADAPTER

The maximum current drain from outlet 74 on the Type CBY-62036 Auxiliary Outlet Adapter must not exceed 0.5 amperes from the L.V. terminal and 15 milliamperes from the H.V. terminal or the dynamotor and RF choke coil will overheat.

ANTENNA TUNING ON "CW" ONLY

Under "preparation for use" it was directed that tuning of the transmitters must be done with the emission selector switch of the transmitter control box on "CW"—that the "ANT. TUNING" must not be retrimmed after switching to "TONE" or "VOICE" even though it results in higher antenna current. This precaution must be observed or considerable distortion on "VOICE" will result.

AVOID SPURIOUS CRYSTAL RESPONSES

In tuning up a transmitter for the first time to check the calibration accuracy against the built-in quartz crystal, the operator must make certain that he is resonating the *lowest* frequency to which the crystal will respond. A spurious resonance will usually be found, but it will be *higher in frequency than the nominal frequency of the crystal.*

AVOID KEYING THE TRANSMITTER ON "VOICE"

Do not key the transmitter with the controls in the "VOICE" position either by using the built-in key, and external key, or the microphone switch. The reason is that in the "VOICE" position, the dynamotor is started and stopped with each such keying. The heavy starting current involved will reduce the life of the dynamotor and the starting relay. In the "CW" and "TONE" positions the dynamotor is constantly running, and the effect of pressing the key is to operate the high voltage relay K-52.

AVOID SWITCHING TRANSMITTERS WHILE TRANSMITTING

Do not switch to transmitter #2 while transmitting on #1, or vice versa, due to the possibility of an arc being formed across the contacts of the selector relay K-54.

AVOID TUNING "ANT. TUNING" BUTTON BEYOND END OF COIL

Do not tune "ANT. TUNING" control (with transmitter power on) so close to either end of L-52 that there is danger of the contactor slipping off the coil and causing an arc.

AVOID SWITCHING S-52 TO POSITION 3 OR 4 WITH S-50 ON "TONE" OR "CW"

Avoid switching the transmitter selector switch S-52 to position 3 or 4 with the emission selector switch S-50 on "TONE" or "VOICE" because the screen voltage will then be nearly 600 volts and may damage the P.A. tubes.

AVOID DYNAMOTOR OVERLOAD

The transmitting dynamotor has a continuous duty, and two intermittent duty ratings (see Table 17). It is essential that no operating requirement be placed on the transmitting equipment which exceeds these ratings. There is no time limit to operation on "CW" as long as it is being keyed for the ordinary transmission of messages. The high-voltage dynamotor current in the "TONE" or "VOICE" positions is ordinarily low enough to be drawn continuously without fear of damage to the equipment.

IRON-CORE COILS

Tuned coils in the RF Coil Set of the receivers contain small iron cores which are used to adjust each of these coils to a precise value of inductance. This is a "laboratory" adjustment and alterations in the setting of any of these should not be attempted without proper equipment and authority. The result may be "mistracking" of the RF circuits. The master-oscillator and power amplifier coils in the transmitters are also adjusted to a predetermined value of inductance at the factory by means of adjustable iron cores. The screw controlling the location of the iron cores in the master-oscillator is located in the dust cover over the master-oscillator coil T-53. The screw controlling the location of the iron core in the power-amplifier coil T-54 is mounted on a bracket attached to the top of the isolantite coil form of T-54. After proper adjustment of the inductance of each of these coils the screws are sealed and the tops painted blue. Subsequent alteration in the setting of these screws will affect the calibration precision and the tracking of the two ganged tuned circuits of the transmitter. *The adjustment should be carried out only under controlled laboratory conditions.*

RF DISTURBANCES FROM WITHIN THE AIRPLANE SHOULD BE REDUCED TO A LOW VALUE

It will be useless to attempt to receive radio signals unless the RF disturbances set up within the airplane due to an imperfectly shielded ignition system, generator system, motors, or other equipment on the airplane, have been reduced to a reasonable level. A rough test of the perfection of these conditions may be performed by the operator with the person in charge of the airplane cooperating. The test follows:

(1) Turn on all receivers with the gain controls at maximum.

(2) Start the airplane engine after noting the back-ground noise level.

(3) Run the engine on both magnetos past the speed at which the electric generator cuts in.

(4) Note the increase in noise level, if any, during these steps.

(5) Start each motor or other electrical device on the airplane in turn, to check its noise contribution.

AVOID STRAINS ON END STOPS

The receivers and transmitters are calibrated directly on the tuning dials with considerable precision. Operators should be careful not to tune beyond the normal end-frequencies in such a manner as to strain the gears or capacitors. End-stops are provided, but if an unreasonable amount of force is applied, damage can be done to the equipment.

TRANSMITTER ANTENNA CIRCUIT FAILS TO TUNE SMOOTHLY

Corrosion may increase the contact resistance between the connector button and the antenna coil. If a transmitter fails to tune smoothly, switch off all power, open the window in front of the antenna coil, and rotate the contactor button while pressing it onto the coil. This will clean the contact. A very light finger application of clock-oil applied to the contacting surfaces will assist in maintaining a good low-resistance contact.

INTERFERING SIGNALS RECEIVED

When a receiver is operating on "CW" at a frequency equal to that of the RF oscillator or CW oscillator of an adjacent receiver, a steady "CW" signal may sometimes be heard. It may be eliminated by slightly detuning the receiver. If the interference is from an RF oscillator it may likewise be eliminated by slightly detuning the offending receiver. The CW oscillator of any receiver operates at the fixed frequency of the IF for that receiver, hence interference caused by it cannot be eliminated by detuning any receiver except the one in which the interference is heard. The table below lists the frequencies of the RF oscillator and of the CW oscillator for each receiver. Separate an offending receiver from a third whenever possible in 3-receiver installations. In 2-receiver installations there is no alternative to detuning.

Receiver	*Frequency of RF Osc.*	*Frequency of CW Osc.*
190-550 KC	275-635 KC	85 KC
520-1500 KC	759-1739 KC	239 KC
1.5-3 MC	2205-3705 KC	705 KC
3-6 MC	4415-7415 KC	1415 KC
6-9.1 MC	8830-11930 KC	2830 KC

EMERGENCY OPERATION

The following suggestions must be considered for use solely under emergency conditions in which communication of some sort must be established in order to complete a mission. Designated units of the equipment are assumed to be defective or destroyed with no replacements available. Most of the following emergency operations require access to the major units and in some cases to the insides of major units, and are therefore not always practicable in flight.

RECEIVING EQUIPMENT

FAULT	EMERGENCY REMEDY
Vacuum tube failure	Replace with corresponding tube from least necessary remaining receiver.
One section of receiver control box defective, due to any part therein.	Remove the plug from the defective section and insert it in place of the plug in the least essential remaining section. If defect includes the tuning mechanism, the mechanical linkage may also be changed, with or without changing the tuning dial.
One or more conductors in a cable destroyed.	In the worst case, in which the cable is completely severed, cut back the outer lacquer covering, braided shield, and rubber covering on both ends by at least 5 inches (assuming there is sufficient slack). Splice like-colored wires and cover with rubber or friction tape, dry paper, or dry cloth. No wire in any of the *receiver* cables is at a potential higher than that of the battery. (In the transmitting equipment the only conductors whose potential is greater than that of the battery are the orange, the inner small white, and the inner small black, of the cable connecting the modulator unit and the transmitter rack, and the inner core green in the cable connecting the modulator unit and the transmitter rack. These wires may be at potentials as great as 600 volts and exceptional care must be used.)
1 dynamotor failure	Replace with dynamotor from least necessary remaining receiver.
AF choke L-15 is open-circuited.	Connect a wire across its terminals and try to receive through the resid ual hum.
Short-circuited by-pass capacitors.	Disconnect and try to receive without the capacitors. In many cases this will be possible.
Defective input stage due to C-1, C-2, C-3, C-4A, L-1, R-1, or C-6C.	Wrap insulated wire around grid lead (top cap) of mixer tube—no direct metallic connection—and connect wire to antenna. The sensitivity may be down by as much as 200 to 1 but reception may still be possible, particularly on "CW".
Fuse blown.	There is one spare fuse under each fuse cover.
To conserve battery.	Turn off all receivers except the one being used.

TRANSMITTING EQUIPMENT

FAULT	EMERGENCY REMEDY
Vacuum tube failure.	Any or all tubes in the modulator unit may fail and the equipment may still be operated on "CW". If the master-oscillator tube becomes defective it may be replaced by one from the second transmitter, or if absolutely necessary, by the tone oscillator tube. The calibration will be thrown off but may be readjusted by operation of the trimmer C-60. If one of the RF power amplifier tubes is defective it may be replaced by the modulator tube and the equipment operated by key on "CW".
Emergency interphone.	Set transmitter control box switch S-50 on "VOICE" and S-52 to position 3 or 4, operate "press-to-talk" button on key, talk. Voice will not be "on the air" but will be heard as sidetone by a listener whose headset is plugged into "A" or "B" jacks. Be sure to return S-52 to correct transmitter position after using this emergency interphone arrangement. S-50 must not be on "TONE" or "CW" because P.A. screen voltage may rise to 600 volts, possibly damaging P.A. tubes.
One or more conductors in a cable destroyed.	See fault 2 under "Receiving Equipment".
Transmitter dynamotor failure due to defective armature.	If the dynamotor output has dropped to 0 nothing can be done, but if there is only a partial breakdown resulting in reduced voltage and excessive ripple noise, operate the equipment by key in the "CW" or "TONE" positions making the best of the reduced power level. The worst that can happen is that the dynamotor will fail completely. In either case the armature will eventually have to be replaced.
AF choke L-51 open-circuited.	Connect a wire across its terminals. Hum level on "VOICE" may be high, but operation while on "TONE" or "CW" will not be adversely affected.
Short-circuited by-pass capacitors.	Disconnect, and attempt operation without them. In many cases this will be possible.
Defective antenna relay unit.	Connect transmitting antenna direct to transmitter and retune antenna circuit of transmitter. Transfer antenna to receiver by hand if a second antenna is not available for connection to the receiver.
Fuse blown.	There is one spare fuse under each fuse cover.
To conserve battery.	If operating on "CW" remove modulator tube (DANGER—top cap is at 600 volts). If only one transmitter is necessary, remove the second from the rack. Keep selector switch S-50 in "VOICE" position when not transmitting in order to stop dynamotor. Set primary power switch S-51 to "OFF" after each transmission if the 15 second warm-up time is practicable.

IV. MAINTENANCE

GENERAL

The equipment should be given a systematic visual inspection at approximately monthly intervals or during "50 hour" inspections on the airplane. This inspection should include at least the following:

(1) Check the condition of all wires, plugs, cables, and antenna and ground leads. Plug-locking rings should be hand-tightened. If the correct position for the sleeve of microphone jack J-65 is grounded, turn the knurled nut back and forth several times to improve the contact of the sleeve to the box.

(2) Check the correspondence of receiver dials with the reading of the receiver control box dials and correct them if necessary. Check the calibration accuracy of the transmitters.

(3) Check all dynamotors for excessive carbon or copper dust. This dust should be blown out. Grease dynamotor bearings about once every 1000 hours of operation—not oftener. Do not overpack bearings, that is, do not use an excessive amount of grease. An amount of grease equal to the volume of a drop of water is sufficient to lubricate these small bearings. Inspect the brushes for excessive wear and replace if less than ¼ inch in length.

(4) Check the operation of the equipment in all control positions. Questionable units should be removed and given an additional inspection according to the routine suggested later in this chapter.

(5) Clean the contact between the wire on the antenna tuning coil and the contact button. This may be done by holding the coil stationary with one hand while pressing and rotating the button with the other. ***Be sure that the power is off.***

OPERATING CHECK ON THE EQUIPMENT BEFORE EACH FLIGHT

An aural check on the operation of each receiver should be made before each flight by listening to signals on "CW" at maximum gain while tuning through the entire band. All receivers except the one being tested should be turned off. If each receiver responds normally, no further test is necessary. If it does not, then LOOK FOR THE SIMPLE CAUSES OF FAILURE FIRST. Check the following: (1) switches are in the proper positions, (2) headsets are connected to the proper jacks, (3) plugs are securely attached, (4) battery voltage is satisfactory, (5) dynamotor is operating properly, (6) tubes are in good condition, (7) antenna is connected and antenna input circuit is properly aligned.

A check on the operation of each transmitter may be made by watching the antenna current indication on the antenna relay unit and by listening to the sidetone. If each transmitter responds normally, no further test is necessary. If it does not, then LOOK FOR THE SIMPLE CAUSES OF FAILURE FIRST. Check that (1) switches are in the proper positions, (2) plugs are securely attached, (3) battery voltage is satisfactory, (4) dynamotor is operating properly, (5) tubes are in good condition, (6) antenna is connected and antenna circuit is properly resonated.

If the above simple tests do not locate the trouble, the unit in which it lies may be discovered quickly by making use of the fact that the equipment is composed of easily removable and replaceable units. The method is merely to insert one good unit after another until the defective one is located. It is then possible to examine that unit in detail.

SERVICING FAULTY RECEIVERS

DISASSEMBLY OF SUCH PARTS AS MAY BE REQUIRED FOR SERVICING FAULTY RECEIVERS.

(1) *Receiver from the rack.*

Disconnect the antenna lead from the receiver antenna binding post, remove safety wires and unscrew the two knurled nuts far enough to allow the lugs to be disengaged from the pointed studs. Slide the receiver out of the rack.

(2) *Cover for bottom of chassis.*

Remove the fourteen bright screws around the bottom edge of the chassis and front panel.

(3) *RF coil set assembly.*

After removing the bottom cover of chassis, as above, remove the two black screws, one at each side of the chassis at approximately the center of the RF coil set assembly, and then lift the coil set assembly out squarely so as not to damage the pin plugs.

(4) *Outer receiver shield.*

First unfasten the four dynamotor snapslides and lift out the dynamotor. Remove the eight bright screws (four rearmost screws along the top edge of the tie strap on each side of the chassis), and slide the outer shield back and off. *This outer shield is NOT fastened by the three foremost black screws along the top edge of the tie strap on each side* *of the chassis, nor by the black screws around the outer edge of the front panel.*

(5) *IF coupling unit assemblies and tubes.*

These components may be removed without taking off the outer receiver shield. Each IF coupling unit assembly is secured by two bright screws at its base. Remove these screws and pull the assembly out squarely so as not to damage the pin plugs.

LOCATION OF FAULTS IN THE RECEIVING EQUIPMENT

One or both of the following methods may be used to locate trouble in a receiver.

Method 1.

After removal of the chassis bottom cover, connect the receiver to Test Set 7918 as shown in Fig. 30. Meters should read as indicated in the table on Fig. 30. Following this, a systematic measurement of the voltages at each of the tube terminals listed in Table 9 will determine which of the dc circuits, if any, is defective. This measurement will also check continuity or shorts in the RF and IF plate circuits. If the trouble is not located at the conclusion of the above tests, use an ohmmeter to check the continuity of all circuits (See Table 11).

Method 2.

A second method of locating faults in a receiver is to measure the microvolts at each of several points required to produce 10 milliwatts (1.73 volts across 300 ohms). Table 6 lists the test points and shows a value of sensitivity in microvolts which may be considered normal for each of these points. By systematically applying the signal generator to the points indicated, the stage in which the fault lies may be quickly determined. Specific instructions follow: *Note the general precautions to observe in the application of Table 6. This table is meant merley as a guide and departures of 2 to 1 from these figures do not necessarily indicate a fault.*

Equipment required: (1) A standard signal generator which covers the tuning range of the receivers which may be modulated 30% at 400 cps, (2) an output meter of the copper oxide rectifier or vacuum tube voltmeter type, (3) a resistor of such value that combined with that of the headset and the voltage measuring instrument across it, the effective load resistance will be close to 300 ohms, (4) a Test Set 7918 consisting of necessary cables, meters, jacks, gain control, and power switch, (5) a crystal frequency standard for accurately determining test frequencies. (The variable portion of the alignment tuning capacitor in this equipment is so small, that unless the signal generator frequency is precise, it may not be possible to find a resonant point within the range of the aligning capacitor.) The receiver may be connected to this equipment for convenient inspection and adjustment in any position. In lieu of this special equipment, a bench test of a receiver may be made by connecting the battery + to terminal 6 (see Fig. 24) and battery – to the chassis. The battery voltage should be close to that indicated in Table 9. The head set, output meter, and load resistor may be connected in parallel to terminal 2 and the chassis.

Order of test. It is not necessary to remove the outer receiver shield for these tests. See Table 6 for intermediate frequency and normal sensitivity values for all receivers.

(1) Connect the ground lead from the signal generator output to the receiver chassis.

(2) Connect the other lead from the signal generator output direct to the antenna binding post. See that the lengths of both leads from the signal generator are no greater than necessary (less than one foot) and that these leads are kept close together (twisted).

(3) Set the signal generator modulation to 30% at 400 cps, set the signal generator microvolts to 200, set the receiver indicated frequency to the lowest calibrated value, switch to MCW position, turn the gain control to maximum, and vary the signal generator frequency through the indicated receiver frequency and far enough on either side to avoid errors in signal generator frequency calibration. Use a headset in the receiver output circuit. If a 400 cycle output is heard, retune the signal generator through this frequency. Keeping the signal generator output microvolts adjusted to produce not more than 10 milliwatts output, tune the signal generator and "align input" knob to produce maximum output. If not more than twice the number of microvolts listed in Table 6 is now required to produce 10 milliwatts output, the receiver sensitivity is not abnormally low, and any serious defect apparent in MCW operation must be found elsewhere. If the MCW sensitivity is satisfactory as indicated above, check the CW position, and consider the CW sensitivity satisfactory if not more than one-half the MCW microvolts is required on CW to produce a maximum beat audio output of 10 milliwatts.

(4) If the receiver sensitivity on MCW is abnormally low, measured at the antenna post, determine whether the fault lies ahead of, within, or following the mixer stage, by checking the sensitivity at the mixer grid (top cap).

(5) Set the signal generator modulation to 30% at 400 cps, and tune its frequency through the indicated receiver frequency as before. If not more than twice the microvolts indicated in Table 6 is required for 10 milliwatts output, the fault lies between the antenna binding post and the output of the RF amplifier stage. If three or four times the number of microvolts indicated in the table is required in this RF test, change the signal generator frequency to the IF for this receiver and vary its frequency and output level progressively to

obtain a maximum output of 10 milliwatts. If the normal number of microvolts is now required, the fault lies in the oscillator circuit of the mixer stage.

(6) Check the mixer tube voltages (see Table 9, page 53), and if these are normal, replace the mixer tube with one known to be satisfactory.

(7) If considerably more than the normal microvolts at IF on the mixer grid is required the fault lies further along the amplifier including, or in, the mixer tube elements not used for oscillation.

(8) Continue with the signal generator sensitivity checks at IF on the control grid of the first IF tube. Wrap a wire around the control grid terminal (fourth terminal clockwise from the locating pin as viewed from the bottom), for connection to the signal generator.

(9) If this check still shows faulty sensitivity, repeat the measurement in a similar manner on the control grid of the second IF tube, checking the terminal voltages of the tubes and circuits involved, in order to locate the position of the fault more exactly. Abnormally low sensitivity at the second IF grid indicates trouble between this point and the audio output circuit. The signal generator is not useful beyond the second IF grid.

Using this method, the source of the trouble may be quickly narrowed down. *It is then possible to use an ohmmeter to check the components between the tube which was found to give correct sensitivity, and the first one toward the antenna which failed to do so.*

(10) After the fault has been removed, recheck the CW operation at IF by returning the signal generator to the mixer grid (top cap) to see if less than half of the MCW microvolts are there required to produce 10 milliwatts beat audio output when in the CW receiver position. The signal generator tuning which here produces maximum MCW output should agree closely with that required to produce zero beat on CW.

An ohmmeter is the only equipment necessary to locate faults in the control boxes, dynamotors, racks, and adapters. See Fig. 24 for schematic wiring diagram of these units.

RECEIVER RF AND IF ALIGNMENT

THIS OPERATION SHOULD NOT BE ATTEMPTED WITHOUT PROPER EQUIPMENT AND AUTHORITY

If the sensitivity of a receiver is found to be low, and the tubes, dynamotor, and circuit elements are normal, it may be necessary to realign (trim) the several stages. The equipment required for this operation is the same as that indicated above for "Location of faults," plus a small screw driver. This screw driver may be made of metal provided that the shank is covered with a thin wall of "spaghetti" or a tough coating of lacquer. The outside diameter of the shank must not exceed ⅛ inch. Insulation is required on the screw driver for alignment of the secondary circuit of the third IF coupling unit in all receivers having two tuned circuits per IF coupling unit. Accidental grounding of any other trimmer rotors in the equipment will do no harm. Grounding the trimmer rotor of the third IF coupling unit secondary short-circuits the diode series resistor R-18 across which audio voltage is developed in the diode detector circuit.

Table 6 shows the sensitivity in microvolts for standard output for all receivers. It also lists the microvolts required at the grid of the RF amplifier, the mixer grid, and the grids of the first and second IF amplifier tubes, required to produce standard output. These values should be used as a guide in determining the condition of the receiver under test. Alignment of these receivers should never be attempted without the use of a good standard signal generator and crystal frequency standard. Never attempt to align any of the several stages on an outside radio signal except in a real emergency and then only on a continuously tone-modulated signal. The alignment operations should be performed in the following order:

(1) Set the signal generator to the IF, modulated 30% at 400 cps. The signal generator setting should be as precise as possible. Use a crystal frequency standard.

The receiver should be operated on "MCW" at maximum gain position of the gain control.

If the receiver is the 190-550KC or the 520-1500 KC unit, the magnetic coupling between the two tuned circuits in each of the coupling unit assemblies should be reduced by raising the protruding bakelite rod (see Fig. 23) until it snaps into its up or loose-coupled position. The following alignment operations should be performed only with all three of the IF coupling units thus set for loose coupling. After alignment of the entire receiver, the coupling rod of only the first and third IF coupling units should be snapped back into its down or over-coupled position. The 1.5-3 MC and the 3-6 MC receivers have three IF coupling units with two tuned circuits per unit, but the coupling between circuits is not adjustable. The 6-9.1 MC receiver has three IF coupling units, but with only one tuned circuit per unit.

(2) Connect the signal generator leads to the control grid of the mixer tube and to the chassis of the receiver, as described under "Location of Faults". Do not remove the grid cap.

(3) Increase the signal generator input to the smallest amount which will produce an easily readable level in the output meter (say 10 milliwatts, which is 1.73 volts across 300 ohms).

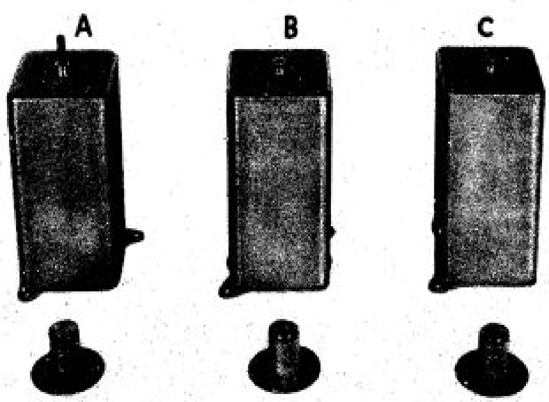


FIG. 23—TYPICAL IF COUPLING UNIT ASSEMBLIES

A. Except for the mounting plate, this is representative of the IF coupling units in the 190-550 KC and 520-1500 KC receivers. Trimmer capacitors reached through holes "1" and "2" tune the input (primary) and output (secondary) tuned circuits respectively. With the bakelite rod actuator in the up position the circuits are undercoupled and in the down position are overcoupled. A strong detent action indicates the two positions which are ¼ inch apart. The actuator in A is shown in the "up" position. The cap shown in front of the coupling unit acts as a dust cover as well as to protect the actuator. For further details see Fig. 37.

B. Except for the mounting plate, this is representative of IF coupling units in the 1.5-3 MC and 3-6 MC receivers. Trimmer capacitors reached through holes "1" and "2" tune the input (primary) and output (secondary) tuned circuits respectively. The coupling between the circuits is not adjustable. For further details see Figs. 37 and 38.

C. Except for the mounting plate, this is representative of IF coupling units in the 6-9.1 MC receiver. These IF coupling units contain one tuned circuit which is trimmed by a capacitor reached through hole "1". For further details see Fig. 38.

(4) There are two holes "1" and "2", in the top of each IF coupling unit shield of the four lowest frequency receivers and one hole "1" in the highest frequency receiver (See Fig. 23), A variable capacitor under "1" tunes the input (plate) tuned circuit and the capacitor under "2" (where present) tunes the output (grid, or diode input tuned circuit). Using a small screw driver, tune the capacitor under "1" and then under "2" in the third IF coupling unit Z-3 for maximum output. Repeat this operation to be assured that it is maximum. In the highest frequency receiver, there is but one circuit to be tuned in each IF coupling unit. The capacitor is reached through the single hole "1".

(5) Similarly, tune the capacitor (or capacitors) in the second IF coupling unit Z-2.

(6) Similarly, tune the capacitor (or capacitors) in the first IF coupling unit Z-1.

(7) Switch to "CW" and tune the CW oscillator trimmer capacitor C-28 for zero beat. Capacitor C-28 may be tuned with a small screw driver through the hole in the right rear side of the chassis.

(8) If further alignment appears necessary, remove the outer receiver shield. It is necessary to remove this to gain access to the RF amplifier trimmer C-4D and to the RF oscillator trimmer capacitors C-4E and C-9. C-4D is reached through the left hole in the gang capacitor shield (as viewed facing the front of the receiver). C-4E may be reached through the next hole to the right and C-9 through the remaining hole.

(9) Next, with the signal generator lead still connected to the mixer grid, and with its output not more than twice the mixer grid sensitivity value listed in Table 6, set the tuning dial of the receiver to the high-end alignment frequency (See Table below) and set the signal generator as accurately as possible to the corresponding frequency.

Next, tune the RF oscillator shunt trimmer capacitor C-4E for maximum output.

(10) Next, connect the signal generator to the antenna post and leaving its frequency and the receiver dial setting unchanged, align the RF amplifier trimmer C-4D, and the antenna input C-2 ("align input") knob. Switch to "CW" and trim C-4E for zero beat.

(11) Next, tune the receiver to the low-end alignment frequency, and the signal generator to the corresponding frequency. Return switch to "MCW". Tune the RF oscillator series trimmer, capacitor C-9 for the maximum output which can be obtained by turning the receiver slowly back and forth between trial settings of trimmer C-9.

PRESELECTOR AND RF OSCILLATOR ALIGNMENT FREQUENCIES.

Receiver	*High-End Alignment Frequency* *Align C-4E C-4D and C-2 At*	*Low-End Alignment Frequency* *Align C-9 At*
190-550 KC	520 KC	210 KC
520-1500 KC	1400 KC	570 KC
1.5-3 MC	2.9 MC	1.55 MC
3-6 MC	5.8 MC	3.1 MC
6-9.1 MC	8.9 MC	6.1 MC

(12) Retune the receiver dial and the signal generator to the high-end alignment frequency, and switch to "CW". Retrim C-4E for zero beat.

(13) The final operation on the 190-500 KC and the 520-1500 KC receivers is to return the first and third IF coupling units to their overcoupled status by pushing down the bakelite rod on these two units only. If the bakelite rods are all

left in the up position, the selectivity near resonance is considerably increased, and the audio fidelity for frequencies even as low as 1500 cycles per second is reduced. See Figs. 37 and 38 for construction details of IF coupling units.

(a) SPECIAL TUNING NOTE.

If two different capacitance settings of C-4E can be found at which the output is a maximum, be sure to use only the setting corresponding to the higher capacitance.

The maximum capacitance position of the rotors of all air trimming capacitors (except auxiliary trimmers C-4F and C-4G under the gang capacitor shield) in the equipment is obtained when the top of the "cross" or "arrow" on the rotor shaft is lined up with the fixed fiducial mark on the dust shield, IF can, or chassis. Turning the rotor 180° in either direction reduces the capacitance to a minimum. When trimming a circuit, always tune in a counter clockwise motion from the maximum capacitance setting. This will always result in a setting of the trimmer such that a clockwise motion increases capacitance. Uniform practice in this operation is desirable.

Auxiliary aligning capacitors C-4F and C-4G are in parallel with aligning capacitors C-4D and C-4E. C4-F and C-4G may be tuned only after removal of the gang capacitor shield. These are adjusted at the factory, either to maximum, half, or minimum capacitance, depending on the receiver and the capacitor, and should not be altered subsequently. The correct settings for each receiver are shown in the following table:

Receiver	*Setting of cross mark on auxiliary gang trimmers, as seen from the front of the receiver. (See Fig. 5)*	
	C-4F	*C-4G*
190-550 KC	Min ▲	Half ►
520-1500 KC	Min ▲	Half ►
1.5-3 MC	Half ►	Half ►
3-6 MC	Half ►	Max ▼
6-9.1 MC	Half ►	Max ▼

Replace all screws holding shields, covers, etc. and securely tighten them. The large number of screws are there for the purpose not only of holding parts together but of reducing undesired electrical interferences created within the receiver.

MAINTENANCE OF RECEIVER DYNAMOTORS

If the receiving equipment is operating satisfactorily with the dynamotor noise at a suitably low level, the dynamotor should rarely be touched. Frequent sanding of commutators, manipulating of brushes, or excessive greasing, is likely to do more harm than good. The dynamotors supplied with this equipment are provided with grease-sealed ball bearings containing sufficient lubricant for 1,000 hours of operation. Hence the routine inspection should consist of a check on the "radio" and "audio" noise attributable to the dynamotor, and a cleaning of carbon or copper dust, which may have accumulated in the vicinity of the commutators.

The check on the "radio" noise may be made by operating the receiver at maximum gain and comparing the noise output with that from a dynamotor known to be satisfactory. After a little experience it will be possible to distinguish dynamotor noise from other types, and a comparison dynamotor will not be necessary. If the equipment is not properly grounded to the metal fuselage, noise will be experienced even when the dynamotor is operating satisfactorily. The check on "audio noise" may be made by operating the receiver at minimum gain. If a loud low pitch tone is heard, it is indicative of commutator or armature trouble. In a normal dynamotor, the ripple will be so low that in the presence of a small amount of external radio noise it can barely be distinguished. If the "audio noise" is loud, make certain that all brushes make good contact with the commutators and that the brushes slide easily in their slots. If the noise still persists, remove the brushes and check each coil winding of the armature for an open or short circuit. This is accomplished by placing the terminals of an ohmmeter on adjacent H. V. commutator bars and continuing the test around the commutator. (Use bridge for L. V. windings.) Ohmmeter prods must not be applied to that section of the commutator which ordinarily comes in contact with the brushes. Each test around the commutator should indicate the same resistance—approximately 25 ohms for the high voltage side and approximately 0.4 ohms for the low voltage side. Any appreciable variation from this indicates an open circuit, a short circuit, or a partial short circuit, in which case the armature must be replaced. The dc resistance of the shunt field winding is 225 ohms.

When it becomes necessary to replace the brushes, make certain that each new brush slides smoothly in its slot, that the pigtail connector inside the spring is secure, and that the brush is the one indicated in the "Parts List by Symbol Designation". Each brush is stamped + or − and the bearing brackets are likewise marked + or − adjacent to the respective brush holders. The brushes should always be inserted in their respective holders with the polarity mark upward in order to insure correct replacement at all times. Low voltage brushes should have a useful life of at least 1,000 hours and high voltage brushes 2,000 hours. The end of the useful life of the brushes comes when they have worn down to ¼ inch. Whenever new brushes are installed, the commutators should be carefully sanded with grade 0000 or finer sandpaper. Machines should be "run-in" on the bench for a period of 6 hours (or until at least 80% of the surface of all brushes is in contact with the commutator) under normal load before replaced in service.

If it becomes necessary to remove the armature or to replace bearings, the following notes may be of assistance: To remove the armature, proceed as follows: Remove the end covers followed by all four brushes, then the tie rods by unscrewing the acorn nuts. The high voltage bracket should then be pulled out of the frame. A bearing puller should be used to remove the bearings from the shaft, as any other method is likely to damage the shaft or commutator. In an emergency, however, two screw drivers inserted between the grease slinger and the iron core of the commutator may be used as wedges to pry the bearings off the shaft. Be sure to straighten the grease slingers, if damaged, and replace them before attaching new bearings. New bearings should never be removed from their cartons until ready for use in order that they be kept free of foreign matter. Be certain that the bearings run smoothly before placing them on the shaft. The shield side of the bearings should be facing the commutator. A light rap with the palm of the hand should be sufficient to drive them onto the bearing shoulders. Reverse the removal procedure in replacing the armature and bearing assembly.

Replacement bearings are furnished lubricated with sufficient grease for several hundred hours of operation and may be operated temporarily without further addition of grease. When available, enough grease should be applied to fill the reserve space before replacing the cover plates. Use only soft grade grease such as Lubriko "M-6" made by Master Lubricants Co., Philadelphia, Pa., or "F-927" made by New York and New Jersey Lubricant Co., New York, N. Y. These are light ball bearing greases of about the consistency of petrolatum.

SERVICING FAULTY TRANSMITTERS

DISASSEMBLY OF SUCH PARTS AS MAY BE REQUIRED FOR SERVICING FAULTY TRANSMITTERS.

(1) *Transmitter from the rack.*

Disconnect the antenna lead from the transmitter antenna binding post and unscrew the two knurled nuts far enough to allow the lugs to be disengaged from the pointed studs. Slide the transmitter out of the rack.

(2) *Cover for bottom of chassis.*

Remove the twelve bright screws around the bottom edge of the chassis and front panel.

(3) *Outer shield.*

Remove the nineteen bright screws around the edge of the shield. Lift the rear end up and slide it backwards and off.

(4) *Shield over the master-oscillator coil T-53 and capacitor C-60.*

The serial number and frequency range of the transmitter should be marked on this with a lead pencil or crayon before it is removed. This is to make certain that it goes back into the same unit because the position of the screw on the left side (with the blue paint) determines the inductance of the master-oscillator coil. The shield may be lifted off after the removal of twelve bright screws.

LOCATION OF FAULTS IN THE TRANSMITTING EQUIPMENT

Defective or questionable units of the transmitting equipment should be checked with the aid of Test Set 7919 shown in Fig. 30. Fig. 30 shows the cabling diagram for use with this test set and also includes a table of voltages and currents which should be obtained with normal equipment. See also Tables 8, 10 and 14. Table 8 lists additional data on typical transmitters. Test Set 7919 indicates input voltage, screen and plate voltages to the RF power amplifiers, plate current to the RF power amplifiers, and master-oscillator plate current. Before testing any of these units make certain that a dynamotor and set of tubes known to be satisfactory are installed. Input voltage should be close to 28. If the screen or plate voltage or amplifier current is abnormal but the oscillator plate current is normal it is an indication of trouble in the RF power amplifier circuits and it will then be possible to concentrate on these circuits with the aid of an ohmmeter and Table 12 in this instruction book. It is important that the test conditions specified in Fig. 30 be followed if the table therein, or Table 8, is to be used as a guide. Test Set 7919 is more useful for tests on the transmitters than on the remaining units of the transmitting equipment, but circuits which are common are automatically checked as for example the high voltage plate supply to the modulation transfomer T-52. If the test set indicates normal plate and screen voltages, the conclusion is that L-51, C-55, K-52, R-63, R-64 and R-65 in the modulator unit are satisfactory.

If the antenna current is correct, on "TONE", "CW", and "VOICE", but the antenna current fails to rise as one talks loudly into the microphone, and there is no "VOICE" sidetone, the trouble has been reduced to the microphone circuit, T-51, C-54B, R-54, R-66, S-53, J-65, or the RS-38 microphone. Ohmmeter tests should then be made on the modulator unit after disconnecting all plugs and removing the dynamotor.

Use schematic circuit diagrams of Fig. 25 in connection with the voltage and resistance tables in locating faults. Occasionally the practical wiring diagrams will assist in tracing leads which are difficult to follow in the actual equipment.

Table 15 shows the value of the "apparent" capacitance of all paper and electrolytic capacitors used in the equipment. The "apparent" capacitance is that which is obtained with a Weston Capacity Meter Type 664, or equal, with all wiring in place. To obtain the true values of these capacitances (in most instances), it is necessary to remove the wiring. ***The values shown in the Table must be considered approximate and should be used only as a guide in the location of faults.*** Note that as in the case of resistance measurements, values shown apply only when that major unit is disconnected from the remainder of the equipment. The dynamotor must be removed from the modulator unit, for example, in order to test C-53 or C-55 and obtain the results in the capacitance table.

CAUTION

WHEN THE OUTER SHIELD A-50 IS REMOVED, PLATE CLIPS ATTACHED TO THE RF AMPLIFIER TUBES ARE EXPOSED. THE VOLTAGE BETWEEN THESE CLIPS AND GROUND MAY REACH 600. EXTREME CAUTION SHOULD BE OBSERVED IN PERFORMING ANY OPERATION INSIDE THE TRANSMITTER. DO NOT ATTACH OR REMOVE TEST SET CABLE WHILE POWER IS ON.

TRANSMITTER ALIGNMENT PROCEDURE

Each transmitter is equipped with a frequency-calibrated tuning dial geared to a single control for tuning both the master-oscillator and the power-amplifier circuits. This means that not only must the values of inductance and capacitance of the master-oscillator circuit be correct to produce the indicated transmitter frequency, but also that the values of inductance and capacitance of the power-amplifier circuit must be correct to "track" with the master-oscillator. The iron-core inductance adjustments are made by means of inductance adjusting screws E-58 and E-59 (Fig. 14). Adjustments of E-58 and E-59 should be made only under controlled laboratory conditions.

The equipment required is a precision frequency supply (such as a quartz crystal oscillator with a multivibrator), and a receiver capable of combining signals from the multivibrator and the transmitter and indicating when the two are equal. A shield with a ½ inch hole in the top directly above the inductance adjusting screw E-59 (Fig. 14) will the facilitate PA iron-core inductance adjustment of the power-amplifier coil.

ADJUSTING THE MASTER-OSCILLATOR

Remove the outer shield and connect the transmitter as shown in Fig. 30. Set the rotor of C-60 to the angle specified in the practical wiring diagram for this transmitter with the vernier adjustment on the side in its mid-position. Set the "FREQUENCY" dial to the highest nominal dial reading, and tune the transmitter on "CW" for maximum power output into Antenna 7777. Switch to "VOICE" without retuning the antenna circuit. Allow the transmitter to warm up for 5 minutes before proceeding. Adjust the trimmer on C-60 for zero beat against the standard frequency corresponding to the transmitter dial setting. If zero beat cannot be obtained by use of the trimmer on C-60, set this midway between the two end-stops and adjust the main rotor of C-60 to produce zero beat. This may be done by loosening the screw at the end of the locking strap attached to the rotor shaft, and adjusting the rotor by means of a screw driver applied to the slot on the end of the main rotor. When this zero beat is obtained lock the rotor by tightening the screw holding the end of the locking strap. Tune the transmitter to approximately zero beat with the standard frequency, corresponding to the lowest dial frequency. (The antenna should be properly tuned and coupled.) Observe the error in dial reading at this lowest frequency. This error must be eliminated by a proper adjustment of both inductance and capacitance. To do this most readily "overshoot" by changing the inductance trimmer E-58 until the dial error, at zero beat with the standard, is about 1½ times as great as it was before, but of the opposite sign (i.e. if the original dial reading was above the calibration line, the new setting for zero beat should be below, and about 1½ times as far away). Next, reset the *dial* accurately to the nominal low frequency and trim C-60 for zero beat.

If the above procedure has been properly followed, no further adjustment should be required. However, it will be well to check the highest frequency point and, if the dial and master-oscillator are not in agreement, repeat the above procedure.

Finally, see that the setting of the capacitance trimmer on C-60 is near the middle of its range. If it is not, set it there and readjust for zero beat at the high-frequency end by variation of the setting of the main rotor. Tighten this lock screw and seal with lacquer. It is desirable to leave the trimmer in the mid-position for greater trimming flexibility after the transmitter leaves the repair section. As a final adjustment, set the dial to the nominal frequency of the crystal in the transmitter and adjust the trimmer on C-60 to maximum shadow angle. Subsequent field checks will always be made using the built-in crystal.

ADJUSTING THE POWER-AMPLIFIER CIRCUIT TO TRACK WITH THE MASTER-OSCILLATOR.

(Outer shield A-50 must be on for this operation)

Remove Antenna 7777 for this part of the test. Tune the transmitter on "CW" to the high frequency end of the dial and adjust C-67 for the minimum amplifier plate current. The rotor of

C-67 can be moved slightly after loosening the locking screw, reached through the larger of the two holes on the right side of the chassis, and moving the locking arm attached to the rotor shaft. A slot in the end of the rotor shaft itself can be reached by a screw driver through the smaller hole, for easier adjustment. Tune the transmitter to the low-frequency end of the dial and note whether or not the amplifier plate current can be reduced by adjusting the iron core by E-59. A special shield A-50 having a ½ inch hole just above E-59 will simplify this operation. If a true minimum cannot be found, the angular setting of the rotor C-67 should be rechecked. If the minimum amplifier current obtained at the low frequency end is within 5 or 6 milliamperes of the lowest obtainable by careful setting of C-67 the tracking is satisfactory. If a minimum can be reached by adjusting the iron core, "overshoot" by about 1½ times as many turns of the adjusting screw as were necessary to obtain minimum plate current, and readjust C-67 for minimum plate current. Return to the high-frequency end and repeat the check.

The order of the adjustments indicated above assumes that the rotor angles of C-60 and C-67 have been made precisely according to the information given on the pertinent practical wiring diagrams.

MAINTENANCE OF TRANSMITTER DYNAMOTORS

If the transmitting equipment is operating satisfactorily, the dynamotor should rarely be touched. Frequent sanding of commutators, manipulation of brushes, or excessive greasing, is likely to do more harm than good. The dynamotors supplied with this equipment are provided with grease-sealed ball bearings containing sufficient lubricant for 3,000 hours of operation. Hence, the routine inspection should consist of a check as to whether or not the brushes are free in their holders, and a cleaning of carbon or copper dust which may have accumulated in the vicinity of the commutators. If the voltage is below normal (see Table 17) remove the brushes and check each coil winding of the armature for an open or short circuit. This is accomplished by placing the prods of an ohmmeter on adjacent H.V. commutator bars and continuing the test around the commutator. (Use bridge to test L. V. windings.) Ohmmeter prods must not be applied to that section of the commutator which normally comes in contact with the brushes. Each test around the commutator should indicate the same resistance—approximately 11.5 ohms for the high voltage side and approximately .04 ohms for the low voltage. Any appreciable variation from this indicates an open or short circuit, in which case the armature must be replaced. The dc resistance of the shunt field winding is approximately 170 ohms.

When it becomes necessary to replace the brushes, make certain that each new brush slides smoothly in its slot, that the pigtail connector inside the spring is secure, and that the brush is the one indicated in the "Parts List by Symbol Designation." Each brush is stamped + or − and the bearing brackets are likewise marked + or − adjacent to the respective brush holder. The brushes should always be inserted in their respective holders with the polarity mark upward in order to insure correct replacement at all times. Low voltage brushes should have a useful life of at least 1,000 hours and high voltage brushes 2,000 hours. The end of the useful life of the brushes comes when they have worn down to ¼ inch. When new brushes are installed, the commutators should be carefully sanded with grade 0000 or finer sandpaper. Machines should be "run in" on the bench for a period of 6 hours (or until at least 80% of the surface of all brushes are in contact with the commutator) under normal load before being replaced in service.

If it becomes necessary to remove the armature, or to replace bearings, the following notes may be of some assistance: To remove the armature, proceed as follows: Remove the end covers followed by all four brushes, then the tie rods by unscrewing the acorn nuts. The high voltage bracket should then be pulled out of the frame. This bracket fits snugly, and if difficulty is encountered in removing it, tap it lightly. Withdraw the armature. A bearing puller should be used to remove the bearings from the shaft, as any other method is likely to damage the shaft or commutator. In an emergency, however, two screw drivers inserted between the grease slinger and the iron core of the commutator may be used as wedges to pry the bearings off the shaft. Be sure to straighten the grease slingers, if damaged, and replace them before attaching new bearings. New bearings should never be removed from their cartons until ready for use, in order that they be kept free of foreign matter. Be certain that the bearings run smoothly before placing them on the shaft. The shielded side of the bearings should be facing the commutator. A slight rap with the palm of the hand should be sufficient to drive them onto the bearing shoulder. Reverse the removal procedure in replacing the armature and bearings assembly.

Replacement bearings are furnished lubricated with sufficient grease for several hundred hours of operation and may be operated temporarily without further addition of grease. The bearing cover plates must be thoroughly cleaned of old grease. When available, enough grease should be applied to fill the reserve space before replacing the cover plates. Use only soft grade grease, such as Lubriko "M-6" made by Master Lubricants Co., Philadelphia, Pa., or "F-927" made by New York and New Jersey Lubricant Co., New York, N. Y. These are light ball bearing greases of about the consistency of petrolatum.

Model ATA and Model ARA Aircraft Radio Equipment

V. SUPPLEMENTARY DATA

TABLE 1

MAJOR UNITS AND ACCESSORIES SUPPLIED ON CONTRACT NOs-74912 AS PART OF MODEL ATA/ARA EQUIPMENT FOR THREE DIFFERENT ASSEMBLIES

(See Figs. 26 and 27 for Dimensions and Weight of Each Unit)

Name of Major Unit or Accessory	Navy Type Designation CBY-	A.R.C. Designation	Quantity per Equipment Assem. 1	Assem. 2	Assem. 3
Aircraft Radio Receiver, 190–550 KC, with tubes	46129	7839	1	1	1
Aircraft Radio Receiver, 520–1500 KC, with tubes	46145	7950	1	0	1
Aircraft Radio Receiver, 1.5–3 MC, with tubes	46104	5005	1	1	1
Aircraft Radio Receiver, 3–6 MC, with tubes	46105	5006	1	1	1
Aircraft Radio Receiver, 6–9.1 MC, with tubes	46106	5007	1	1	1
Aircraft Radio Transmitter, 2.1–3 MC, with tubes	52232	7916	1	1	1
Aircraft Radio Transmitter, 3–4 MC, with tubes	52208	5009	1	1	1
Aircraft Radio Transmitter, 4–5.3 MC, with tubes	52209	5010	1	1	1
Aircraft Radio Transmitter, 5.3–7 MC, with tubes	52210	5011	1	1	1
Aircraft Radio Transmitter, 7–9.1 MC, with tubes	52211	5012	1	1	0
Antenna Relay Unit	29125	5017	1	1	1
Antenna Relay Unit Mounting	29126	7056	1	1	1
Auxiliary Outlet Adapter. (Attached to 520–1500 KC receiver only)	62036	9074	1	0	1
Modulator Unit, with Tubes	50083	5013	1	1	1
Modulator Unit Mounting	50084	7058	1	1	1
Receiver Control Box (2-unit) with 2 of the dials listed below under "Dials, for Receiver Control Box"	23155	6546	1	1	0
Receiver Control Box (3-unit) with 3 of the dials listed below under "Dials, for Receiver Control Box"	23251	5014	0	0	1
Receiver Control Box Mounting (2-unit)	.....	6831	1	1	0
Receiver Control Box Mounting (3-unit)	.....	7054	0	0	1
Receiver Dynamotor Unit. Attached to each receiver. (See Note 1)	21531	7351	5	4	5
Receiver Mounting (2-unit)	46085	5694	1	1	0
Receiver Mounting (3-unit)	46150	7060	0	0	1
Receiver Rack (2-unit)	46110	5018	1	1	0
Receiver Rack (3-unit)	46149	7537	0	0	1
Switch Panel Adapter. Attached to each receiver except 520–1500 KC	49107	6433	4	4	4
Transmitter Control Box	23243	7095	1	1	1
Transmitter Control Box Mounting	.....	7083	1	1	1
Transmitter Dynamotor Unit	21626	5168	1	1	1
Transmitter Mounting (2-unit)	52213	7062	1	1	1
Transmitter Rack (2-unit)	52212	5020	1	1	1

MISCELLANEOUS

Name of Major Unit or Accessory	Navy Type Designation CBY-	A.R.C. Designation	Assem. 1	Assem. 2	Assem. 3
Cable Assembly Components (See Fig. 29), consisting of:					
Plug (Receiver Rack, battery)	.....	6578	1	1	1
Plug (Receiver Rack, Modulator)	.....	6784	2	2	2
Plug (Receiver Rack, Receiver Control Box)	.....	6577	4	4	6
Plug (Modulator, Transmitter Control Box)	.....	6963	2	2	2
Plug (Transmitter Rack, Modulator)	.....	6964	2	2	2
Plug (Modulator, battery)	.....	6965	1	1	1
Plug (Transmitter Rack, Antenna Relay Unit)	.....	6967	2	2	2
Bulk Cable (2 conductor)	.....	6712	20 ft.	20 ft.	20 ft.
Bulk Cable (6 conductor)	.....	6794	20 ft.	20 ft.	20 ft.
Bulk Cable (8 conductor)	.....	6711	20 ft.	20 ft.	30 ft.
Bulk Cable (12 conductor)	.....	6795	10 ft.	10 ft.	10 ft.
Bulk Cable (18 conductor)	.....	6796	10 ft.	10 ft.	10 ft.

(Continued on next page)

TABLE 1—MISCELLANEOUS—Continued

Name of Major Unit or Accessory	*Navy Type Desig-nation CBY-*	*A.R.C. Desig-nation*	*Quantity per Equipment* Assem. 1	Assem. 2	Assem. 3
Nut	.....	7546	2	2	2
Ferrule	.....	6780	2	2	2
Tag	.....	6803	2	2	3
Tag	.....	6941	1	1	1
Tag	.....	6971	1	1	1
Tag	.....	6975	1	1	1
Tag	.....	7539	1	1	1
Tag	.....	7626	1	1	1
Tag	.....	7627	1	1	1
Dials, for Receiver Control Box. Two, or three of the following dials will normally be supplied on the Receiver Control Box (2-unit, or 3-unit):					
190–550 KC (Note 1)	.....	6051	1	1	1
520–1500 KC (Note 1)	.....	6052	1	0	1
1.5–3 MC (Note 1)	.....	7575	1	1	1
3–6 MC (Note 1)	.....	6053	1	1	1
6–9.1 MC (Note 1)	.....	6054	1	1	1
Instruction Books, Final. 1 book is packed with each equipment, remainder go to Naval Aircraft Factory	.....	....	5	5	5
Mechanical Linkage 6151 Components (See Fig. 29), consisting of:					
Casing	.....	3406	20 ft.	20 ft.	30 ft.
Shafting	.....	1174	20 ft.	20 ft.	30 ft.
Nut	.....	1167	4	4	6
Sleeve	.....	6585	4	4	6
Spline	.....	6788	4	4	6
Tag	.....	6789	2	2	3
Operating Spare Parts (Contents, weight and dimensions of box listed below)	.....	....	1 Box	1 Box	1 Box
Receiver Test Set 7918, and Transmitter Test Set 7919 (See Note 2)	.....	....			
Tools, Set Consisting of:					
Tube Extractor	.....	7489	1	1	1
Bristo Wrench #6	.....	8021	1	1	1
Phillips Screw Driver #1A	.....	8020	1	1	1
Knob Assembly, local tuner	.....	6,43	1	1	1

NOTE 1: The quantity of this item per equipment is in all cases equal to the quantity of receiver units per equipment.

NOTE 2: Parts of Receiver Test Set 7918 and Transmitter Test Set 7919 are listed in Fig. 30. These Test Sets may be used for testing, but are not parts of Model ATA/ARA equipment. They are supplied in quantities not equal to the number of complete equipments.

*CONTENTS OF OPERATING SPARE PARTS BOXES

Serial Numbered above 806

Gross weight: 26 pounds

Dimensions: 17¼ in. long, 10½ in. wide, 9¾ in. high

Quantity	*Description*	*Part No.*
Brushes		
5 sets	RECEIVER DYN. BRUSHES, each set consisting of 1 each of	23609-3(+)
		23609-3(−)
		23609-4(+)
		23609-4(−)
1 set	TRANSMITTER DYN. BRUSHES, consisting of 1 each of	23609-6(+)
		23609-6(−)
		23609-9(+)
		23609-9(−)

Quantity	*Description*	*Part No.*
Capacitors, Foil-Paper and Electrolytic		
1	Capacitor, .05 mfd.	7715
1	Capacitor, .05/.01/.05 mfd.	5415
1	Capacitor, .05/.05/.05 mfd.	5414
1	Capacitor, .22/.22/.22 mfd.	5413
1	Capacitor, .5/.5 mfd.	5418
1	Capacitor, 1.2 mfd.	7210
1	Capacitor, 3 mfd.	7582
1	Capacitor, 5 mfd.	6350
1	Capacitor, 15 mfd.	5416
1	Capacitor, 20/5 mfd.	5417

Model ATA and Model ARA Aircraft Radio Equipment

TABLE 1—CONTENTS OF OPERATING SPARE PARTS BOXES—Continued

Quantity	Description	Part No.
Capacitors, Mica and Ceramic		
1	Capacitor, 3 mmf.	7020
1	Capacitor, 8.5 mmf.	9045
1	Capacitor, 11 mmf.	9046
1	Capacitor, .0001 mfd.	4520
1	Capacitor, .00012 mfd.	8013
1	Capacitor, .000180 mfd.	7935
1	Capacitor, .0002 mfd.	4513
1	Capacitor, .001 mfd.	4114
1	Capacitor, .001 mfd.	4157
1	Capacitor, .001 mfd.	4251
1	Capacitor, .002 mfd.	4190
1	Capacitor, .006 mfd.	4091
1	Capacitor, .006 mfd.	8052
1	Capacitor, .01 mfd.	7012
Clips		
4	Clips, large	2313
4	Clips, small	4754
Chokes, AF		
1	Choke, 3H	5634
1	Choke, 1.7H	5650
Chokes, RF		
1	Choke, 15 microhenries	2092
1	Choke, 112 microhenries	5546
1	Choke, 9 turns on 51 ohm res.	7515
Fuses		
10	Fuses, 10 ampere	4414
10	Fuses, 20 ampere	4004
Resistors, Carbon, Fixed		
1	Resistor, 20 ohms	8033
1	Resistor, 51 ohms	8035
1	Resistor, 200 ohms	4497
1	Resistor, 200 ohms	8005
1	Resistor, 390 ohms	6006
1	Resistor, 510 ohms	6005
1	Resistor, 620 ohms	6004
1	Resistor, 1,000 ohms	4136
1	Resistor, 1,500 ohms	4506
1	Resistor, 5,100 ohms	6001
1	Resistor, 10,000 ohms	4491
1	Resistor, 15,000 ohms	4492
1	Resistor, 20,000 ohms	4510
1	Resistor, 30,000 ohms	8006
1	Resistor, 51,000 ohms	4569
1	Resistor, 75,000 ohms	8003
1	Resistor, 91,000 ohms	8001
1	Resistor, 100,000 ohms	4501
1	Resistor, 100,000 ohms	8004
1	Resistor, 150,000 ohms	4571
1	Resistor, 200,000 ohms	4502
1	Resistor, 300,000 ohms	4530
1	Resistor, 300,000 ohms	8002
1	Resistor, 360,000 ohms	8032
1	Resistor, 510,000 ohms	4570
1	Resistor, 1,000,000 ohms	4170
1	Resistor, 2,000,000 ohms	4439
1	Resistor, 2,000,000 ohms	4503
Resistors, Variable		
1	Resistor, 0–50,000 ohms	6488
Resistors, Wire Wound		
1	Resistor, 20 ohms	8044
1	Resistor, 42 ohms	8007
1	Resistor, 126 ohms	7010
1	Resistor, 7,000 ohms	5895
1	Resistor, 10,000 ohms	3238
1	Resistor, 15,000 ohms	5986
1	Resistor, 20,000 ohms	5987
Transformers		
1	Transformer (Receiver Output)	5631
1	Transformer (Tone Osc.)	5635
1	Transformer (Modulation)	5651
1	Transformer (Microphone)	6261
Vacuum Tubes		
15	Type 12SK7 Tubes	
5	Type 12K8 Tubes	
5	Type 12SR7 Tubes	
5	Type 12A6 Tubes	
11	Type 1625 Tubes	
5	Type 1626 Tubes	
5	Type 1629 Tubes	
1	Type 12J5GT Tube	
1	Type VR-150-30 Tube	

*Operating spare part boxes bearing serial numbers 806 or below have the following dimensions and weight: 17 in. long, 9⅛ in. wide, 9⅞ in. high. Gross weight 23.5 pounds. These boxes contain fewer items than listed above as follows: 3 sets of receiver dynamotor brushes instead of 5; no capacitor 8.5 mmf., part No. 9045; no capacitor 11 mmf., part No. 9046: no capacitor .000180 mfd., part No. 7935; and the following reduced numbers of tubes: 9 type 12SK7, 3 type 12K8, 3 type 12SR7, 3 type 12A6, 9 type 1625, 4 type 1626, and 4 type 1629

TABLE 2

INPUT CURRENT

(Connect equipment as shown in Fig. 28)

	Amperes DC from 28 volt primary source
(1) Three receivers and two transmitters with all receivers "on" and one transmitter transmitting on "CW". This is the maximum load for this assembly	14.1
(2) Same as (1) except two receivers instead of three. This is the maximum load for this assembly	12.4
(3) Three receivers, each with its own dynamotor	5.1
(4) Two receivers, each with its own dynamotor	3.4
(5) Two transmitters, one transmitter transmitting on "CW", including modulator unit and transmitter dynamotor	8.8
(6) Stand-by current for transmitting equipment (2 transmitters and modulator unit), "VOICE" or "TONE" position	2.5

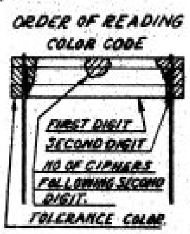
A variation of ±10% in the above values may be expected due to differences in dynamotors, tubes, circuit elements, and measuring equipment. See Table 17 for receiver and transmitter dynamotor ratings.

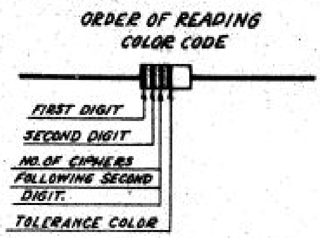
TABLE 3

RESISTOR COLOR CODE

Carbon resistors are color coded by one of two methods to indicate the nominal resistance in ohms and the tolerance from this nominal. The first method is as follows: first digit, by body color, second digit by tip color, and the number of ciphers after the second digit by a dot painted on the body. A gold or a silver colored tip, when used, indicates a tolerance from nominal of ±5% and ±10% respectively. The second method is as follows: four narrow rings are painted around the body starting at one end. The color of the ring at the end represents the first digit, the second ring the second digit, the third ring the number of ciphers after the second digit. The fourth ring indicates the tolerance from nominal, ±5% by gold and ±10% by silver.

0—Black	5—Green
1—Brown	6—Blue
2—Red	7—Violet
3—Orange	8—Gray
4—Yellow	9—White





EXAMPLE: 360,000 ohms ±5%, First method: body orange, tip blue, dot yellow, and a gold colored tip to represent the tolerance. Second method: Orange, blue, yellow and gold rings starting at one end.

NOTE: These resistors increase in resistance with age and with the application of heat. See table below for a classification of the acceptable operating resistance tolerances for the carbon resistors used in this equipment.

TABLE 4

CAPACITOR COLOR CODE

Fixed-capacitance molded mica capacitors, which are too small to be conveniently marked with capacitance values, are color coded by the use of three dots. Colors represent the same numbers as listed above for resistors. Reading from left to right in the direction of the arrow, the micromicrofarads capacitance is indicated by the following: first color, first digit, second color, second digit; third color the number of ciphers after the second digit

EXAMPLE: 200 micromicrofarads (0.00020 mfd.) would have a red dot, a black dot, and a brown dot, reading from left to right.

Fixed capacitors C-10, C-12, C-14, C-17, C-19, C-22, C-23, C-27, C-36, C-37, C-38, C-59 are coded to show their nominal capacitance in micromicrofarads by three dots arranged clockwise looking at the end with the soldering lug. Colors represent the same numbers as listed above for resistors except that the third dot represents the third digit instead of the number of ciphers after the second digit.

EXAMPLE: 180 micromicrofarads (0.00018 mfd.) would have a brown dot followed clockwise by a gray and black dot. Each of these capacitors is subject to a manufacturing tolerance of ±2.5 micromicrofarads, hence a capacitor coded as 180 may have any value between 177.5 and ±182.5 micromicrofarads.

TABLE 5

EQUIPMENT OPERATING RESISTANCE TOLERANCES FOR CARBON RESISTORS

These resistors increase in resistance with time and the application of heat. The equipment will be satisfactorily operable if the resistors are within the following tolerance ranges:

±20% R-1, R-3, R-4, R-6, R-9, R-12, R-15, R-16, R-17, R-21, R-28, R-52, R-53, R-54, R-55, R-57, R-58, R-59, R-60, R-64, R-66, R-67, R-68, R-69, R-70, R-72, R-73, R-74, R-75, R-77.

±30% R-5, R-10, R-11, R-14, R-18, R-51, R-61, R-76, R-78, R-79.

±50% R-2, R-7, R-8, R-13, R-19, R-20.

TABLE 6

SENSITIVITY

Microvolts, modulated 30 per cent at 400 cps. required to produce 10 milliwatts output (1.73 volts into 300 ohms resistive load) is shown for six points in each of the receivers, operating independently. The frequencies at which the measurements must be made are in parenthesis. Input voltage, 28. Sensitivity values are in microvolts.

Receiver	*Ant. RF, at Ant. Bind. Post*	*RF Control Grid RF, at Term. #4*	*Mixer Control Grid RF, at Top Cap*	*Mixer Control Grid IF, at Top Cap*	*First IF Control Grid IF, at Term. #4*	*Second IF Control Grid IF, at Term. #4*
190–550 KC	7 (550 KC)	90 (550 KC)	600 (550 KC)	470 (85 KC)	11,000 (85 KC)	117,000 (85 KC)
520–1500 KC	8 (1500 KC)	120 (1500 KC)	600 (1500 KC)	470 (239 KC)	8,600 (239 KC)	100,000 (239 KC)
1.5–3 MC	6 (3 MC)	130 (3 MC)	650 (3 MC)	660 (705 KC)	6,500 (705 KC)	115,000 (705 KC)
3–6 MC	7 (6 MC)	140 (6 MC)	550 (6 MC)	430 (1415 KC)	3,000 (1415 KC)	110,000 (1415 KC)
6–9.1 MC	8 (9.1 MC)	180 (9.1 MC)	670 (9.1 MC)	550 (2830 KC)	3,000 (2830 KC)	88,000 (2830 KC)

This table of sensitivities is for use as a guide in servicing receivers. It applies to undamaged and perfectly-aligned receivers, under reasonable climatic conditions. Microvolt values shown are to be regarded as "desired", to be obtained if possible when adjusting the equipment after overhaul or long service use. Departures from these values of as much as 2 to 1 do not necessarily indicate defective equipment. Values in this table should be employed with caution and discretion, particularly in the case of measurements carried out under extreme conditions of temperature or humidity. A signal generator whose accuracy is not definitely known and a set of vacuum tubes which are not "average" may contribute to results varying considerably from those shown in the table.

TABLE 7

SELECTIVITY

The SELECTIVITY, expressed in kilocycles, is defined as the displacement of the carrier frequency from the resonant frequency, required to produce 10 milliwatts output, (1.73 volts into 300 ohms resistive load), when the radio frequency voltage input is twice (2X), ten times (10X), one hundred times (100X), and one thousand times (1000X) that required to produce 10 milliwatts output at resonance. The radio frequency voltage input to the receiver must be modulated 30% at 400 cycles for both the resonant and off-resonant measurements. The selectivity values shown below are those resulting from an average of the selectivity measurements made on either side of resonance.

		Selectivity			
Receiver	*Frequency*	*2X*	*10X*	*100X*	*1000X*
190–550 KC	190 KC	1.7	3.1	4.3	5.5
520–1500 KC	520 KC	2.9	4.9	6.7	8.7
1.5–3 MC	1.5 MC	3.9	6.4	9.5	13.1
3–6 MC	3 MC	7.5	12.5	18.6	25.8
6–9.1 MC	6 MC	9.8	24.2	42.2	70.6

The above table of selectivities is presented for use as a guide in servicing receivers. It applies to undamaged and perfectly-aligned receivers, under reasonable climatic conditions. These values are to be regarded as "desired", to be obtained if possible when adjusting the equipment after overhaul or long service use. Departures from these values do not necessarily indicate defective equipment. The values in the table should be employed with caution and discretion, particularly in the case of measurements carried out under extreme conditions of temperature or humidity, or with a signal generator whose accuracy is not definitely known.

TABLE 8

TYPICAL TEST DATA ON TRANSMITTERS

Input Voltage 28.0, Antenna 7777 (5 ohms, 100 mmfd.), Transmitter Tuning and Coupling Should be Adjusted for Maximum Antenna Current on "CW" and *must not be Readjusted for "TONE" or "VOICE" measurements.*

Transmitter	*Frequency (MC)*	*Emission*	*Plate Voltage to RF Power Amp. Tubes*	*Screen Voltage to RF Power Amp. Tubes*	*Plate Current to RF Power Amp. Tubes*	*Plate Current to M.O. Tube*	*Ant. Current Into Ant. A.R.C. 7777*	*Setting of "Ant. Inductance" Control*	*Setting of "Ant. Coupling" Control*
	2.1	CW	520	270	165	17	1.8	11.6	5.1
	2.1	TONE	540	150	95	18	1.2	11.6	5.1
2.1–3 MC	2.1	VOICE	540	150	90	18	1.0	11.6	5.1
	3	CW	515	265	178	15	2.1	6.4	5.1
	3	TONE	535	150	105	15	1.4	6.4	5.1
	3	VOICE	535	150	102	15	1.1	6.4	5.1
	3	CW	518	265	165	19	2.2	12.8	5.8
	3	TONE	535	150	95	20	1.5	12.8	5.8
3–4 MC	3	VOICE	535	150	92	20	1.1	12.8	5.8
	4	CW	515	262	175	17	2.5	8.1	6.2
	4	TONE	530	150	102	18	1.6	8.1	6.2
	4	VOICE	530	150	100	18	1.4	8.1	6.2
	4	CW	530	267	165	20	2.5	11.8	5.2
	4	TONE	547	150	95	21	1.8	11.8	5.2
4–5.3 MC	4	VOICE	547	150	91	21	1.4	11.8	5.2
	5.3	CW	520	262	170	18	2.8	7.5	5.6
	5.3	TONE	545	150	98	19	2.0	7.5	5.6
	5.3	VOICE	545	150	98	19	1.6	7.5	5.6
	5.3	CW	530	275	167	20	2.7	11.9	3.5
	5.3	TONE	552	150	94	21	1.9	11.9	3.5
5.3–7 MC	5.3	VOICE	552	150	91	21	1.5	11.9	3.5
	7	CW	522	270	177	18	3.0	7.2	4.0
	7	TONE	545	150	103	19	2.2	7.2	4.0
	7	VOICE	545	150	100	19	1.8	7.2	4.0
	7	CW	525	273	167	19	2.8	7.5	4.8
	7	TONE	547	150	97	20	2.0	7.5	4.8
7–9.1 MC	7	VOICE	547	150	94	20	1.6	7.5	4.8
	9.1	CW	520	274	179	18	3.1	4.8	5.8
	9.1	TONE	545	150	102	19	2.2	4.8	5.8
	9.1	VOICE	545	150	98	19	1.8	4.8	5.8

Approximate transmitter sidetone voltage across 300 ohms:

TONE and CW: 2.3 volts.

VOICE: 5 volts for loud sustained tone in RS-38 Microphone, or approximately 7 volts at maximum modulation at 1,000 cycles per second (approx. 1.5 volts at microphone jack, and 3 volts at grid of modulator tube).

RS-38 Microphone current: Approximately 36 milliamperes dc.

If the conditions of test shown above this table are followed precisely, variations of ±10% may be observed and may be considered satisfactory for all readings except "Plate Voltage to RF Power Amp. Tubes" which should be within ±5%. If the test conditions have been carefully met, and the voltage and current readings fall outside of these limits, important consideration should be given to the seriousness of the discrepancy or discrepancies before the equipment is considered unsatisfactory.

IT IS RECOMMENDED that one or more sets of specially marked "average" or "standard" tubes be set aside and used in checking all units which are found to be outside the specified limits.

An example of the results of testing a *normal* 7–9.1 MC transmitter under a *different* set of conditions follows. Input voltage 27.6 Frequency 8 MC, antenna resistance 1 ohm, antenna capacitance 108 micromicrofarads. Transmitter tuning and coupling should be adjusted for maximum antenna current on "CW", and not readjusted for "TONE", or "VOICE" measurements. Antenna current in "CW", "TONE" and "VOICE" positions is 4.8, 3.4, and 2.8 amperes respectively. The RF power amplifier plate current is 212, 122, and 118 milliamperes respectively for the three positions. A comparison of these figures with those in the above table will demonstrate the importance of observing standard test conditions, if the values shown in this table are to be used as a guide.

TABLE 9

VACUUM TUBE TERMINAL VOLTAGES IN THE RECEIVERS

Normal dc voltages between each of the tube socket terminals and the chassis. Input voltage 28. Receiver in the "CW", maximum gain condition. Variations of ±10% from the following values may be expected due to differences in tubes, resistors, dynamotors, and measuring equipment. Some terminals are accessible only with a bent voltmeter prod. Reference to the wiring diagrams will indicate more accessible points which connect directly to these terminals. Plate and screen voltages shown in the following table were measured with a voltmeter having a resistance of 600,000 ohms. Voltage at terminal 6 on the 12SR7 tube is 0 in "MCW" position, while all other voltages remain the same on "CW" and "MCW".

*Base Connection	RF 12SK7	Mixer 12K8	First IF 12SK7	Second IF 12SK7	Detector-CW Osc. 12SR7	Audio Amp. 12A6
#1	0	0	0	0	0	0
#2	0	14	14	0	**No Test	28
#3	4	240	4	3.7	0	240
#4	0	85	0	0	0	240
#5	4	**No Test	4	3.7	0	0
#6	85	***30–50	85	85	*50–80	...
#7	14	28	28	14	14	14
#8	240	4	240	240	0	17
Top Cap	...	0	...	...	...	...

* Base connections are numbered clockwise from the locating pin as viewed from the bottom.

** Under oscillating conditions, a small dc voltage exists between these terminals and ground, but the application of voltmeter leads may stop oscillations, resulting in unreliable voltmeter readings.

*** The voltage between these terminals and ground will vary with the frequency range of the receiver.

TABLE 10

VACUUM TUBE SOCKET TERMINAL VOLTAGES IN THE MODULATOR UNIT AND TRANSMITTERS

Normal dc voltages between each of the tube socket terminals and the chassis. Input voltage 28. Variations of ±10% from the following values may be obtained due to differences in tubes, transmitters, dynamotors, and measuring equipment. Transmitter connected to Antenna A.R.C. 7777 and tuned according to instructions on Fig. 30.

	Tone Osc. 12J5-GT			Modulator 1625			Voltage Regulator VR-150-30			RF Amp. #1 1625			RF Amp. #2 1625			Master Osc. 1626			***Resonance Indicator 1629			Crystal		
*Base Connection	Tone	CW	Voice	Tone	CW	Voice	Tone	CW	Voice	Tone	CW	Voice	Tone	CW	Voice	Tone	CW	Voice	Tone	CW	Voice	Tone	CW	Voice
#1			–	28	28	28	–	–	–	28	28	28	14	14	14	–	–	–	0	0	0	0	0	0
#2	14	14	14	–	–	–	0	0	0	–	–	–	545	525	545	14	14	14	28	28	28	–	–	–
#3	115	115	55	124	137	130	–	–	–	150	270	150	150	270	150	193	190	193	50	50	50	0	0	0
#4	–	–	–	0	0	0	–	–	–	**	**	**	**	**	**	193	190	193	128	128	128	–	–	–
#5	**	**	0	0	23	0	150	270	150	545	525	545	150	270	150	**	**	**	0	0	0	–50	–50	–50
#6	–	–	–	10	25	10	–	–	–	0	0	0	0	0	0	–	–	–	193	190	193	–	–	–
#7	0	0	0	14	14	14	–	–	–	14	14	14	0	0	0	0	0	0	14	14	14	0	0	0
#8	0	0	0	–	–	–	–	–	–	–	–	–	–	–	–	0	0	0	****	****	****	0	0	0
Top Cap	–	–	–	520	525	520	–	–	–	545	525	545	545	525	545	–	–	–	–	–	–	–	–	–

* Base connections on all tubes except the 1625 are numbered clockwise from the locating pin as viewed from the bottom. Base connections on the 1625 tubes are numbered clockwise beginning with the more clockwise of the two large pins as viewed from the bottom.

** Under normal operating conditions a dc voltage exists between these control-grid terminals and ground, but the application of dc voltmeter leads alters the circuits to such an extent that voltmeter readings are unreliable. The application of voltmeter leads to either heater terminal 2 or 7 on the 1626 tube may stop oscillations, hence the test should be made quickly so as not to damage the equipment.

*** Plate voltage (terminal 3) measured on 600,000 ohm volt scale of voltmeter. Master oscillator frequency is *not* equal to crystal frequency for these measurements. When the master oscillator frequency *is* equal to the crystal frequency the voltage at terminal 3 is approximately 20 volts.

**** 6.2 volts in transmitters where R-70 is 1500 ohms, and 8 volts in transmitters where R-70 is 1000 ohms

TABLE 11

RESISTANCE TO GROUND FROM RECEIVER SOCKET AND RECEPTACLE TERMINALS

Resistance to ground in ohms from all socket and receptacle terminals in the receivers. Remove the adapter and the dynamotor and disconnect the receiver from the rack.

Terminal	*RF Amp. 12SK7*	*Mixer 12K8*	*1st IF 12SK7*	*2nd IF 12SK7*	*DET-CW Osc. 12SR7*	*Audio 12A6*	*J-1*	*J-2*	*J-3*
1	0	0	0	0	0	0	300,000	0	0
2	0	8	8	0	(A)* 51,000 (B)*100,000 (C)*100,000 (D)*100,000 (E)*100,000	8	0	8	21
3	300,000	14,000	300,000	510	0	15,000	H	14,000	300,000
4	2,100,000	7,000	100,000	100,000	510,000	14,000	21		(A)*320,000 (B)*210,000 (C)*210,000 (D)*110,000 (E)*110,000
5	300,000	52,000	300,000	510	0	2,000,000	(A)*320,000 (B)*210,000 (C)*210,000 (D)*110,000 (E)*110,000	-	7,000
6	7,000	(A)*520,000 (B)*310,000 (C)*210,000 (D)*210,000 (E)*160,000	7,000	7,000	(A)*330,000 (B)*230,000 (C)*230,000 (D)*120,000 (E)*120,000	H	8	–	H
7	8	8	8	8	8	8	H	–	14,000
8	14,000	620	14,000	14,000	0	1,500	**14,000	–	–
Top Cap	–	0	–	–	–	–	–	–	–

* A, B, C, D, E values are for the five receivers in order of increasing frequency range.

** Value of 14,000 ohms applies to all receivers except serial No. 1 to 50, inclusive, of 190-550 KC, 3-6 MC, and 6-9.1 MC. Value for these receivers is "H" (there is no connection to terminal 8 on J-1).

NOTE: "H" signifies "over 2 megohms". The value of 300,000 appears in several places. This is the leakage resistance of C-5. Apply positive lead of ohmmeter to C-5 and negative to ground for consistent results.

TABLE 12

RESISTANCE TO GROUND FROM TRANSMITTER SOCKET AND RECEPTACLE TERMINALS

Resistance to ground in ohms from all socket and receptacle terminals in the transmitters. Remove the transmitter from the rack.

Terminal	*1625 #1 RF Amp.*	*1625 #2 RF Amp.*	*1626 Master Oscillator*	*1629 Res. Ind.*	*Crystal*	*J-64*
1	7	4.7	H	0	0	0
2	H	H	7	7	H	15,000
3	H	H	H	H	*	H
4	15,000	15,000	H	H	H	H
5	H	H	51,000	*	15,000	119
6	51,000	51,000	H	H	H	7
7	4.7	0	0	7	0	H
8	–	–	0	300	0	–
Top Cap	H	H	–	–	–	–

* Same as R-73 for the particular transmitter, viz.: 5,000, 10,000 or 15,000 ohms.

NOTE: "H" signifies "over 2 megohms"

TABLE 13

RESISTANCE TO GROUND FROM MODULATOR UNIT SOCKET AND RECEPTACLE TERMINALS

Resistance to ground in ohms from all socket and receptacle terminals in the modulator unit. Remove the dynamotor and all plugs before testing.

Terminal	*12J5-GT Tone OSC.*	*1625 Mod.*	*VR-150-30 Volt. Reg.*	*J-51*	*J-52*	*J-53*	*J-54*	*J-58*
1	H	17	H	0	H	H	H	H
2	12	H	H	H	H	0	H	H
3	125,000	30,000	H	105,000	0	H	H	220
4	H	700	H		H		H	17
5	100,000	52,000	120,000		200		H	0
6	H	52,000	H		17		H	H
7	0	12	H				0	H
8	23		H				250	H
9							220	H
10							H	90,000
11							H	82,000
12							212	110,000
13							51,000	
14							50	
15							17	
16							H	
17							H	
18							H	
Top Cap		106,000						

NOTE: "H" signifies "over 2 megohms"

TABLE 14

CONTINUITY TESTS

DYNAMOTORS, RELAYS, CHOKES, AND TRANSFORMERS

Terminals	*Approximate Resistance in ohms*
Adjacent segments, L.V. side of receiver dynamotor	0.4
Adjacent segments, H.V. side of receiver dynamotor	25
Shunt field coil of receiver dynamotor	225
Adjacent segments, L.V. side of transmitter dynamotor	.04
Adjacent segments, H.V. side of transmitter dynamotor	11.5
Shunt field coil of transmitter dynamotor	170
Series field coil, L.V. side of transmitter dynamotor	less than .1
K-1, K-2, K-3 in parallel, as measured between terminals 5 and 6 on J-6 or J-7 is 107 ohms	321, each coil
K-50, terminals 12 to 15 on J-54	200
K-51, K-52, in parallel, as measured between terminals 9 and 15 on J-54 is 200 ohms	400 each coil
K-53, K-54, in parallel, as measured between terminals 5 and 6 on J-64 is 112 ohms	300 for K-53 coil 180 for K-54 coils (in series)
K-55, terminals 1 and 4 on J-61	180 for K-55 coils (in series)
L-14, terminal 7 on J-1 to 6 on J-3	less than 0.1
L-15, terminal 3 on J-2 to 7 on J-3	325
L-50, terminal 1 or 3 on J-53 to 2 on J-51 (hold K-50 closed)	less than 0.1
L-51, terminal 3 on J-51 to terminal on C-55	67
RL-50, RL-51, across each unit	less than 1
T-1, primary, terminals 1 to 2 on T-1	1160
T-1, secondary, terminal 3 on T-1 to ground	21
T-50, terminals 1 to 4 on T-50. Same as C-51A to terminal 11 on J-54 with K-51 closed	62
T-50, terminal 6 to ground	5
T-51, terminals 1 to 2 on T-51. Same as C-54B to terminal 8 on J-54	35
T-51, terminals 3 to 4 on T-51. R-55 (15,000 ohms) need not be disconnected for this test	700
T-52, terminals 1 to 2 on T-52	1000
T-52, terminals 3 to 4 on T-52. R-62 (10,000 ohms) need not be disconnected for this test	208
T-52, terminal 6 to ground	16

TABLE 15

CAPACITOR TESTS

Disconnect major unit under test from remaining equipment. The following table gives the normal "apparent" capacitance of each paper or electrolytic capacitor in the equipment. The apparent capacitance will be different from the nominal in those cases where the capacitor is shunted by a resistor or inductor. To obtain the true capacitance it will be necessary to disconnect all leads shunting the capacitor. ***The values shown must be considered only as rough approximations because of production variations in the circuit elements.*** The following data were taken on a Capacity Meter, Weston Type 664, which consists of a 60 cycle voltage in series with a rectifier type current measuring instrument, and the capacitor under test. The meter is calibrated in capacitance.

Capacitor	*Apparent Capacitance (Mfd.)*	*Capacitor*	*Apparent Capacitance (Mfd.)*	*Capacitor*	*Apparent Capacitance (Mfd.)*
C-5	6	C-16B	1	C-53	1.2
C-6A	5	C-16C	greater than 10	C-54A	5
C-6B	6	C-20A	3	C-54B	greater than 10
C-6C	2	C-20B	7	C-55	1.2
C-7A	.6	C-20C	4	C-56A	.5
C-7B	2.5	C-30	greater than 10	C-56B	.5
C-7C	.05	C-32	10	C-57	.05
C-15A	.05	C-51A	.05	C-58A	.05
C-15B	2	C-51B	greater than 10	C-58B	.05
C-15C	.05	C-51C	greater than 10	C-58C	.07
C-16A	.4				

TABLE 16

VACUUM TUBE DATA

VALUES SHOWN ARE "CHARACTERISTIC RATINGS" FOR THE TYPE OF TUBE, AND ARE NOT NECESSARILY THE VALUES AT WHICH THEY ARE OPERATED IN THIS EQUIPMENT

Type	*12SK7*	*12K8*	*12SR7*	*12A6*	*12J5-GT*	*1625*	*1626*	*1629*	*VR-150-30*
Function in this equipment	RF & IF Amp.	Mixer	DET. & CW OSC.	Audio Amp.	Tone Osc.	Mod. and RF Power Amplifier	Master Osc.	Resonance Indicator	Voltage Regulator
Heater voltage	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6	
Heater current	.15	.15	.15	.15	.15	.45	.25	.15	
Control grid voltage	-3	-3	-9	-12.5	-8	-29	-32		
Plate voltage	250	250	250	250	250	600	250	200	
Screen grid voltage	100	100		250		300			
Plate current	9.2	2.5	9.5	30	9.0	42	25		
Screen grid current	2.4	6.0		3.5		Approx. 1			
Transconductance (Micrombos)	2000	3000 (Triode)	1900	3000	2600		2000		
Plate resistance	.8 megohm	.6 megohm (hexode)	8500	70,000	7700		2500		
Amplification factor	1600	Conversion conductance 350 micromhos	16	210 2.8 watts power output into 7500 ohms, 7% total harmonic distortion	20	8 (G-Gs) 25 watts on plate and 3.5 watts on screen grid max. allowable dissipation.	5	.19 ma with target-to-plate resistor of 1 megohm. 3 ma to target. Shadow angle 90° for grid bias of 0 volts and 0° for grid bias of -6.5 volts.	Starting voltage 180 max. dc. volts, operating 150 dc volts (approximately). Operating current 5 min. dc. ma and 30 max. dc ma.
*Base connections #1	Shell (S)	Shell (S)	Shell (S)	Shell (S)		Heater (H)			
#2	Heater (H)	Heater (H)	Control grid (G)	Heater (H)	Heater (H)		Heater (H)	Heater (H)	Cold cathode (K)
#3	Suppressor (Su)	Plate (hexode) (P)	Cathode (K)	Plate (P)	Plate (P)	Screen grid (Gs)	Plate (P)	Plate (P)	Jumper to 7
#4	Control grid (G)	Screen grid (hexode) (Gs)	Diode plate (2) (Dp2)	Screen grid (Gs)		Control grid (G)		Target (TA)	
#5	Cathode (K)	Control grid (osc) and grid #1 hexode (Go)	Diode plate (1) (Dp1)	Control grid (G)	Control grid (G)		Control grid (G)	Control grid (G)	Anode (AN)
#6	Screen grid (Gs)	Plate (osc) (Po)	Plate (triode) (P)			Cathode (K)			
#7	Heater (H)	Heater (H)	Heater (H)	Heater (H)	Heater (H)	Heater (H)	Heater (H)	Heater (H)	Jumper to 3
#8	Plate (P)	Cathode (K)	Heater (H)	Cathode (K)	Cathode (K)		Cathode (K)	Cathode (K)	
Top Cap		Control grid (hexode) (G)				Plate (P)			
**R.M.A. Type	12SK7	12K8	12SR7	12A6	12J5-GT	1625	1626	1629	VR-150-30
Signal Corps Type	VT-131	VT-132	VT-133	VT-134	VT-135	VT-136	VT-137	VT-138	VT-139
**Bulb	Metal shell MT-8	Metal shell MT-8	Metal shell MT-8	Metal shell MT-8	T-9	ST-16	ST-12	T-9	ST-12
**Cap		Miniature				Small metal			
**Base	Small wafer Octal 8-pin	Small wafer Octal 8-pin	Small wafer Octal 8-pin	Small wafer Octal 8-pin	Intermediate shell Octal 6-pin	Medium 7-pin	Small shell Octal 8-pin	Small shell Octal 7-pin	Small shell Octal 6-pin

* Base connections are numbered clockwise from the locating pin as viewed from the bottom, *except for type 1625.* This tube has a "medium 7-pin base" on which the numbering proceeds clockwise from the embossed arrow (clockwise from the more clockwise of the two large pins as seen from the bottom).

** Radio Manufacturer's Association standard designation.

NOTE.—Keys on the tube bases vary somewhat in size, with the result that occasionally a tube may be found which can be jammed part way down into the socket with incorrect pin orientation. Line up the key on the tube base with the keyway of the socket visually or by feel, before exerting any considerable pressure on the tube.

TABLE 17

DYNAMOTOR RATINGS

(Ratings are based on 60° C temperature rise by change-of-resistance method)

Dynamotor Unit	*Duty*	*Input (dc)*		*Output (dc)*	
		Amperes	*Volts*	*Milliamperes*	*Volts*
Type CBY-21531	Continuous	1.1	28	60	250
Type CBY-21626	Continuous	3.7	28	100	590
	1 Hour	5.0	28	160	565
	Intermittent (½ minute on and ½ minute off)	7.0	28	250	540

TABLE 18

PLUGS AND BULK CABLE REQUIRED TO ASSEMBLE CABLES FOR USE WITH MODEL ATA/ARA EQUIPMENT

(See Figure 28 for Cabling Diagram, and Figure 29 for Drawings of Cable Assemblies)

Cable	*For Details of Assembly and Wiring See Fig. 29, Dwg. No.*	*A.R.C. Part No. of Plugs, Etc.*	**A.R.C. Part No. of Bulk Cable*
Modulator Unit to Transmitter Rack (1 REQ.)	5804	6964 (2 req. per cable)	6795 (12 conductors)
Modulator Unit to Receiver Rack (1 REQ.)	5808	6784 (2 req. per cable)	6794 (6 conductors)
Transmitter Rack to Antenna Relay Unit (1 REQ.)	5810	6967 (2 req. per cable)	6794 (6 conductors)
Receiver Rack to Receiver Control Box (1 REQ. FOR EACH RECEIVER INSTALLED)	6693	6577 (2 req. per cable)	6711 (8 conductors)
Modulator Unit to Transmitter Control Box (1 REQ.)	7538	6963 (2 req. per cable)	6796 (18 conductors)
Primary power supply to Receiver Rack	7547	6578 (plug) 7546 (nut) 6780 (ferrule) (1 each req. per cable)	6712 (2 conductors)
Primary power supply to Modulator Unit	7548	6965 (plug) 7546 (nut) 6780 (ferrule) (1 each req. per cable)	6712 (2 conductors)

* All bulk cables listed are shielded and lacquer-covered. These drawings give complete specifications.
One mechanical linkage assembly 6151 is required for remote tuning of each receiver. For assembly details see drawing 6151, part of Figure 29.

Model ATA and Model ARA Aircraft Radio Equipment

TABLE 19

PARTS LIST BY SYMBOL DESIGNATION

Parts of Type CBY-46129 (190-550 KC), CBY-46145 (520-1500 KC), CBY-46104 (1.5-3 MC), CBY-46105 (3-6 MC), CBY-46106 (6-9.1 MC) Aircraft Radio Receivers

Parts shown below are the same for all receivers unless specifically indicated to the contrary

Symbol	*Function*	*Description*	*Navy Type*	*Mfr.*	*Mfr's. Desig.*	*Dwg. and Part No.*
A-3		Shield over coupling receptacle J-1		A		5691
A-4		Shield, over gang capacitor		A		5738
A-6		Cover, over tube compartment		A		6266
A-7		Shield, over tubes, IF units, etc.		A		6276
A-11		Shock absorber assembly (for dynamotor)		A		4681
A-12		Mounting plate, 1st IF		A		4638
A-13		Mounting plate, 2nd IF		A		5220
A-14		Mounting plate, 3rd IF, same as A-12				
A-18		Cover (under side of chassis)		A		5508
C-1	Ant. Series	Capacitor, fixed, 500 volts, ceramic				
		For 190-550 KC receiver, 11 mmf., ±½ mmf.		C	807	9046
		For 520-1500 KC receiver, 11 mmf., ±½ mmf.		C	807	9046
		For 1.5-3 MC receiver, 11 mmf., ±½ mmf.		C	807	9046
		For 3-6 MC receiver, 11 mmf., ±½ mmf.		C	807	9046
		For 6-9.1 MC receiver, 8.5 mmf., ±½ mmf.		C	807	9045
C-2	Input Alignment	Capacitor, variable, air ΔC approximately 15 mmf.		A		5676
C-3	RF amp. grid blocking	Capacitor, 0.0001 mfd., ±5%, 400 volts, mica	48674-5	CD	5	4520
C-4 (A to G)	Gang tuning	Gang capacitor assembly with tuning and aligning sections C-4A to C-4G				
		For 190-550 KC receiver		A		3936
		For 520-1500 KC receiver		A		3936
		For 1.5-3 MC receiver		A		4601
		For 3-6 MC receiver		A		4601
		For 6-9.1 MC receiver		A		6558
C-5	Gain control line filter	Capacitor, 3 mfd., 300 volts, dry electrolytic polarized. Impedance at 60 cycles not greater than 1750 ohms. Capacitance at 20°C may be 4 to 12 mfd.		A		7582
C-6 (A,B,C)	See below	Capacitor, 0.05/0.05/0.05 mfd., ±15%, 300 volts, paper		A		5414
C-6A	Mixer plate by-pass	Part of C-6				
C-6B	Gain control line by-pass	Part of C-6				
C-6C	First RF cathode by-pass	Part of C-6				
C-7 (A,B,C)	See below	Capacitor, 0.05/0.05/0.05 mfd., same as C-6				
C-7A	Mixer screen by-pass	Part of C-7				
C-7B	Mixer cathode by-pass	Part of C-7				
C-7C	AGC line by-pass	Part of C-7				
C-8	RF osc. grid blocking	Capacitor, 0.0002 mfd., ±5%, 400 volts, mica	48675-5	CD	5	4513
C-9	RF osc. series trimmer	Capacitor, variable air, ΔC approximately 40 mmf.		A		3865

TABLE 19—PARTS LIST BY SYMBOL DESIGNATION—Continued

Parts of Type CBY-46129 (190-550 KC), CBY-46145 (520-1500 KC), CBY-46104 (1.5-3 MC), CBY-46105 (3-6 MC), CBY-46106 (6-9.1 MC) Aircraft Radio Receivers—Continued

Symbol	*Function*	*Description*	*Navy Type*	*Mfr.*	*Mfr's. Desig.*	*Dwg. and Part No.*
C-10	RF osc. fixed series	Capacitor, fixed, 400 volts, mica. See color code in Table 4.				
		The nominal capacitances as listed below are each subject to a manufacturing tolerance of ±2.5 mmf.				
		For 190-550 KC receiver 690 mmf., ±5 mmf., in two units. These two units may be 340 mmf., 345 mmf., or 350 mmf., provided the sum is equal to 690 mmf., ±5 mmf.		ER		7935
		For 520-1500 KC receiver 670 mmf., ±5 mmf., in two units. These two units may be 330 mmf., 335 mmf., or 340 mmf., provided the sum is equal to 670 mmf., ±5 mmf.		ER		7935
		For 1.5-3 MC receiver, 360 mmf., 365 mmf., or 370 mmf.		ER		7935
		For 3-6 MC receiver, 360 mmf., 365 mmf., or 370 mmf.		ER		7935
		For 6-9.1 MC receiver, 235 mmf., 240 mmf., or 245 mmf.		ER		7935
C-11	RF osc. tube drift compensator	Capacitor, compensator, 3 mmf., ±1/4 mmf., with temperature coefficient of −0.00075 mmf., per mmf., per degree Centigrade, ±15%		C	807	7020
C-12	Fixed capacitance part of 1st IF tuning	Capacitor, 180 mmf., ±2.5 mmf., 400 volts, mica, part of assembly Z-1		ER		7935
C-13	1st IF trimmer	Capacitor, variable, air ΔC approximately 17 mmf., part of assembly Z-1				
C-14	Fixed capacitance in 1st IF coupling unit	Capacitor, see below, 400 volts, mica, part of assembly Z-1. See color code in Table 4. The nominal capacitances listed below are each subject to a manufacturing tolerance of ±2.5 mmf.				
		For 190-550 KC receiver, 180 mmf.		ER		7935
		For 520-1500 KC receiver, 180 mmf.		ER		7935
		For 1.5-3 MC receiver, 180 mmf.		ER		7935
		For 3-6 MC receiver, 180 mmf.		ER		7935
		For 6-9.1 MC receiver, 175, 180 or 185 mmf.		ER		7935
C-15 (A,B,C)	See below	Capacitor, 0.05/0.05/0.05 mfd., same as C-6				
C-15A	2nd IF grid resistor by-pass	Part of C-15				
C-15B	1st IF cathode by-pass	Part of C-15				
C-15C	CW osc. plate filter	Part of C-15				
C-16 (A,B,C)	See below	Capacitor, 0.22/0.22/0.22 mfd., ±20%, 300 volts, paper		A		5413
C-16A	2nd IF screen by-pass	Part of C-16				
C-16B	Dynamotor H.V. filter	Part of C-16				
C-16C	Dynamotor L.V. filter	Part of C-16				
C-17	Fixed capacitance part of 2nd IF tuning	Capacitor, 180 mmf., same as C-12, but part of Z-2				
C-18	2nd IF trimmer	Capacitor, variable, ΔC approx. 17 mmf., same as C-13, but part of Z-2				
C-19	Fixed capacitance in 2nd IF coupling unit	Capacitor, 180 mmf., same as C-14, but part of Z-2. Refer to C-14 for more details.				

Model ATA and Model ARA Aircraft Radio Equipment

TABLE 19—PARTS LIST BY SYMBOL DESIGNATION—Continued

Parts of Type CBY-46129 (190-550 KC), CBY-46145 (520-1500 KC), CBY-46104 (1.5-3 MC), CBY-46105 (3-6 MC), CBY-46106 (6-9.1 MC) Aircraft Radio Receivers—Continued

Symbol	*Function*	*Description*	*Navy Type*	*Mfr.*	*Mfr's. Desig.*	*Dwg. and Part No.*
C-20 (A,B,C)	See below	Capacitor, 0.05/0.01/0.05 mfd., ±15%, 300 volts, paper		A		5415
C-20A	2nd IF amp. cathode by-pass	0.05 mfd. section of C-20				
C-20B	Output filter	0.01 mfd. section of C-20				
C-20C	2nd IF amp. plate by-pass	0.05 mfd. section of C-20				
C-21	3rd IF trimmer	Capacitor, variable, ΔC approx. 17 mmf., same as C-13, but part of Z-3				
C-22	Fixed capacitance part of 3rd IF tuning	Capacitor, 180 mmf., same as C-12, but part of Z-3				
C-23	Fixed capacitance in 3rd IF coupling unit	Capacitor, 180 mmf., same as C-14, but part of Z-3. Refer to C-14 for more details				
C-24	Diode series resistor by-pass	Capacitor, 0.0002 mfd., same as C-8				
C-25	CW osc. plate by-pass	Capacitor, 0.001 mfd., ±5%, 400 volts mica, part of CW osc. assembly Z-4		CD	5	4157
C-26	CW osc. grid blocking	Capacitor, fixed, 400 volts, mica,				
		200 mmf. for 190-550 KC receiver		CD	5	4513
		100 mmf. for all other receivers		CD	5	4520
C-27	Fixed capacitance part of CW osc. tuning	Capacitor, nominal, see below, ±2.5 mmf., 400 volts, mica, part of CW osc. assembly Z-4. See color code in Table 4				
		For 190-550 KC receiver, 345 mmf.		ER		7935
		For 520-1500 KC receiver, 335 mmf.		ER		7935
		For 1.5-3 MC receiver, 180 mmf.		ER		7935
		For 3-6 MC receiver, 180 mmf.		ER		7935
		For 6-9.1 MC receiver, 180 mmf.		ER		7935
C-28	CW osc. trimmer	Capacitor, variable, air, ΔC approximately 34 mmf., part of CW osc. assembly Z-4				
C-29	Audio coupling	Capacitor, 0.006 mfd., ±5%, 400 volts, mica	48672	AV	1461	4091
C-30	Audio amp. cathode by-pass	Capacitor, 15 mfd., 35 volts, dry electrolytic, polarized. Impedance at 60 cycles not greater than 350 ohms. Capacitance at 20°C may be 15 to 90 mfd.		A		5416
C-31	Output filter	Capacitor, 0.001 mfd., ±5%, 400 volts, mica	48695	AV	1461	4114
C-32	High voltage filter	Capacitor, 5 mfd., 300 volts, dry electrolytic, non-polarized. Impedance at 60 cycles not greater than 1050 ohms. Capacitance at 20°C may be 4.5 to 15 mfd.		A		6350
C-33	CW osc. coupling	Capacitor, 3 mmf., ±½ mmf., used only in 190-550 KC receiver. In all other receivers, C-33 is formed by capacitance between pin plugs in the second IF receptacle and is less than 2 mmf.		C	807	7020
C-36	Output circuit trimmer in Z-1	Capacitor, variable, ΔC approx. 17 mmf., same as C-13				
C-37	Output circuit trimmer in Z-2	Capacitor, variable, ΔC approx. 17 mmf., same as C-13, but part of Z-2				
C-38	Output circuit trimmer in Z-3	Capacitor, variable, ΔC approx. 17 mmf., same as C-13, but part of Z-3				
C-39	Across pri. of RF amp.	Capacitor, .00012 mfd., ±2.5%, 400 volts, mica, in 190-550 KC receiver only		CD	5RS	8013

TABLE 19—PARTS LIST BY SYMBOL DESIGNATION—Continued

'arts of Type CBY-46129 (190-550 KC), CBY-46145 (520-1500 KC), CBY-46104 (1.5-3 MC), CBY-46105 (3-6 MC), CBY-46106 (6-9.1 MC) Aircraft Radio Receivers—Continued

Symbol	*Function*	*Description*	*Navy Type*	*Mfr.*	*Mfr's. Desig.*	*Dwg. and Part No.*
E-1		Antenna binding post with engraved "A"		A		4667
E-3		Screw cap—top of assemblies Z-1, Z-2, Z-3		A		4664
E-4		Binding post insulator in two sections. 1 washer 6481, 1 washer 5727 and 1 nut 6009 required to complete assembly		ISO		3485 (outside) 6597 (inside)
E-8		Grid clip		A		4754
E-9	Input alignment control	Knob		A		4713
H-3		Snapslide		A		3888
		Other parts of the mechanism include:				
		Guide (on cover)		A		3887
		Button (on cover)		A		3890
		Stud (in shield)		A		4708
		Washers (on cover)		A		3889
H-5		Stud, for prevention of incorrect insertion of dynamotor		A		5480
H-6		Typical resistor panel assembly		A		5452
H-10		Conical stud for locking receiver in rack		A		4710
J-1		Coupling receptacle assembly, 8 circuit (to switch panel adapter)		A		4724
J-2		Coupling receptacle assembly, 3 circuit (to dynamotor)		A		4718
J-3		Coupling plug, 7 circuit (to rack)		A		5488
J-28		Typical IF coupling unit receptacle assembly		A		4723
J-29		Typical RF coil receptacle assembly		A		4722
L-1	Input tuning inductor	Input tuning inductor. The inductance is set to a standard value with the coil in the shield can, by means of an adjustable iron core. This core is subsequently locked in place and sealed. Part of Z-5 assembly.				
L-2,L-3	Mixer input RF transformer	Mixer input RF transformer. The inductance of L-3 is set to a standard value with the coil in the shield can by means of an adjustable iron core. This core is subsequently locked in place and sealed. Part of Z-5 assembly.				
L-4,L-5	RF osc.	RF oscillator, plate and grid coils. L-5 inductance is set to a standard value in the shield can, by means of an adjustable iron core. This core is subsequently locked in place and sealed. Part of Z-5 assembly.				
L-6,L-7	1st IF	Coils, part of 1st IF coupling unit assembly Z-1				
L-8,L-9	2nd IF	Coils, part of 2nd IF coupling unit assembly Z-2				
L-10, L-11	3rd IF	Coils, part of 3rd IF coupling unit assembly Z-3				
L-12, L-13	CW osc.	Plate and grid coils, part of CW oscillator assembly Z-4				
L-14	RF choke	Choke, 112 microhenries, ±10%, dc resistance not over .15 ohms		A		5546
L-15	AF choke	Choke, 3 Henrys with .05 amperes dc, dc resistance 325 ohms, ±15%		A		5634

Model ATA and Model ARA Aircraft Radio Equipment

TABLE 19—PARTS LIST BY SYMBOL DESIGNATION—Continued

Parts of Type CBY-46129 (190-550 KC), CBY-46145 (520-1500 KC), CBY-46104 (1.5-3 MC), CBY-46105 (3-6 MC), CBY-46106 (6-9.1 MC) Aircraft Radio Receivers—Continued

Symbol	Function	Description	Navy Type	Mfr.	Mfr's. Desig.	Dwg. and Part No.
N-1		Calibrated dial				
		For 190-550 KC receiver		A		5613
		For 520-1500 KC receiver		A		5610
		For 1.5-3 MC receiver		A		7327
		For 3-6 MC receiver		A		5622
		For 6-9.1 MC receiver		A		5608
P-5		Pin plug (on dynamotor receptacle assembly). *Note:* Make replacements of pin plug assembly 3995 with pin plug and terminal assembly 7949 consisting of a special pin plug assembly nut, and soldering terminal.		A		3995 (See "Note" under Description)
R-1	First RF cathode auto-bias	Resistor, 620 ohms, ±10%, ⅓ watt, carbon	63433	AB	E	6004
R-2	RF amp. grid	Resistor, 2 megohms, ±10%, ⅓ watt, metallized		IRC	F ⅓	4439
R-3	RF osc. grid	Resistor, 51,000 ohms, ±10%, ⅓ watt, carbon (part of assembly Z-5C)	63433	AB	E	4569
R-4	Mixer cathode	Resistor, 620 ohms, same as R-1				
R-5	AGC line decoupling	Resistor, 0.15 megohm, ±10%, ⅓ watt, carbon	63433	AB	E	4571
R-6	RF osc. series plate	Resistor, see below, nominal, ±10%, ⅓ watt, carbon, part of RF osc. Z-5C				
		For 190-550 KC receiver, .51 megohm	63433	AB	E	4570
		For 520-1500 KC receiver, .30 megohm	63433	AB	E	4530
		For 1.5-3 MC receiver, .20 megohm	63433	AB	E	4502
		For 3-6 MC receiver, .20 megohm	63433	AB	E	4502
		For 6-9.1 MC receiver, .15 megohm	63433	AB	E	4571
R-7	Mixer plate decoupling	Resistor, 200 ohms, ±10%, ⅓ watt, carbon	63433	AB	E	4497
R-8	RF amp. and mixer screen decoupling	Resistor, 200 ohms, same as R-7				
R-9	1st IF cathode auto-bias	Resistor, 620 ohms, same as R-1				
R-10	Connects H.V. to gain control resistor	Resistor, 0.36 megohm, ±10%, ⅓ watt, carbon	63433	AB	E	8032
R-11	AGC resistor	Resistor, 0.1 megohm, ±10%, ⅓ watt, carbon	63433	AB	E	4501
R-12	2nd IF cathode auto-bias	Resistor, 510 ohms, ±10%, ⅓ watt, carbon	63433	AB	E	6005
R-13	2nd IF plate decoupling	Resistor, 200 ohms, same as R-7				
R-14	CW osc. grid	Same as R-3 (51,000 ohms) for 190-550 KC receiver, and same as R-11 (0.1 megohm) for all others				
R-15	CW osc. plate dropping and decoupling	Resistor, see below, nominal ±10%, ⅓ watt, carbon				
		For 190-550 KC receiver, 20,000 ohms	63433	AB	E	4510
		For 520-1500 KC receiver, 20,000 ohms	63433	AB	E	4510
		For 1.5-3 MC receiver, 20,000 ohms	63433	AB	E	4510
		For 3-6 MC receiver, 5100 ohms	63433	AB	E	6001
		For 6-9.1 MC receiver, 5100 ohms	63433	AB	E	6001
R-16	CW osc. plate dropping and decoupling	Resistor, see below, nominal ±10%, ⅓ watt, carbon				
		For 190-550 KC receiver, .15 megohm	63433	AB	E	4571
		For 520-1500 KC receiver, .10 megohm	63433	AB	E	4501
		For 1.5-3 MC receiver, .10 megohm	63433	AB	E	4501
		For 3-6 MC receiver, 51,000 ohms	63433	AB	E	4569
		For 6-9.1 MC receiver, 51,000 ohms	63433	AB	E	4569