RESTRICTED

SERVICE AND INSTRUCTION MANUAL

RADIO

B-24D AIRPLANE

CONSOLIDATED AIRCRAFT

CONSOLIDATED AIRCRAFT CORPORATION
SAN DIEGO, CALIFORNIA

SERVICE AND INSTRUCTION MANUAL

RADIO

B-24D AIRPLANE

THIS MANUAL IS CORRECT AS OF NOVEMBER 1, 1942

RESTRICTED

PREPARED BY THE

FLIGHT AND SERVICE DEPARTMENT

OF

CONSOLIDATED AIRCRAFT CORPORATION

LINDBERGH FIELD

SAN DIEGO, CALIFORNIA

Printed in the United States of America
April, 1944

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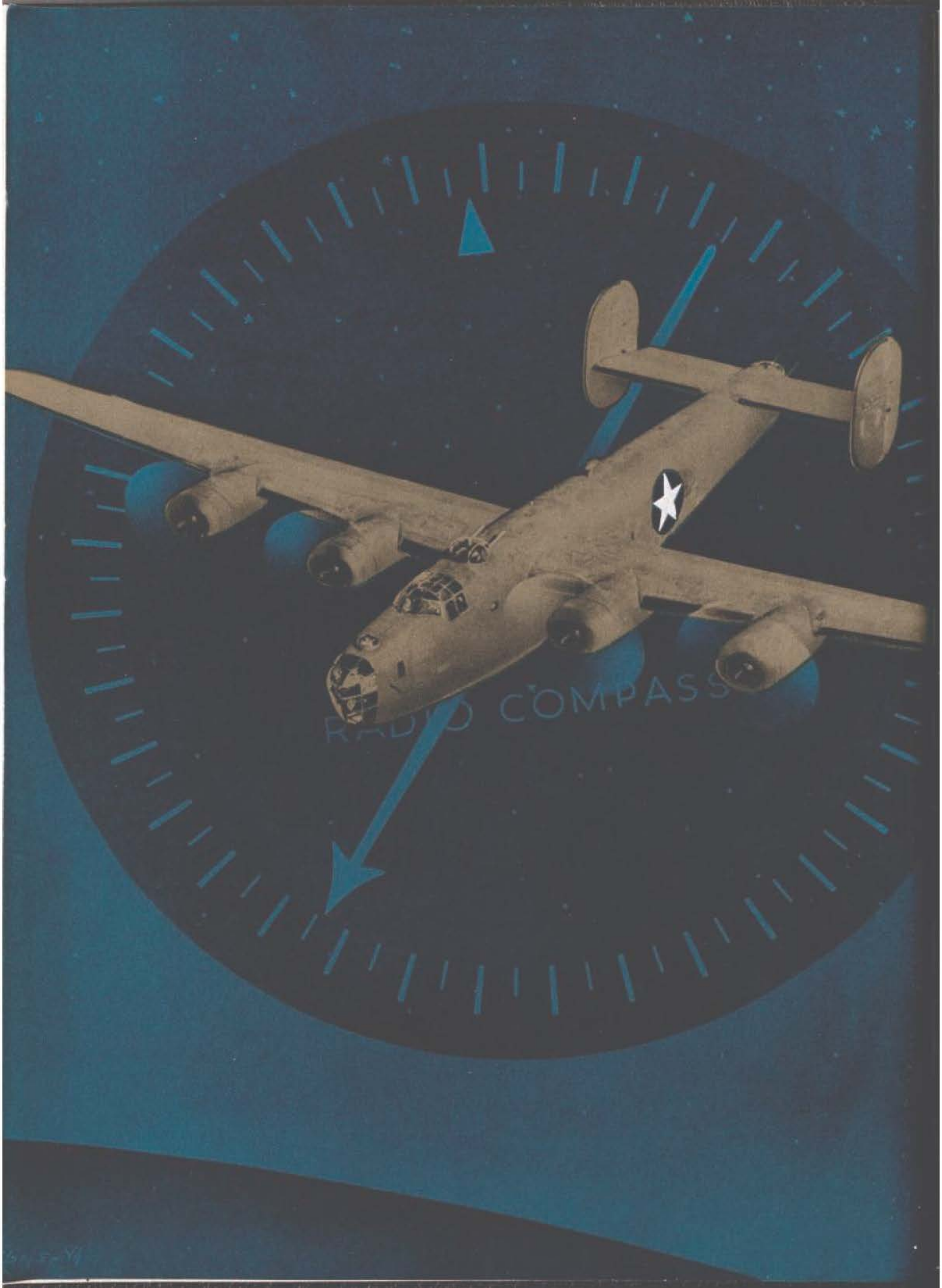
FOREWORD

This Radio Manual has been prepared by the Flight and Service Department of the Consolidated Aircraft Corporation primarily for the instruction and guidance of personnel engaged in operating and servicing the B-24D Airplane.

The elementary theory of radio is given in simple direct language, and is intended as a "refresher" for those who have, at least, a background knowledge of radio, electricity, and sound.

This Manual can become an invaluable "tool" in the hands of the serious minded technician, if he will familiarize himself with the material contained herein.

Refer to manufacturers' latest manual or bulletins when available, since changes are made from time to time on units covered in this book. K.C.H.


RADIO COMPASS

Chapter I

THEORY OF RADIO

Transmitting and receiving signals or impulses of action are not new functions of electrical circuits, but changes are continually being made in circuit and equipment design to improve performance or to add entirely new functions of usefulness.

A good groundwork in basic theory is needed to understand circuit details when analyzing its function or when shooting trouble. This is particularly true in modern commercial and military design where, for example, greater use is made of the advantages of extended frequency ranges in the field of radio. The complex nature of some power and signal circuits in present heavy aircraft may at first appear difficult, but a knowledge of fundamentals coupled with clear thinking will be found most helpful in solving the problems that arise.

It is not the purpose of this manual to be a textbook on radio for those unfamiliar with the subject. It is assumed the operating and service personnel assigned in this field have at least a background knowledge of electricity, radio, and sound. The theory presented in the following pages of this chapter is intended as a "refresher" course only.

All matter is composed of one or more of the 92 known chemical elements. Copper, oxygen, and mercury are common examples of elements in the metal, gaseous, and liquid forms respectively. A combination of elements forming a new substance is a **compound.**

The smallest form in which a compound can exist without losing its characteristics is a **molecule.** Likewise, the smallest form in which an element can exist without losing its characteristics is an **atom.** For example, one atom of the poison Sodium (symbol Na) combines with one atom of another poison Chlorine (symbol Cl) to form one molecule of the useful food seasoning, table salt or sodium chloride (symbol NaCl).

Each of the 92 different atoms, of the elements, is composed of electrons and protons. Electrons and protons from one element are identical to those from any other element. The 92 elements differ only in the **arrangement** of their electrons and protons.

The electron is an infinitely small mass with a negative charge. The proton is a relatively larger mass with an equal amount of positive charge. The weight, mass, and charge of an electron and a proton have been measured and are known.

An atom consists of protons as a nucleus around which electrons rotate. In this sense, atoms are similar to our solar system. The hydrogen atom has the simplest structure, one proton for the nucleus and one electron rotating about it. Other atoms are more complicated with many protons in the nucleus and an identical number of electrons rotating at various distances from the center and in various directions. The electrons rotating in orbits close to the nucleus never leave their paths and are called **planetary** electrons. Those in more distant orbits can change paths or jump from one orbit to another. These orbits frequently overlap. Such electrons are called **free** electrons.

The progress made by free electrons from one orbit to another, or in a free path from point to point, constitutes the characteristic of CONDUCTANCE which a material offers to the flow of electricity. On the other hand, the absence of free electrons is identified by a RESISTANCE to flow. "Flow of electrons" and "Flow of electric current" do not, strictly speaking, mean the same thing.

Thus far we have considered principally matter. On the other hand **energy** is intangible. It can be represented merely by its effects on matter and is defined as the capacity for doing work. Energy can be evident in various forms such as heat energy, chemical energy, mechanical energy, and electrical energy. It can be converted from one form to another. Electrical energy in the form of radio impulses is emitted and transmitted as wave trains. These waves are identical for all practical purposes to the waves of the ocean, although insensible in character. **Radio** waves are long waves, varying in length from 10,000 meters or more to a few meters or even less. A meter equals 39.37 inches or about 3¼ feet. **Heat** waves are short, and **light** waves are even shorter (.0008 to .0003 millimeters). There are 1000 millimeters in a meter. The wave length of **ultra-violet** waves is less than the shortest light wave. X-rays are about one millionth of a millimeter in length, and Cosmic rays, the shortest waves known, are probably 1/500 of the length of the shortest X-ray.

The velocity of radio waves is the same as that of light or about 186,000 miles (300,000,000 meters) per second. Knowing the wave length and the velocity, it is a simple calculation to determine the frequency of any wave. The frequency is the number of complete cycles per second. For example, since velocity (V) equals the product of wave length (l) and frequency (n), the frequency of a radio wave 1500 meters in length can be computed by dividing 300,000,000 by 1500 which equals 200,000 cycles per second. This large number is usually expressed in terms of kilocycles or thousands of cycles per second. Therefore, 200,000 cycles per second becomes 200 kilocycles per second. When dealing with very short radio waves where the frequencies run into the millions, they are expressed in terms of megacycles or millions of cycles. A radio wave 10 meters long has a frequency of 30,000,000 cycles or 30 megacycles per second. With a given power, transmission distance increases with frequency.

All of these waves are transverse vibrations. A wave that moves at right angles to the path along which it travels is a transverse wave. Water waves are transverse waves because as the wave advances the water rises and falls, but there is actually no forward movement of the water itself. Moving a rope back and forth either up and down or from side to side also produces transverse waves.

Sound waves vary in length from about 50 feet to less than 1 inch, and are longitudinal vibrations. A wave that moves only in the same direction as the path in which it is traveling is a longitudinal wave. A tuning fork, a drum, or a compressor produces alternately condensations then rarefactions of air which are examples of longitudinal waves. A person with a good ear can hear sound waves ranging in frequency from about 20 to 12,000 cycles per second. This is the pitch of the sound wave. Its loudness (energy level) depends on the amount of force with which it strikes the ear drums. Intelligibility of the voice is greater for the moderately high voice frequencies than for low voice frequencies. Therefore, radio impulses as transmitted are above the audible range and must upon reception be converted to audible or "Audio" frequency. In sound we know it is necessary to have some vibrating body to produce the waves, some medium to transmit them, and the ear to receive them. Likewise, in radio, equipment is necessary to produce the waves. How they are transmitted is still not thoroughly understood, but it is necessary to detect them for they are everywhere present although they cannot be directly heard nor seen nor felt.

A knowledge of the phenomena going on in a condenser under the action of an electromotive force is essential to the basic understanding of the production of radio waves. If a battery is connected to a condenser, we have an incomplete circuit. A **steady** current cannot flow, but a current will flow for a small fraction of a second only. One plate will become charged positively, and the other plate will have a negative charge. The potential difference across the condenser will equal that across the battery terminals. If the battery is removed, these charges will remain on the plates of the condenser. This can be shown by short-circuiting the condenser which will produce a spark. However, as long as the plates do not touch each other, or if there is no leakage path from one to the other, the potential difference between them will be maintained; and the insulating medium or dielectric will be in a condition of **strain** opposing the **stress** created by the difference in potential. The same condition prevails with a dam holding back a body of water or a balloon in keeping the inside gas pressure from being neutralized by escaping. If the insulation, or the balloon breaks, then the stress disappears because difference in potential ceases to exist.

The electrical force creating the difference of potential on the plates, controls the amount of charge on those plates. Motion of each particle of charge is accompanied by a motion of the Faraday lines of force attached to it through every surface which surrounds the charged plate. Since, according to Faraday, "electricity is wherever the lines of force are," it follows that the motion of the lines through any surface means motion of electricity through that surface; that is, Faraday regarded electricity as being capable of motion within a non-conductor or dielectric as well as within a conductor, but with this difference: In a conductor, its motion resembles the flow of water through a pipe, which retards the flow by a "frictional" resistance but has no tendency to reverse its motion; while in a non-conductor there is an elastic reaction opposing the flow which becomes greater as the displacement "strain" becomes greater and which tends to reverse it. This motion of electricity, as represented by the lines of force, is an electrical current just as much as is the motion of electrical charges. Electrical charges are terminals, only, of the lines of force and have no more ability than the remaining parts—the lines of force. Therefore, the motion of electrical charges through conductors does not stop at the surface of the conductor but continues in the non-conducting space beyond as motion of lines of force—**as motion of electrical energy.**

A better view of this idea may be obtained by considering the battery and condenser circuit previously described as replaced by pipes, the battery by a pump, electricity by water, and the condenser by an elastic membrane which the water cannot penetrate but which can be stretched when the water is pumped away from one side and to the other side. When the pump is started, water flows through the pipes, and the membrane is bulged outward toward one side. The flow stops when the membrane exerts a back pressure equal to that produced by the pump.

Now, if another pipe is added, running from one side of the membrane to the other, the membrane will flatten out, discharging water through this new path. If the resistance is small, the inertia of the water will cause the membrane to over-shoot the point of stability at neutralized pressure; and it will bulge out on the other side. Then there will be a series of these oscillations in the flow of water, each one less than the one preceding, until the membrane finally comes to rest after the energy has been dissipated by the friction in the pipes.

In the same manner, electrical oscillations occur when a condenser is suddenly discharged through a circuit of small resistance such as a wire conductor or an ionized path created by a spark discharge. Notice that the effect of pipe or path resistance on the water is in the nature of a drag which retards the flow. It increases when the velocity of flow increases and becomes zero when the velocity is zero. However, the reaction of the membrane depends

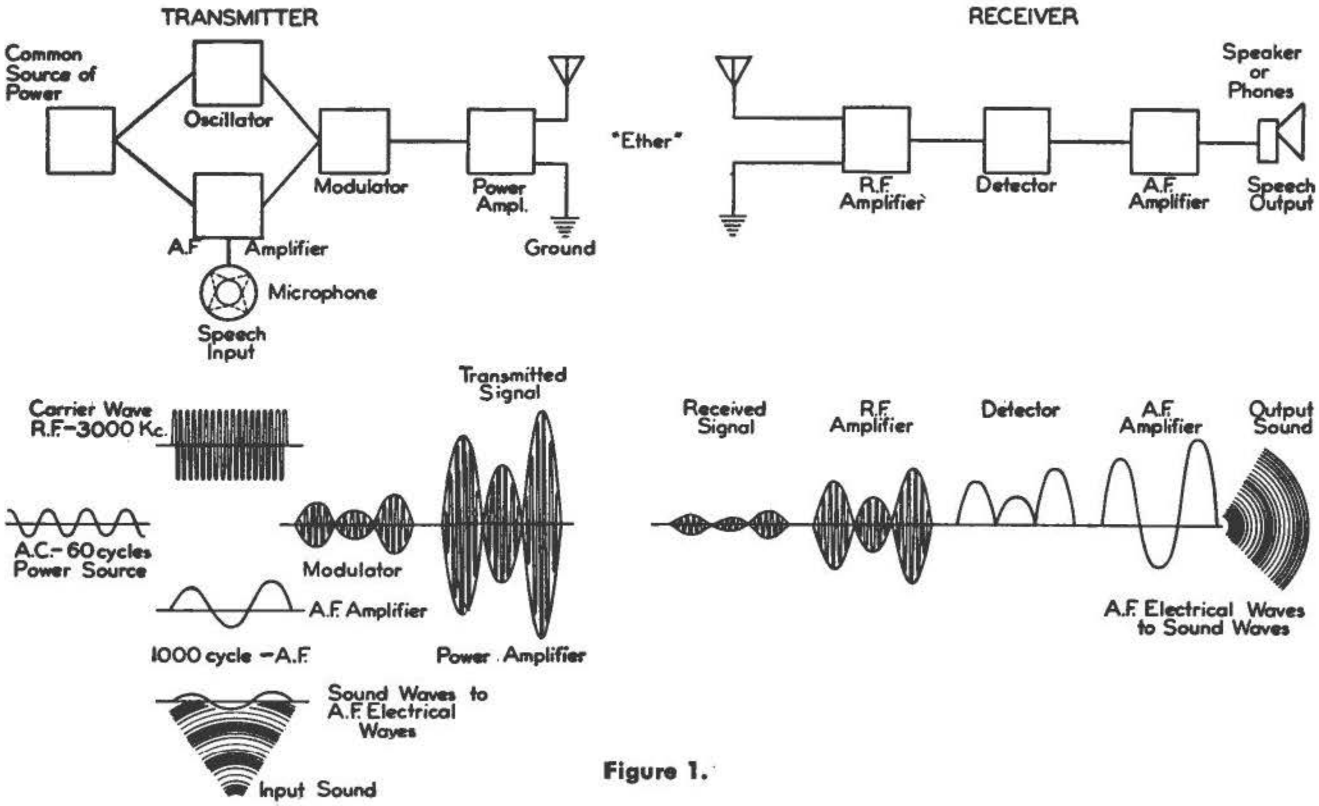


Figure 1.

not at all upon the velocity of flow, but only upon how much water was pumped from one side to the other; that is, upon the inertia of the mass of water.

In the wires of the electrical circuit there is a real current or flow of electricity when the condenser is being charged and discharged just as there is a real flow of water in the pipes when the membrane is being bulged out first on one side and then on the other. Faraday regarded the condenser as causing a flow of electricity which was opposed by an elastic reaction instead of only a "drag" resistance. Such a flow has been called a **displacement current,** as distinguished from the **conduction current** that takes place in metal wires.

When an antenna is set up it serves as one plate of a condenser. The ground will act as the opposing plate. If this antenna system is energized, electro-static lines of force will be established by the charges and will create an electro-static field. If the charges on the conductors are in motion, then a magnetic field will be created. The electro-static lines of force are radial about the conductor while the magnetic field is concentric about it. These two fields will always be found at right angles to each other. Furthermore, the strength of the electric field (or concentration of the lines of force) depends on the concentration of the charges on the conductor—in other words, when the voltage between the ends of the conductor is greatest. Therefore, when current has ceased flowing in the antenna at the end of a cycle, the charge is greatest, since no charges are flowing away from it. Consequently, when the current has reached zero, the electro-static field about the antenna will be a maximum. On the other hand, when the current has its maximum value, the magnetic field about the conductor will also be maximum. In other words the electro-static and magnetic fields are in opposite phase, when one is a maximum the other is a minimum. This magnetic field, however, is not a true **radiation** field. It is called the induction field. It does not contribute materially to the radiation as it is not effective very far from the antenna.

In order to more fully understand how energy may be radiated in the form of electromagnetic waves by means of an antenna, some fundamental principles concerning magnetic and electric fields should be recalled to mind. Electromagnetic waves are due to a disturbance of an electromagnetic nature and produce at points all around the center of disturbance a varying magnetic field and a varying electric field. An electric field is the region wherein electric forces are manifested, and the intensity at any point is measured by the force acting upon a unit charge of electricity placed at that point. Similarly, a magnetic field is the region wherein magnetic forces are manifested, and the intensity at any point is measured by the force acting upon a unit magnetic pole at that point.

The lines of action of the electric or magnetic forces, called electric or magnetic lines of force, represent at any point the direction of the force. This force exists everywhere throughout the space occupied by the field and not merely where the "lines" are drawn to represent graphically the intensity of the field. It is absolutely necessary not to confuse a concept given by a convenient graphic representation with the real nature of the facts being portrayed. Always remember that the field exists between the "lines of force" as much as it does at a point through which one of the lines passes.

Whatever the nature is of the stresses and strains in the medium (ether) which carries the disturbance, the following well-known facts may be stated:

1. An electric field or a magnetic field represents a definite amount of energy per unit volume of the field.
2. A magnetic field in motion produces an electric field.
3. An electric field in motion produces a magnetic field.

It becomes evident, therefore, that the motion of the electrostatic field traveling away from the antenna system, previously mentioned, will set up a magnetic field as it travels in the same way a current in a moving conductor will produce its magnetic field. Under these conditions the radiated electrostatic field is **in phase** with the radiated magnetic field it produces. These are called the open electric and magnetic fields.

All circuits give rise to radiation fields, but radiation is most effective when the current is alternating at high frequency and the radiator is of an appreciable size. The amount of radiation is an important characteristic.

Radio communication requires more than merely the continuous radiation of radio frequency power from an antenna. Application to the transmitted wave of the intelligence to be sent is accomplished by a process of modulation. A further processing of the wave must occur in the receiver to make the message understandable to the human senses. Since the frequencies used in radio transmission are carriers bearing modulation, this processing in the receiver is called detection or demodulation. The term demodulation indicates a reversal of the process which takes place in the transmitter because the modulation envelope is, in effect, detached from the carrier wave and made audible.

A brief review of vacuum tube fundamental operation at this point will give a basis for proceeding further with an analysis of signal treatment.

Vacuum Tube Operation—Consider a simple type of vacuum tube with two elements, a cathode ($-$) and an anode or plate ($+$). The cathode, when heated, emits electrons which flow to the anode only when it is positive with respect to the cathode. This unidirectional current indicates the rectifier action that is always present except under special conditions of ionization in gaseous tubes. As an example, if the negative terminal of a battery is connected to the cathode and the positive terminal to the anode of this tube, a

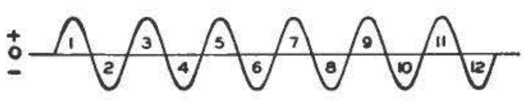


Figure 2

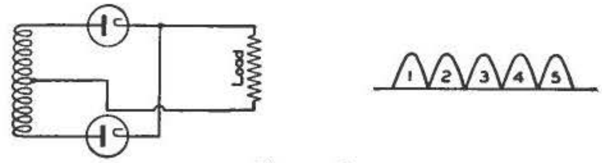


Figure 4

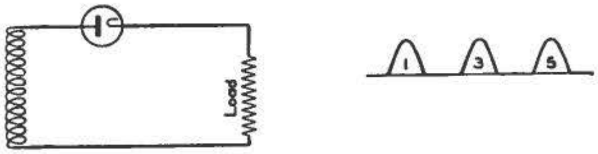


Figure 3

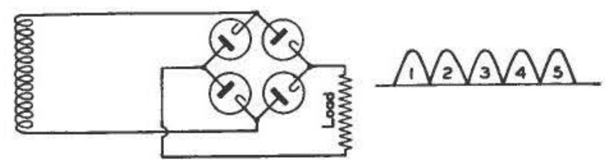


Figure 5

continuous flow of electron current will occur from cathode to anode. On the other hand, if an alternating voltage is applied to these two elements, current will flow only when the anode is in the positive half-cycle of the applied voltage. Rectifiers for receiving are provided with one or two plates depending upon whether the tube is designed for half-wave or full-wave rectification. The function of a rectifier circuit is illustrated in Figures 2, 3, 4, 5.

Figure 2, representing the wave form of the impressed alternating voltage.

Figure 3, fundamental circuit of a half-wave rectifier and its output wave form.

Figure 4, fundamental circuit of a full-wave rectifier and its output wave form.

Figure 5, fundamental circuit of the "bridge" rectifier and its output wave form.

Although the output of any of the above circuits is d.c., the amplitude is continually changing from zero to positive to zero, etc. To be usable, it needs to be passed through a filter circuit in order to smooth out the pulsations. A good type of two-section filter, shown in Figure 6, is very effective when the ripple voltage in the output must be low.

The inductances (L) store electrical energy in their electromagnetic fields, and the capacitances (C) store energy in their dielectric fields. This energy is stored while the amplitude of the rectified a.c. wave is increasing. After the peak has been reached and the amplitude begins to decrease, the stored up energy is released from the filter circuit and thus converts a pulsating output voltage to a relatively smooth one.

The performance of tubes can be reduced to easily understood terms by plotting and analyzing their characteristic curves. For example, with the two element tube considered at the beginning of this section, if we measure the plate current as the plate voltage is increased, a curve such as Figure 7 will be obtained.

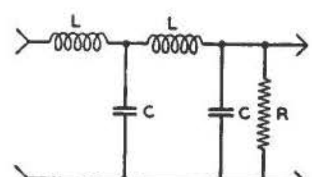


Figure 6

As long as the cathode temperature remains constant, the total number of electrons emitted from the cathode will be the same, regardless of the value of the plate voltage. However, with low plate voltage, only those electrons nearest the plate are attracted to it. The electrons in the space near the cathode, being themselves negatively charged, repel the similarly charged electrons which are just leaving the cathode surface and cause them to fall back on the cathode. This is called the **space charge** effect. As the plate voltage is increased, more and more electrons are attracted to the plate until finally the space

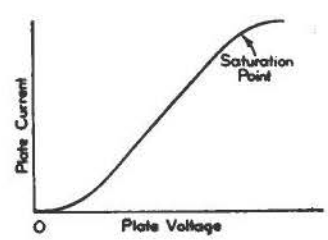


Figure 7

charge effect is completely overcome and all electrons emitted by the cathode are attracted to the plate. Further increase in plate voltage can not cause more plate current flow. This is known as the **saturation point.**

If a third element in the form of a spiral or a mesh is added, the uses the tube can be put to become very numerous. This added element is known as the **control grid,** and it is placed between the cathode and the anode. When the grid is made negative with respect to the cathode, the space charge is reinforced and a decrease in plate current results. If the grid is given more positive values, the plate current increases. When a resistance or impedance is connected in the plate circuit, the variation in plate current will cause a variation in voltage across this load that will be a magnified version of the variation in grid voltage applied as an input to the tube. This illustrates use of the tube as an amplifier.

Another characteristic curve typical of a three element tube shows the change in plate current as the grid voltage is varied and is illustrated in Figure 8.

Suppose that a radio frequency voltage, such as would be received on an antenna, is applied to the grid. Now we can plot the tube's dynamic characteristic, Figure 9, with its static characteristics, Figure 8, as a base of values.

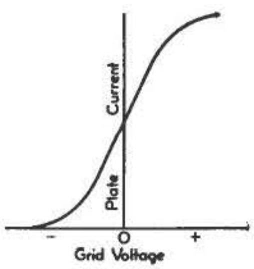


Figure 8

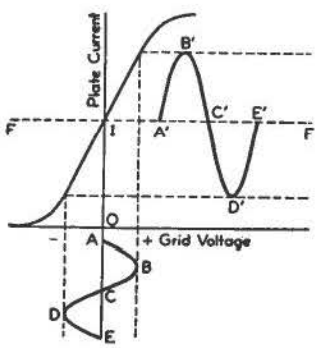


Figure 9

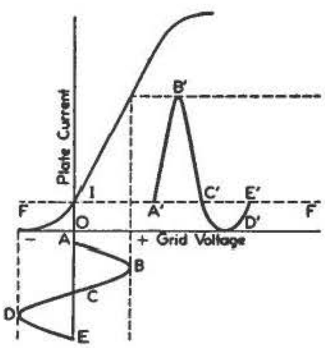


Figure 10

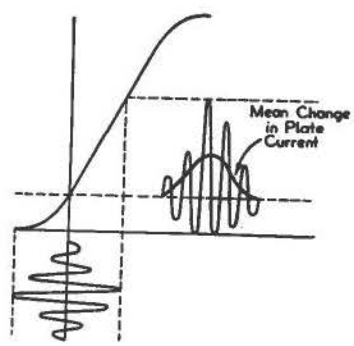


Figure 11

When no signal voltage is applied to the grid and it is at zero potential, the value of plate current is OI, and it is constant as shown by the straight line FF. Let one voltage cycle of an incoming r.f. wave be represented by A B C D E.

As the grid voltage rises from zero (A) to its maximum positive value (B), the plate current also rises from A′ to B′, since a positive grid voltage produces an increase in plate current. Thus the transition can be followed through the whole cycle.

The important feature to notice is that changes in the plate current take place along the straight portion of the curve, and equal changes in grid voltage produce equal changes in plate current. Therefore, the average value of plate current does not change. This tube then is operating as an amplifier only. It cannot serve as a detector until the grid is made more negative as shown in Figure 10.

Here the same incoming signal is being received, but changes in the plate current occur at a point where equal grid voltages on positive and negative sides do not produce equal plate current changes. Since positive change is greater than the negative change, there will be a change in the average plate current. This indicates a partial rectifier action since a greater change is produced in one direction than in the other, and the tube is operating as a detector.

Finally, consider a series of r.f. voltages as shown in Figure 11 impressed on the negative grid mentioned above. Since the increases in plate current at radio frequency are greater than the decreases, the average plate current will rise, and this average change takes place at audio frequency. Hence, the signal can now be recorded by a telephone receiver because of the rectifying action of the detector. It is this audio frequency component of the plate current which is a reproduction of the modulation envelope of the incoming carrier wave.

Modern tube designs incorporate more than the three elements which have been thus far mentioned. The performance of more than one function is possible in a single tube by the addition of one or more grids. Such grids are useful as electro-static shields or as control elements, or as plates (anodes) of different circuits. Many combinations of these tube elements are possible, and their design and construction can become quite complex. At first it may appear that the possibilities of combining tube elements are unlimited. However, it must be remembered that two conductors separated by an insulator always make a condenser. If two elements in the same tube are part of different circuits, there will surely be a capacitive coupling between these circuits. The amount of this inter-electrode capacity is, at times, admittedly small, but in the wrong place a small capacity can cause a lot of trouble.

When cathodes are directly heated by the passage of current through them, they are known also as filaments. Such filaments consist of a ribbon of tungsten coated with the oxides of some rare chemical elements (metals and earths) which are capable of emitting large quantities of electrons with comparatively small heating power. If the current for directly heated cathodes is taken from an alternating source, it causes an a.c. component or hum to appear in the output circuit. This is eliminated by using an indirectly heated cathode in the form of a sleeve which encloses the heating element. The two heater terminals and the single cathode terminal then do not have common contacts. When the heater brings the cathode up to operating temperature, its coating will emit electrons in the same manner as the directly heated filament. The extra time required for the cathode to come up to a state of full electron emission is called the warm-up period.

Tubes are referred to by the function they perform in the circuit or by their type number or sometimes by the number of elements they contain. For instance, a tube with but two elements is known as a diode; three elements, as a triode; four elements, as a tetrode; five elements, as a pentode, etc. The bases for these various tubes are equipped with from four to eight pins, connecting to the elements. The two filament or heater pins are heavier in all except the five and eight prong types. Pins are numbered consecutively in a clock-wise direction, looking at the base, starting with the left-hand cathode which is No. 1. It is customary to designate filament or heater as F or H, cathode as C or K, plate as P, control grid as G, screen grid as S, and suppressor (or shield) grid as SUP. In multi-grid tubes the grids are numbered in order from cathode outward as G1, G2, G3, etc. Also P1, and P2 denote separate plates in multi-purpose or twin tubes having separate sets of elements. Sometimes two elements are connected to the same pin in a tube, such as two grids, two cathodes, or two plates, or one grid and one plate. In this case elements having the same numerical subscript or postscript belong together.

For maximum results and longer life, **tubes should always be operated at the voltage and current values listed by the manufacturer.** This is important, and emphasis is placed on ability to function at maximum performance whenever needed.

It will be noted from the previous reference to amplifier action that the strengthening of signals is accomplished by the control which the weak incoming voltages exert on releasing a local supply of energy. If the wave form of the newly released energy is an exact reproduction of the miniature wave which controlled its release, then undistorted amplification has been accomplished. Because of this action, the tube and its circuit are known as a "repeating amplifier," or sometimes merely as a "repeater," but most commonly as an "amplifier."

Conditions of Resonance.

When a coil is connected to a source of alternating current, the rise and collapse of the field at each alternation will induce a back e.m.f. in the coil. The current resulting from this back e.m.f. will always be in the opposite direction to that which originally passed through the coil. In other words, there is a constant opposition to any change in the current. This is known as the **self induction** of the coil. On the other hand, if the coil is connected to a source of direct current, the effect of self induction is exerted only on the initial make and a subsequent break of the circuit; and the current is limited only by the resistance of the wire in the coil.

The higher the frequency of the impressed alternating current, the more the inductance will prevent its flow. The combined effect of frequency and inductance in coils is called **reactance** or **inductive reactance.**

The action of a condenser has already been described when a direct voltage is applied. Alternating voltages, on the other hand, will charge the condenser first in one direction and then in the other. This alternating stress applied to the condenser is practically equivalent to a flow of the current through the condenser, although not with the same freedom as in a non-capacitive circuit. Condensers are used to prevent flow of a direct current and to by-pass an alternating current. The impedance offered to this flow is known as **capacitive reactance,** and it is inversely proportional to the capacity of the condenser and to the frequency of the applied voltage. Therefore, the larger the condenser and the greater the frequency, the less the reactance will be.

Now consider a circuit with inductance and capacity connected in parallel, as shown in Figure 12, and impressed with an alternating voltage. If the frequency is low, practically all of the current will pass through the coil; since its reactance is low, and the capacitive reactance is high at low frequencies. When the frequency of the applied voltage is high, practically all of the current will flow through the condenser, since its reactance is low and that of the coil is high. However, at some value between these two limiting cases, there will be a frequency at which the inductive reactance of the coil and the capacitive reactance of the condenser will be the same. At this point, called the **resonant frequency,** a minimum amount of current will flow through the circuit.

The effective result is just the opposite in the series circuit, shown in Figure 12, although the reaction of the coil and condenser to frequency limits is the same. For example, when the frequency is low, the condenser limits the current flow with its

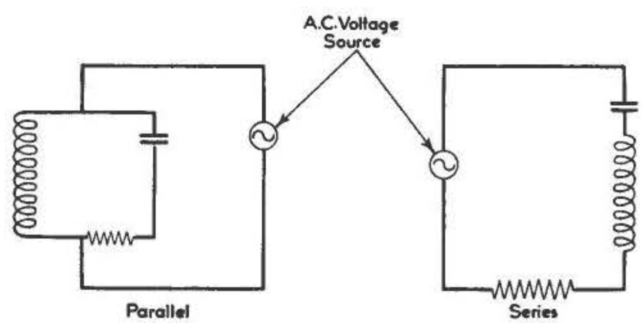


Figure 12. Resonance Circuits

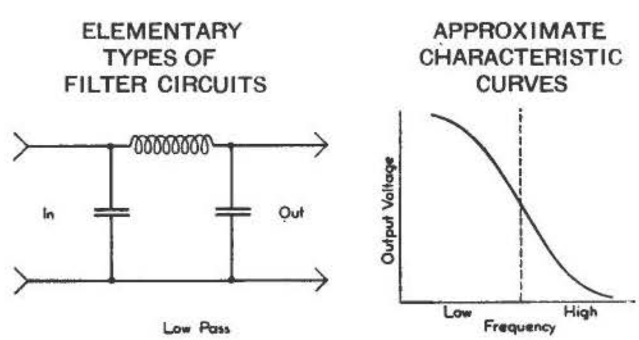


Figure 13

ELEMENTARY TYPES OF FILTER CIRCUITS

APPROXIMATE CHARACTERISTIC CURVES

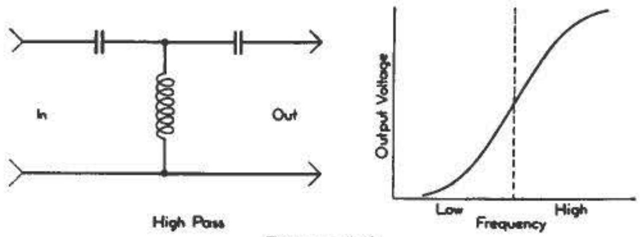


Figure 14

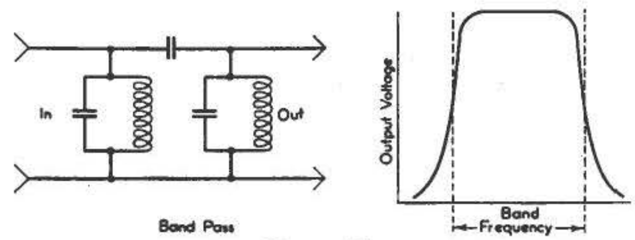


Figure 15

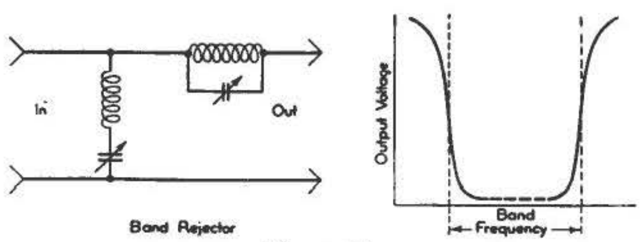


Figure 16

high reactance; and when the applied frequency is high, the coil limits the current flow with its high reactance. Likewise, at some intermediate frequency value, the **resonant frequency,** when the reactances are the same, there will be a maximum amount of current flowing through the series circuit.

The resistances shown in Figure 12 indicate the small amount of ohmic resistance distributed in the circuits which is always present. Without this resistance, the oscillations occurring at resonance would continue indefinitely.

It is evident that if either the inductive reactance or the capacitive reactance in the circuits of Figure 12 are changed in value, the frequency at which resonance occurs will also be changed. If values are selected for a definite frequency, a fixed tuned circuit results. Coil or condenser units designed to allow a change of these values result in a variable tuned circuit.

By choosing combinations of several of these circuit elements, it is possible to obtain resonance at more than one frequency. This is known as a filter circuit. Different types of filters have very different characteristics with respect to the frequencies which are rejected or transmitted. Figures 13, 14, 15, 16 illustrate some elementary filter circuits and their characteristics.

As an example, consider the filter circuit between two stages of a resistance amplifier shown in Figure 17.

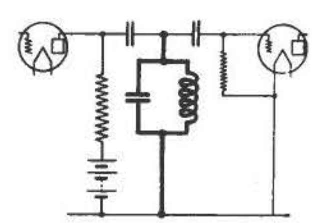


Figure 17

The filter is a parallel circuit (illustrated in Figure 12) in which a minimum amount of current will flow at the resonant frequency. It will practically short-circuit the resistance in the preceding plate circuit at all frequencies except the one to which the filter capacitance and inductance are tuned. The variation of impedance with frequency is illustrated in Figure 18.

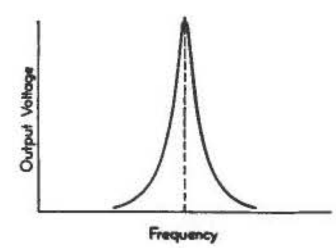


Figure 18

The lower the resistance is in the filter circuit, the sharper (or narrower) is the resonance curve. Therefore, at the resonant frequency, the maximum voltage resulting will be effective in energizing this voltage operated type of amplifier.

Filter circuits can be quite complex, but their useful characteristic is the sharpness with which they cut-off at a given frequency to either reject or transmit a desired signal.

RADIO EQUIPMENT OF B-24D AIRPLANES

All radio equipment used in B-24D airplanes derives power from the 24V D.C. supply of the main power system. The radio system includes the following individual systems:

Unit 1	**Interphone System**—Used for intercommunication between crew members and to provide for reception or transmission of radio messages from any crew station except as noted on page 26.
Unit 1-1	One amplifier mounted immediately behind Co-Pilot.
Unit 2	**Command Equipment**—Which is normally used for ship to ship communication.
Unit 2-1	2 Transmitters located over wing center section.
2-2	
2-3	3 Receivers located over wing center section.
2-4	
2-5	
Unit 3	**Liaison Equipment** (of medium power)—Used for ship to base or ship to ground communictaion.
Unit 3-1	1 Transmitter on flight deck under Radio Operator's table.
3-2	1 Receiver on flight deck on Radio Operator's table.
Unit 4	**Radio Compass Receiver**—Used for direction finding and in cross country navigation.
Unit 4-1	1 Receiver located over wing center section right side.
Unit 5	**Marker Beacon**—Used in making instrument landings.
Unit 5-1	1 Receiver located in bomb bay at Station 5.0.
Unit 6	FL-5C Filters Units 6-3 and 6-4, with BC-345 switch box for Pilot Unit 6-1 and Co-Pilot Unit 6-2, right and left by Pilot's and Co-Pilot's seats.

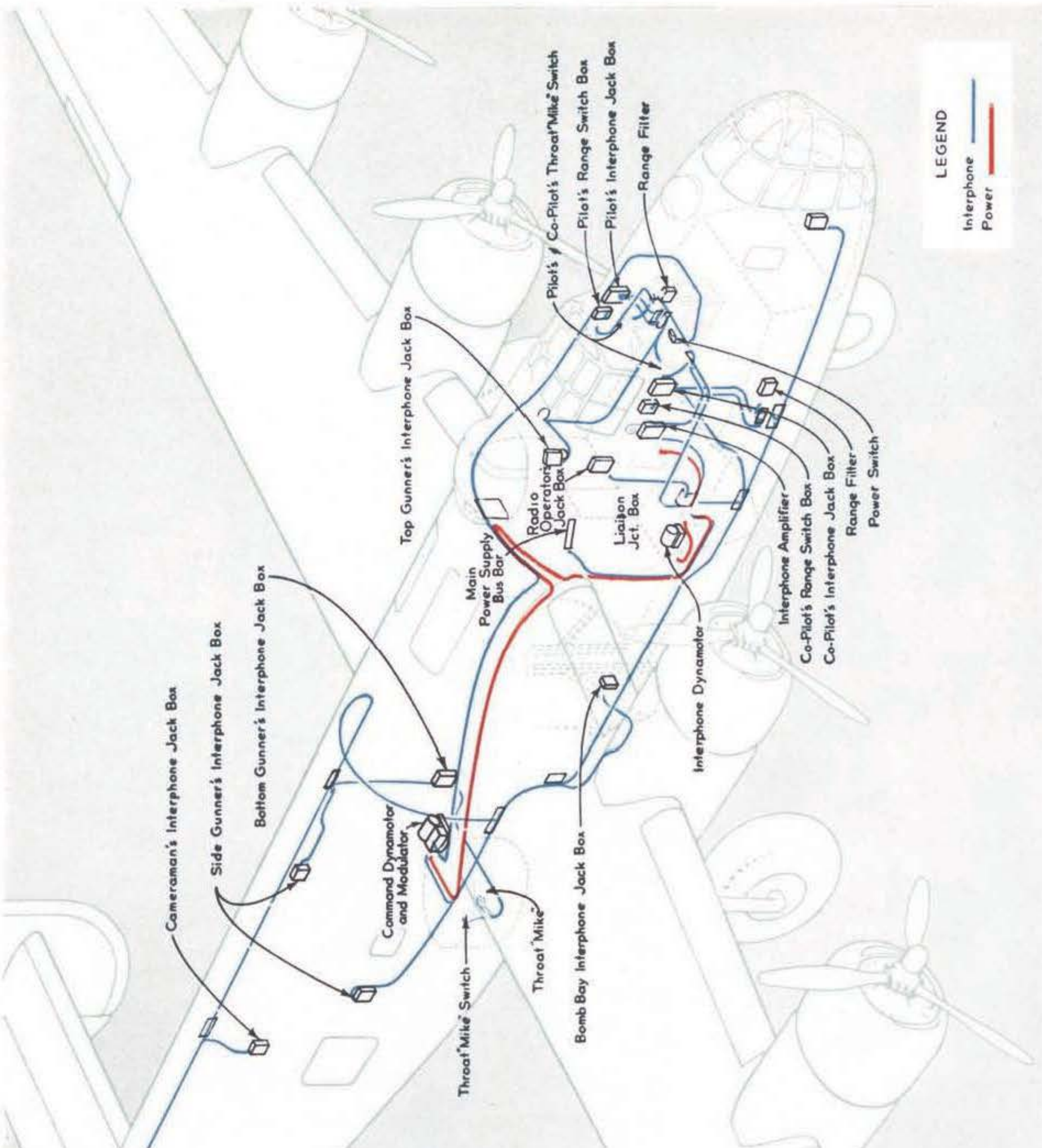
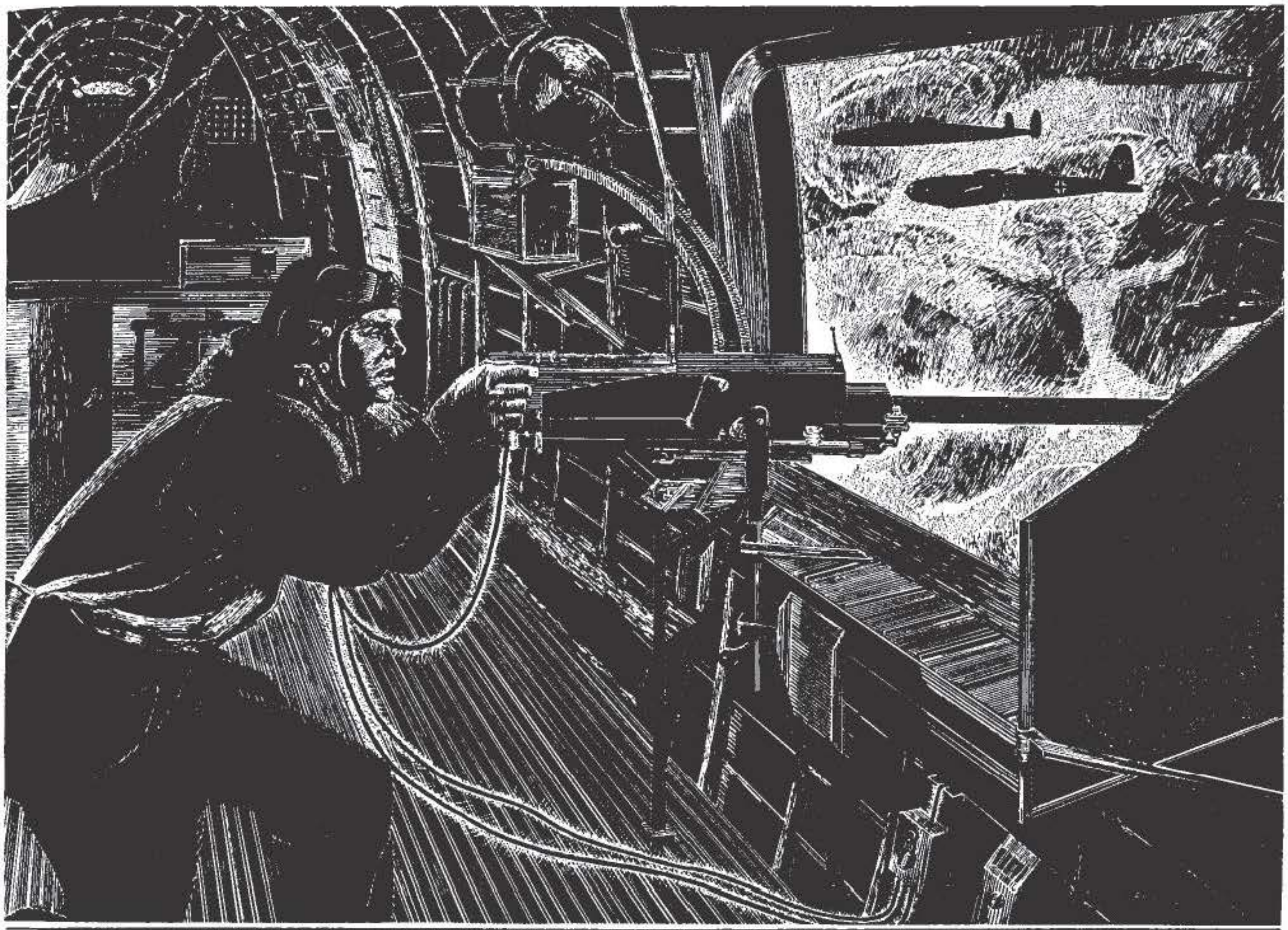


Figure 19. General Location of Interphone Equipment and Main Cable Routing



Chapter II

INTERPHONE EQUIPMENT

INTERPHONE EQUIPMENT—RC-36—The interphone system consists of a type BC-347 Interphone Amplifier, one PE-86 Dynamotor, one BC-366 jack box for each crew station, and one T-17 Throat Microphone or T-20 Microphone with RC-19-A Microphone Amplifying Equipment for each crew station.

Each throat microphone is equipped with either a CD-318 switch cord or a contractor furnished "push-to-talk" switch as the installation requires.

Each jack box is equipped with a headset connector cordage, on one end of which is a PL-55 plug for inserting in the jack box, and on the opposite end, a JK-26 jack into which is plugged the crew member's head set.

A stowage book is provided adjacent to each jack box for stowing the cordages and switch when not in use.

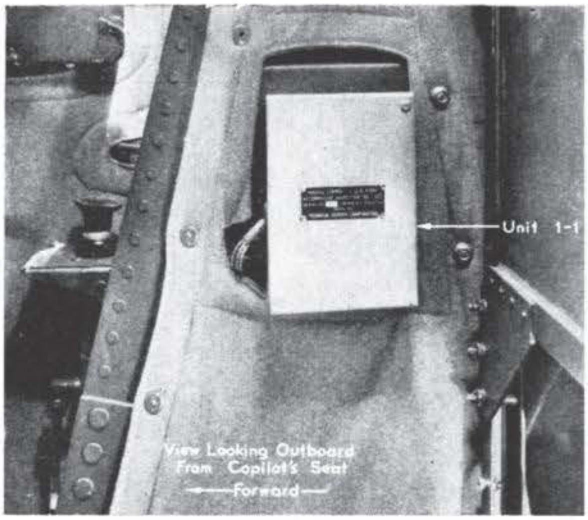


Figure 20. Interphone Amplifier

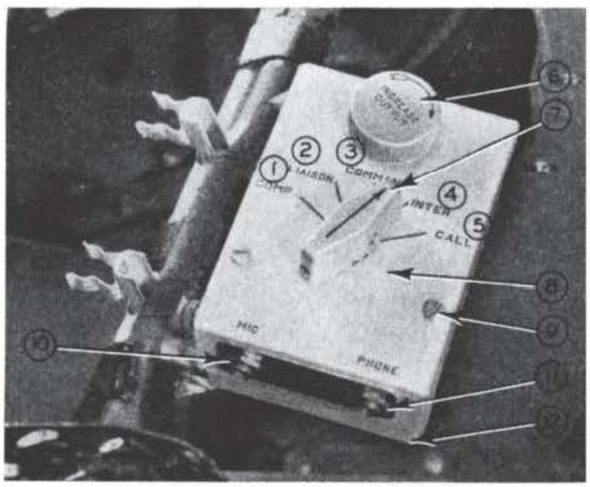


Figure 21. Top Gunner's Interphone Control

Unit 1-6—Top Gunner's Interphone Control

Units 1-2 to 1-12—Interphone Jack Box

(1)—Compass Position
(2)—Liaison Position
(3)—Command Position
(4)—Interphone Position
(5)—Call Position
(6)—Volume Control
(7)—Position Selector
(8)—Jack Box Cover
(9)—Cover hold down Screws
(10)—Microphone Jack
(11)—Telephone Jack
(12)—Jack box base

The various interphone stations are located as follows:

Unit 1-2 Bombardier's
Station 0.1 Right Side.

1-3 Pilot's
Station 2.1 Left Side Flight Deck.

1-4 Co-Pilot's
Station 2.1 Right Side Flight Deck.

1-5 Radio Operator's
Station 3.0 Right Side Flight Deck.

1-6 Top Gunner's
Right Seat Support Member of Turret.

1-7 Bomb Bay
Station 5.0 Right Cross Member of Bulkhead.

1-8 Bottom Turret
Station 6.1 Left Side.

1-9 and 1-10 Side Gunner's
Station 7.1—Right and Left. Forward of Gun Doors.

1-11 Camera
Station 7.5 Left Side.

1-12 Tail Gunner's
Station 9.1 Left Side.

The Bombardier's, Radio Operator's, Top Gunner's, Bomb Bay, Bottom Gunner's, Two Side Gunners', Camera, Tail Gunner's Stations are all equipped with standard interphone station equipment, which consists of the following:

One BC-366 Jack Box.

One T-17 Throat Microphone.

One CD-318 Microphone with "push-to-talk" switch and cordage, Units 7-3 and 7-4:

One headset cordage with PL-55 plug and JK-26 jack.

NOTE: The output of the Pilot's or Co-Pilot's throat microphones is connected to the interphone or radio circuits, through push-button switches, Unit 7-1, 7-2 located on the Pilot's or Co-Pilot's Control Wheels (Figures 24, 25, and 26). These switches are functionally identical with the push-to-talk switches in the CD-318 cordage, and when depressed, give the same operation.

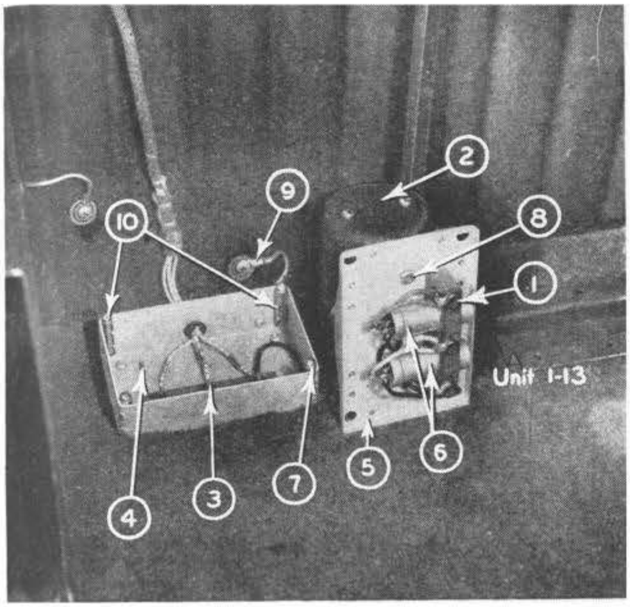


Figure 22. Interphone Dynamotor—Open

Unit 1-13—Interphone Dynamotor (Power Supply)

(1)—Jack terminal strip
(2)—Dynamotor
(3)—Plug terminal strip
(4)—Box
(5)—Box cover
(6)—Filter condensers
(7)—Slide fastener studs
(8)—Dynamotor mounting bolt and nut
(9)—Bonding braid
(10)—Mounting bolts

Since no provision is made to take power for the interphone system from the command equipment, a separate supply is provided and a separate amplifier is used. The amplifier, known as Type BC-347, is installed on the side of the Pilot's Compartment, directly aft of the Co-Pilot's seat (Figure 20). The dynamotor, Type PE-86, used for interphone power supply, is mounted on the floor alongside the Radio Operator's table (Figures 22 and 35). The interphone system is turned "ON" or "OFF" by switch (3) of Unit 2-8 (Figure 34) simultaneously with the Command Transmitter.

Interphone System Operation—Each interphone jack box has five positions to which the selector switch may be adjusted along with a manual volume control. From these five selector positions the following may be accomplished: (See Figure 21, for interphone jack box markings.)

Position 1—"Compass." The audio output of the "Compass Receiver" only will be heard. A limited control of headset volume can be had by manipulation of the volume control. The microphone circuit is inoperative. This position is available at all stations.

Position 2—"Liaison." The liaison receiver output and the side tone of the liaison transmitter will be heard. A limited control of headset volume is possible

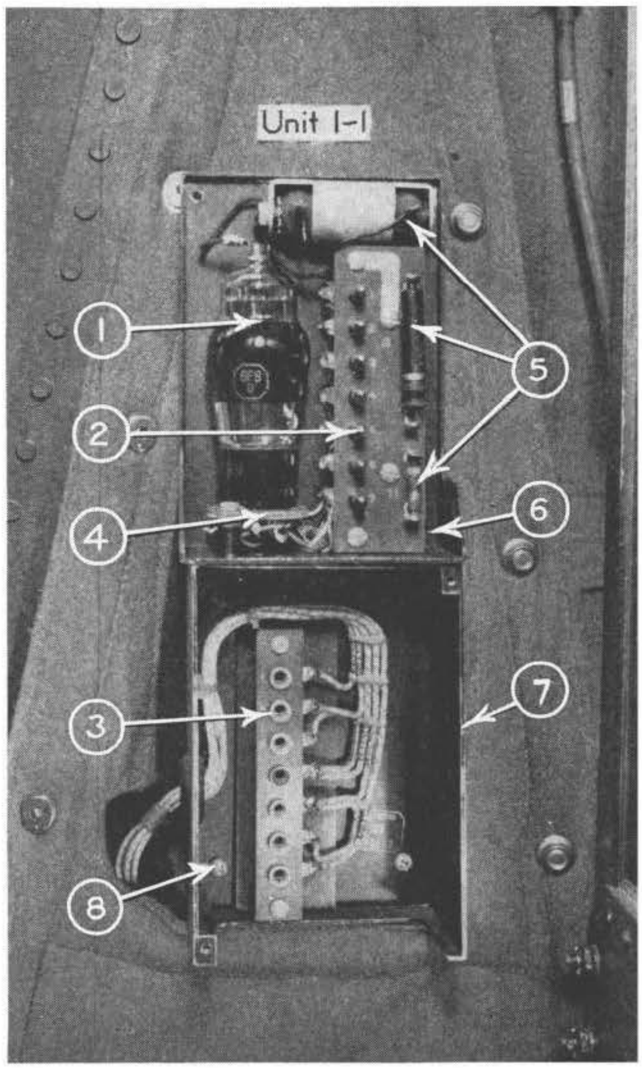


Figure 23. Interphone Amplifier—Open

Unit 1-1—Interphone Amplifier

(1)—Amplifier Tube
(2)—Plug Terminal Strip
(3)—Jack Terminal Strip
(4)—Tube Socket
(5)—Resistors
(6)—Amplifier Box Cover
(7)—Amplifier Box
(8)—Mounting Bolts

INTERPHONE STATION CONTROL

	Nose	Flight Deck				B. Bay	Tunnel				
	Bombardier Nav.	Pilot	Co-Pilot	Radio	Top Gun.	Bomb Bay	Bot. Tur.	Side Gun.	Side Gun.	Cam-era	Tail
COMMAND											
Reception...........	X	X	X	X	X	X	X	X	X	X	X
Transmission.........	X	X	X	X	X	X	X	X	X	X	X
Headset Volume Cont..	X	X	X	X	X	X	X	X	X	X	X
COMPASS											
Reception...........	X	X	X	X	X	X	X	X	X	X	X
Transmission.........	—	—	—	—	—	—	—	—	—	—	—
Headset Volume Cont..	X	X	X	X	X	X	X	X	X	X	X
LIAISON											
Reception...........	X	X	X	X	X	X	X	X	X	X	X
Transmission.........	—	X	X	X	—	—	—	—	—	—	—
Headset Volume Cont..	X	X	X	X	X	X	X	X	X	X	X
INTERPHONE											
Reception...........	X	X	X	X	X	X	X	X	X	X	X
Transmission.........	X	X	X	X	X	X	X	X	X	X	X
Headset Volume Cont..	—	—	—	—	—	—	—	—	—	—	—
CALL											
Reception...........	—	—	—	—	—	—	—	—	—	—	—
Transmission.........	X	X	X	X	X	X	X	X	X	X	X
Headset Volume Cont..	—	—	—	—	—	—	—	—	—	—	—

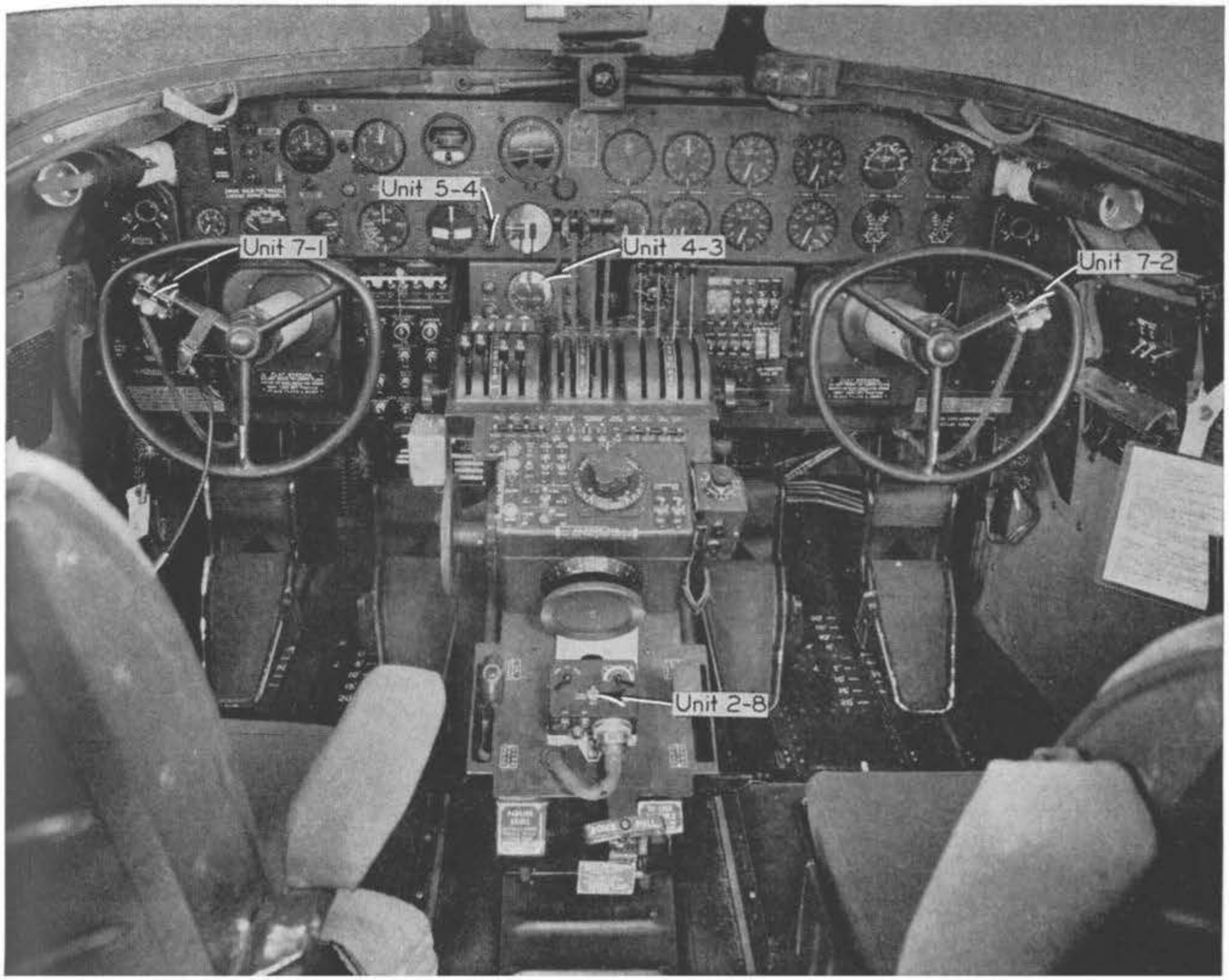


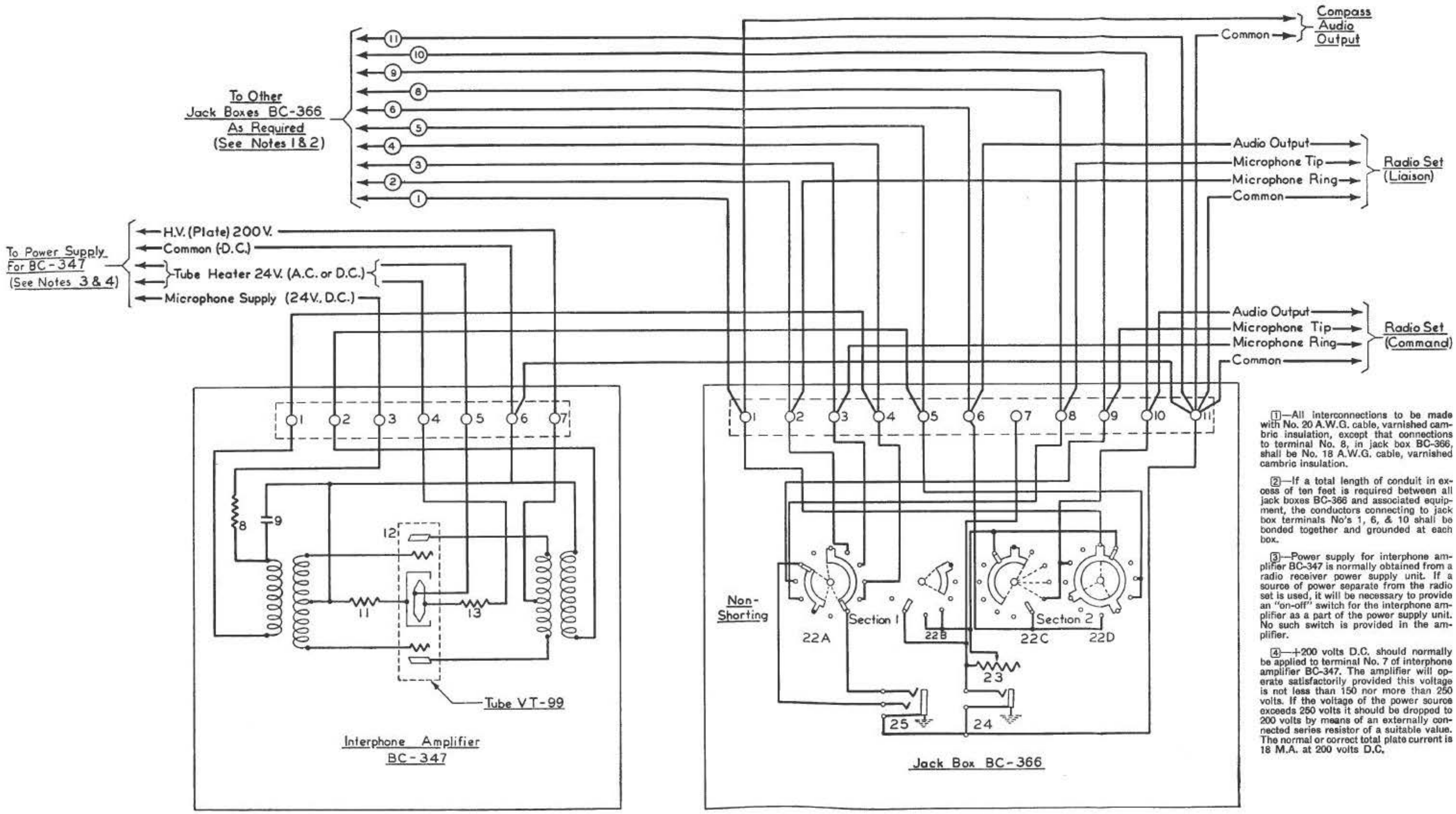
Figure 24. Pilot's and Co-Pilot's Radio Controls

Unit 7-1—Pilot's Microphone Push-Button Switch
Unit 5-4—Marker Beacon Indicator
Unit 4-3—Radio Compass Indicator
Unit 7-2—Co-Pilot's Microphone Push-Button Switch
Unit 2-8—Command Transmitter and Interphone Power Control Box

with operation of the volume control. The microphone, "push-to-talk" switch operates the transmit-receive relay located within the liaison transmitter. The microphone will modulate the liaison transmitter when the microphone switch is closed, and the transmitter is in the "Voice" position.

Voice transmission from the "Liaison" position is available only from the Pilot's, Co-Pilot's, and Radio Operator's Interphone Stations.

Position 3—"Command." The command receiver output and the sidetone from the command transmitter will be heard. A limited control of headset volume can be had by varying the volume control. The microphone "push-to-talk" switch operates the command send-receive relays which are located in the command receiver rack. The microphone will modulate the command transmitter when the "push-to-talk" switch is closed and the transmitter is in the "Voice" position. **This position is available at ALL interphone** stations.



1—All interconnections to be made with No. 20 A.W.G. cable, varnished cambric insulation, except that connections to terminal No. 8, in jack box BC-366, shall be No. 18 A.W.G. cable, varnished cambric insulation.

2—If a total length of conduit in excess of ten feet is required between all jack boxes BC-366 and associated equipment, the conductors connecting to jack box terminals No's 1, 6, & 10 shall be bonded together and grounded at each box.

3—Power supply for interphone amplifier BC-347 is normally obtained from a radio receiver power supply unit. If a source of power separate from the radio set is used, it will be necessary to provide an "on-off" switch for the interphone amplifier as a part of the power supply unit. No such switch is provided in the amplifier.

4—+200 volts D.C. should normally be applied to terminal No. 7 of interphone amplifier BC-347. The amplifier will operate satisfactorily provided this voltage is not less than 150 nor more than 250 volts. If the voltage of the power source exceeds 250 volts it should be dropped to 200 volts by means of an externally connected series resistor of a suitable value. The normal or correct total plate current is 18 M.A. at 200 volts D.C.

Figure 27. Interphone Equipment RC-36 — Schematic Wiring Diagram

HS-17 or HS-23 headsets in parallel. The amplifier assembly is mounted on the back of the cover and wired as a unit to a plug terminal strip (See Figure 23). All external connections are made to the jack terminal strip mounted in the bottom of the amplifier case. This plug-in chassis construction allows the amplifier and tube to be removed from the case without disturbing any soldered connections.

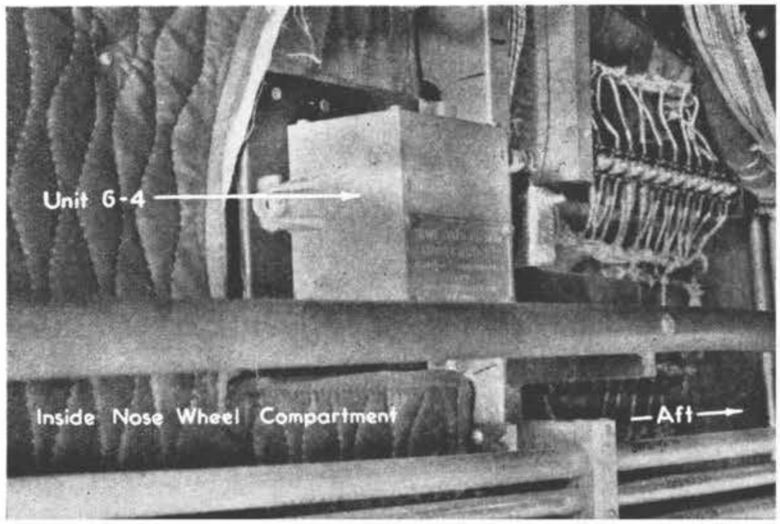


Figure 28. Co-Pilot's Range Filter Installation

The plug strip terminal numbering coincides with that on the jack strip as shown on the wiring diagram in the amplifier case.

SERVICE: Low volume at the "Inter" position with normal volume at the "Comp," "Liaison," and "Command" positions indicates trouble in the amplifier or its associated circuits. When difficulty is experienced with the amplifier, the vacuum tube should be checked first by replacing it with a new one. Usually the trouble will be found here. If the tube is normal, check all voltages (See Figure 27) at the jack terminal strip. A Test Set (Volt Ohmmeter) should be used for making these measurements and for checking any component parts of the amplifier. If the trouble is found to be in the amplifier chassis assembly, steps should be taken to replace the defective unit with a serviceable one. All BC-347 cover chassis assemblies are interchangeable. Repairs other than replacing defective tubes should not be attempted except at authorized Signal Corps repair shops and radio sections. Signal Corps radio sections at air depots are authorized and equipped for servicing defective aircraft radio equipment.

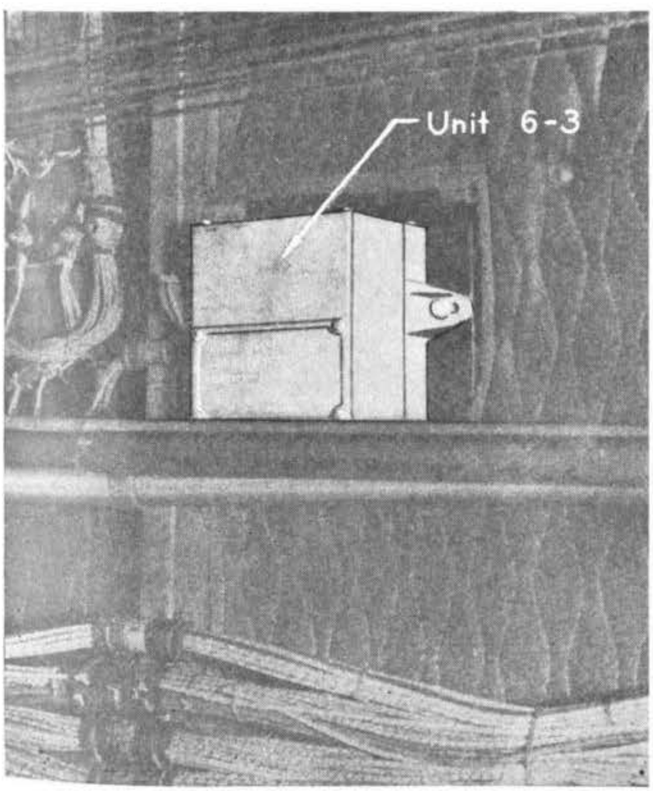


Figure 29. Pilot's Range Filter Installation

A parts list and wiring diagram (Figure 27) for the Interphone Amplifier and the Interphone Jack Box are given in the following pages.

BC-366 Interphone Jack Box: Units 1-2 to 1-12 inclusive.

All Interphone Jack Boxes have the same jack and plug strip terminal construction outlined for the Amplifier.

PE-86 Interphone Power Supply: Unit 1-13.

The Dynamotor which provides power for the interphone amplifier uses the same type of plug-in construction. Attached to the cover are the dynamotor and the capacitors used as filters for the DC supply to the amplifier, and for dynamotor brushes to eliminate noise. See Figure 22.

MAINTENANCE

General—Provided the Component units of Interphone Equipment RC-36 are properly installed and interconnected, little or no maintenance will be required.

LIST OF REPLACEABLE PARTS

Interphone Amplifier BC-347

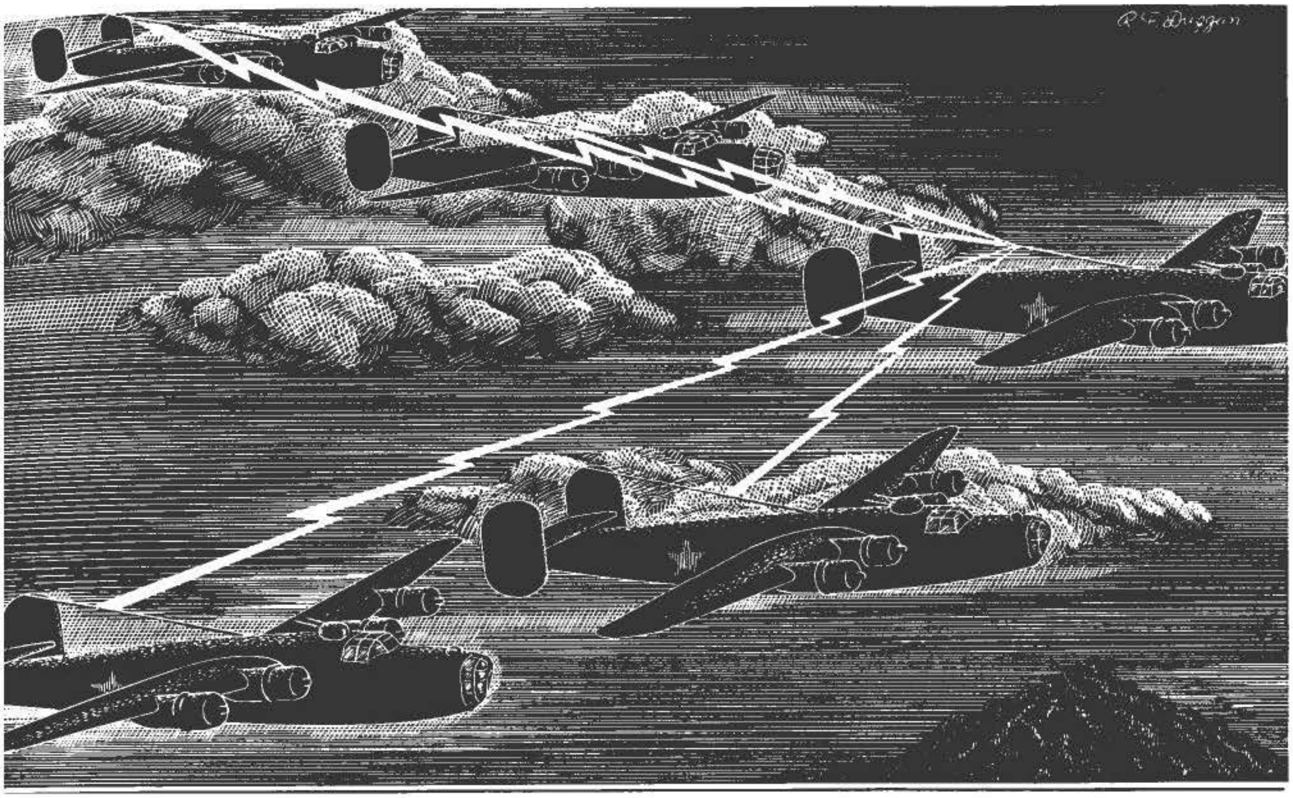
Name	Part Ref. No.	Description	Function
Resistor RS-227	8	Insulated Wire Wound 200 ohms, 2 watt	Microphone series
Capacitor CA-360	9	Electrolytic, 25 MFD., 25 V. DC	Audio frequency by-pass
Transformer C-251	10	Pri. res. (DC) 4 ohms max. Turns ratio (Ns/Np) = 70	Input Transformer
Resistor RS-228	11	Insulated, 450 ohms, ½ watt	Cathode Bias
Socket SO-96	12	8-pin octal	Amplifier tube
Resistor RS-226	13	Vitreous, wire wound, 35 ohms, 20 watt	Filament series
Transformer C-252	14	Pri. res. (DC) 1000 ohms max. Turns ratio (Np/Ns) = 14	Output Transformer
Terminal strip sub-assembly, pin jack complete with pin jacks.	15		
Terminal strip sub-assembly, pin plug, complete with pin plugs.	16		

LIST OF REPLACEABLE PARTS

Jack Box BC-366

Name	Ref. No.	Description	Function
Switch SW-145	22	Wafer type, rotary, 2-sections, 5-positions, non-retentive on 5th position.	Selector Switch
Potentiometer RS-232	23	Inclosed, molded carbon-in-bakelite resistance element, 150,000 ohms	Volume control
Jack JK-34-A	24	Two conductor jack	Headset Jack
Jack JK-33-A	25	Three conductor jack	Microphone Jack
Terminal plate sub-assembly, pin jack, complete with pin jacks	26		
Terminal plate sub-assembly, pin plug, complete with pin plugs	27		
Insulator plate, jack	28	Rectangular, natural laminated phenolic sheet	Jack insulator
Insulator plate, plug	29	Triangular, natural laminated phenolic sheet	Plug insulator
Knob MC-183	30	Rectangular, selector, aluminum alloy	For Switch SW-145
Knob MC-168	31	Round, knurled edge, aluminum alloy, "Increase Output"	For Potentiometer RS-232

Figure 30. General Location of Command Equipment and Main Cable Routing



Chapter III

COMMAND EQUIPMENT

SAFETY NOTICE FOR COMMAND EQUIPMENT

THE DYNAMOTOR DM-33-A, Unit 2-10, ON THE MODULATOR, Unit 2-6 OF THIS RADIO SET GENERATES 600 VOLTS, DC. THIS IS SUFFICIENT TO CAUSE SEVERE SHOCK, OR EVEN DEATH. MAKE ABSOLUTELY CERTAIN THAT THE DYNAMOTOR IS NOT RUNNING BEFORE MAKING ANY ADJUSTMENT WHATEVER EXCEPT TUNING UP THE RADIO TRANSMITTERS.

Opening up the tube covers on the transmitters and modulator unit exposes the high voltage plate connections to the top caps of Tubes VT-136. These covers should be safety-wired in place at the time of installation. Do not attempt to connect or disconnect a transmitter or a power plug while dynamotor DM-33-A is running. Do not depend alone upon **hearing** the dynamotor or upon observing the several switch positions to determine whether or not the dynamotor is running—feel it.

In tuning up the antenna circuit of the transmitters, be careful to avoid touching the antenna when the power is on or severe, irritating burns will result. Warn anyone who may be working near the antenna, of your intentions to turn on the power.

FIRE. If the radio set compartment over the center wing section has been exposed to gasoline vapor, make certain that it is aired out well before turning on power. The antenna must be installed as far as possible from any inflammable material such as fabric covering, canvas baggage compartments, etc., because of the possibility of sparking through this material to grounded metal beyond, and setting fire to the material.

The Dynamotor DM-32-A, Unit 2-12 (Figure 38), on each of the radio receivers, develops 250 volts DC. The danger of exposure to this voltage must not be ignored. Make certain that all dynamotors are "OFF" before performing any adjustment to the equipment other than antenna alignment.

COMMAND EQUIPMENT—SCR-274-N—The "Command" equipment Unit 2, used in B-24D Airplane consists of the following units:

Unit 2-1 One BC-458-A Transmitter, Figure 32.

2-2 One BC-459-A Transmitter, Figure 32.
One FT-226-A Rack for 458 and 9-A Transmitters.
One FT-227-A Mounting for FT-226-A Rack.

2-3 One BC-453-A Receiver, Figure 32.

2-4 One BC-454-A Receiver, Figure 32.

2-5 One BC-455-A Receiver, Figure 32.
One FT-220-A Rack for BC-453-4 and 5-A Receivers.
One FT-221-A Mounting for TF-220-A Rack.

Unit 2-6 One BC-456-A Modulator Unit, Figure 31.
One FT-225-A Mounting for Modulator Unit.

2-7 One BC-442-A Antenna Switching Relay, Figure 32.
One FT-229-A Mounting for Relay.

2-8 One BC-451-A Transmitter Control Box, Figure 34.
One FT-228-A Mounting for Control Box.

2-9 One BC-450-A Receiver Control Unit, Figure 33.

2-10 One DM-33-A Dynamotor, Figure 31.

2-11 Q6202-16 Terminal Strip.

2-12 DM-32-A Receiver Dynamotors (3).
Necessary cordages and flexible control shafts for proper interconnection and operation of the equipment.

Since both mechanical and electrical control of the Command equipment is normally

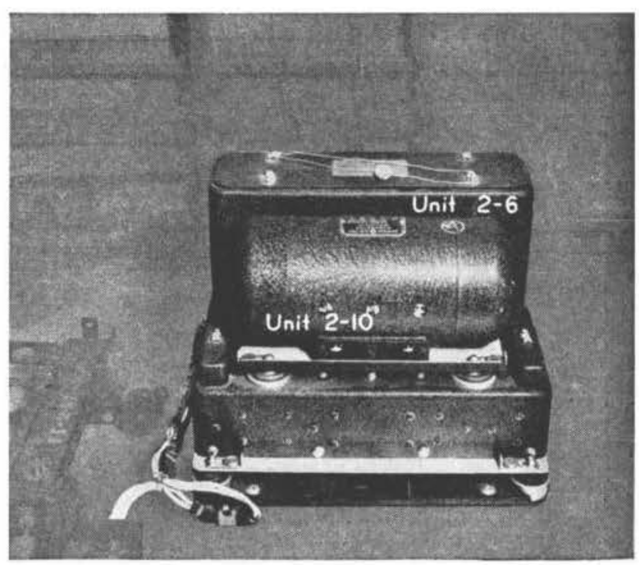


Figure 31. Command Modulator and Dynamotor
Unit 2-6—Command Modulator
Unit 2-10—Command Dynamotor

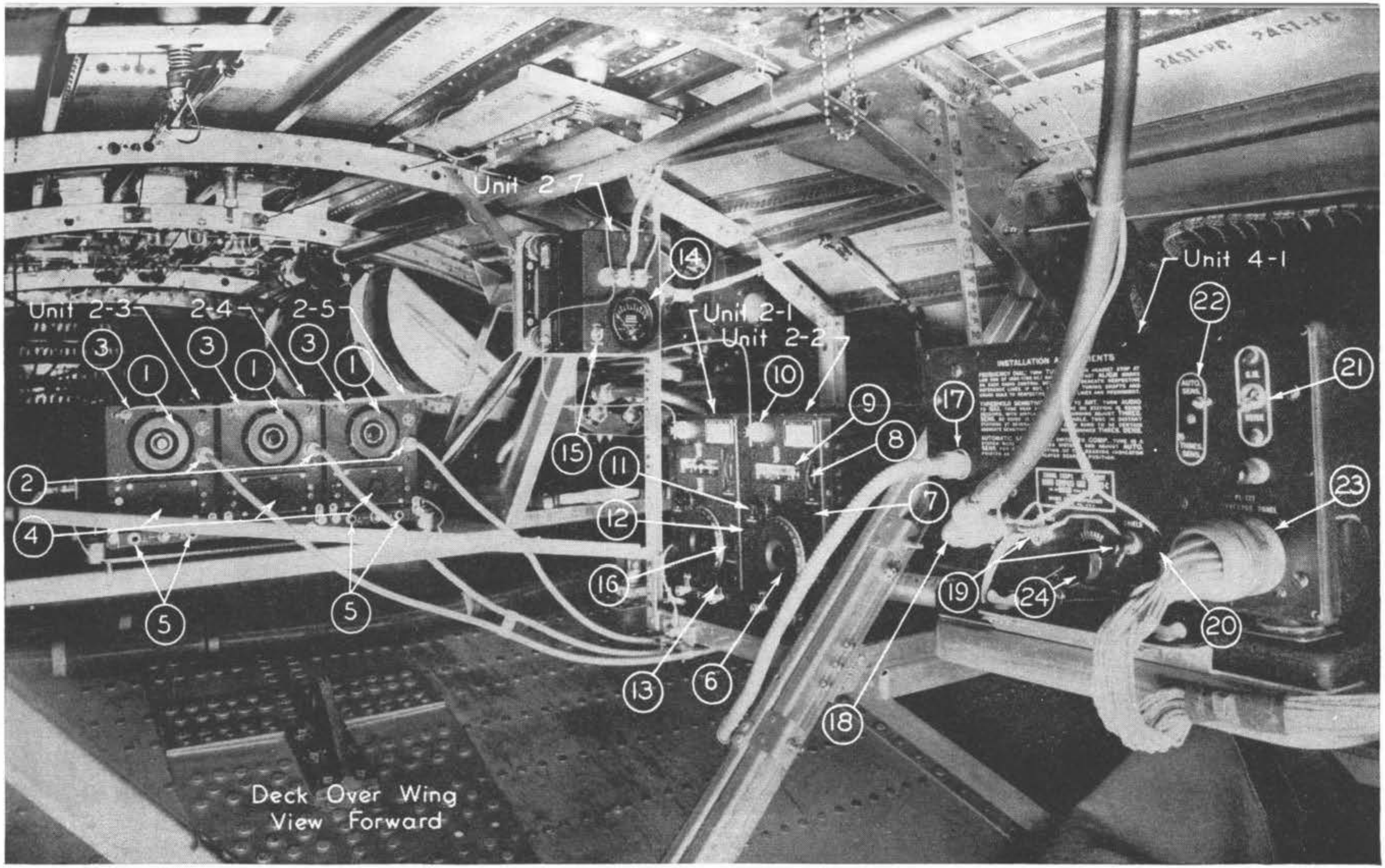


Figure 32. Radio Equipment over Wing Center Section

Units 2-3, 2-4, 2-5—Command Receivers
(1)—Command receiver tuning dials
(2)—Command receiver flexible tuning shafts
(3)—Antenna connections
(4)—Covers
(5)—Telephone Jacks

Units 2-1, 2-2—Command Transmitters
(6)—Command transmitter tuning dial
(7)—Antenna Inductance tuning lock
(8)—Antenna Inductance tuning control
(9)—Antenna Inductance tuning dial
(10)—Antenna connection for transmitters
(11)—Antenna coupling control
(12)—Lock
(13)—Tuning control
(16)—Lock

Unit 2-7—Antenna Transfer Relay
(14)—Antenna Ammeter
(15)—Ammeter selector switch

Unit 4-1—Compass Receiver
(17)—Compass receiver flexible tuning shaft
(18)—Loop connector cable
(19)—Ground connections
(20)—Sense antenna connection
(21)—CW-Voice Selector Switch
(22)—Sensitivity adjustments
(23)—Connector plug
(24)—Release

delegated to the Pilot and Co-Pilot, the receiver control unit BC-450-A (Unit 2-9) is mounted on the top of the cockpit between the Pilot and Co-Pilot; and the transmitter control unit, BC-451-A (Unit 2-8) is mounted on the pedestal.

The command set is a short range communication system used primarily for ship to ship communication. The BC-458-A transmitter has a frequency range of 5300 to 7000 KC, while the BC-459-A has a frequency range of 7000 to 9100 KC. The three receivers, namely BC-453-A, BC-454-A, and BC-455-A cover frequency ranges of 190 to 550, 3000 to 6000, and 6000 to 9100 KC. respectively. No spare coils are needed for either transmitters or receivers.

The BC-453-A, BC-454-A, and BC-455-A receivers, Units 2-3, 2-4, 2-5, and the BC-458-A and BC-459-A transmitters, Units 2-1, 2-2 (Figure 32), are mounted above the wing center section just aft of the life raft area. The BC-456-A modulator Unit 2-6 and the DM33-A dynamotor, Unit 2-10, are mounted aft of the compass receiver on the rack for the RADAR equipment (Figure 31).

A terminal strip, Unit 2-11, connects the transmitter remote control unit with the modulator unit, transmitter side tone, receiver output and interphone system. It is located on the right side of the compartment above the wing center section outboard of the compass receiver unit and contains terminals only.

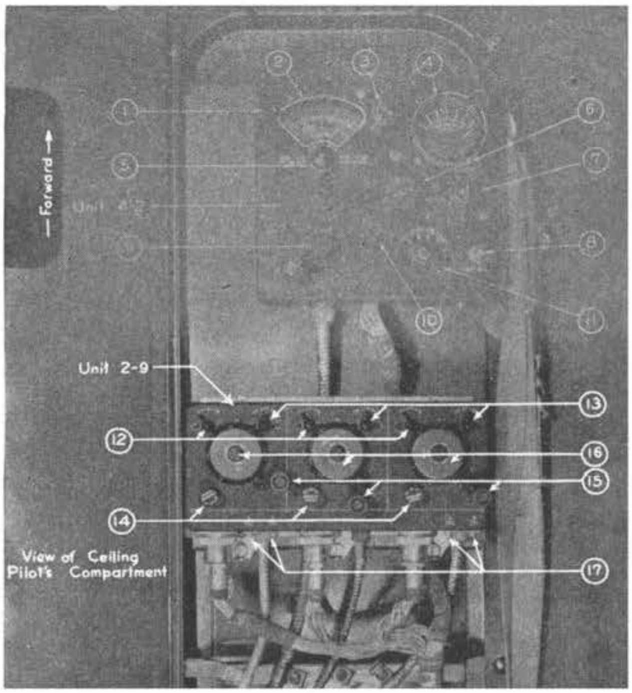


Figure 33. Pilot's Command Receiver Control

Unit 4-2—Compass Receiver Control Box

(1)—Dial Light	(7)—Electric Loop Direction Control Switch
(2)—Tuning Dial	(8)—Control Transfer Switch
(3)—Dial Light Rheostat	(9)—Tuning Control
(4)—Tuning Meter	(10)—Control Indicating Light
(5)—Band Change Switch	(11)—Power & Antenna Selector Switch
(6)—Volume Control	

Unit 2-9—Command Receiver Control Box

(12)—Output Selector Switches	(17)—Phone Jacks
(13)—Power & CW or MCW Selector Switches	(18)—Phone Jack
(14)—Volume Controls	(19)—Compass Receiver Flexible Drive
(15)—Tuning Controls	(20)—Compass Receiver Flexible Drives
(16)—Tuning Dials	

The receiver control box (Figure 33), Unit 2-9, is divided into three identical control sections, except for dial calibrations, each connected to its own receiver. Thus, command receivers can be used individually or in any combination desired by the operator. A switch (13) is located in the upper right corner of each control section and has "CW," "MCW," and "OFF" positions. Two phone jacks marked "A-Tel," and "B-Tel" (17) are located on the aft side of the receiver control box through which receiver output and command transmitter side tone may be heard. These jacks are not normally used since the Command set is connected to the interphone system, and transmission or reception may be accomplished from any interphone station throughout the airplane as long as the Command equipment is turned "ON." Output to these jacks is controlled by the switch (12) in the upper left corner of each control marked "A"-"B." For interphone station operation turn all three switches to position "A." On the face of the BC-451-A transmitter control Unit 2-8 (Figure 34), which is mounted on the pedestal, are three switches. The center switch (3) is marked "Trans. Power," "ON," "OFF." The switch (1) on the left has three positions marked "Tone-CW-Voice." On "Tone" a keyed signal modulated at approximately 1000 cycles per second can be transmitted. "CW" is for keyed transmission of an unmodulated signal. The third position is for voice transmission. Two positions on the right hand selector switch (2) connect to the two command transmitters. The other two positions are not used.

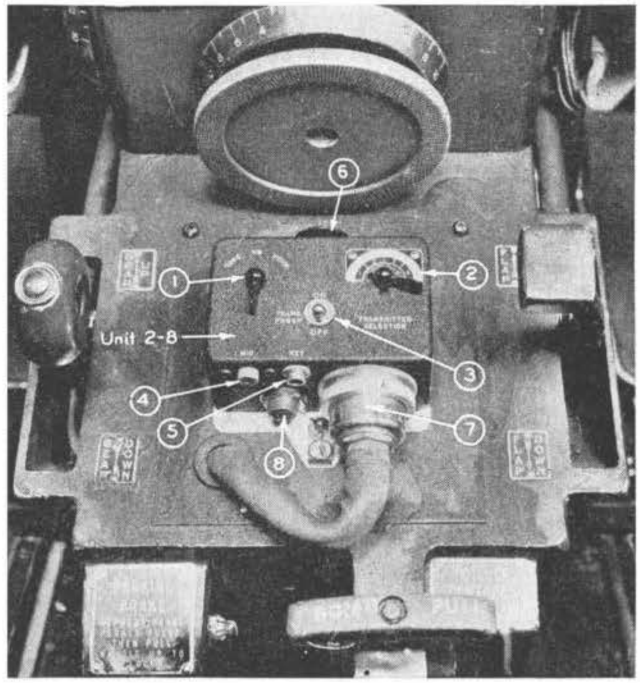


Figure 34. Command Transmitter and Interphone Power Control Box

Unit 2-8—Command Transmitter and Interphone Power Control Box

(1)—Signal Selector Switch
(2)—Transmitter Selector Switoh
(3)—Power Switch
(4)—Microphone Jack
(5)—External Key Jack
(6)—Key (for CW transmission)
(7)—PL153 Plug
(8)—Antenna Ammeter cable receptacle

On both "CW" and "Tone" positions, the microphone is inoperative but the push-to-talk switch may be used for keying the signal, or the key (6) on top of the BC-451-A control may be used. In addition to the two methods so far mentioned, an external or separate key may be plugged into the jack marked "Key" (5) on the aft side of the control box. Next to the key jack is the "Mic" jack (4) for plugging in a microphone on the Command set only.

Each transmitter is supplied with a special frequency checking circuit and a plug-in crysta resonator. This crystal and its circuit are used for checking frequency at a definite point on the dial only. **The crystal does NOT control the frequency being transmitted.**

PREPARATION FOR USE

Precautions preparatory to turning on the power to this equipment have been covered in the Safety Notice, Page 23. The final adjustments to the equipment prior to normal use are: (1) antenna circuit alignment of the receivers; (2) tuning up the transmitters. Before making these adjustments read Chapter III carefully on operation of the equipment so that the functions of the controls are well understood.

Antenna Circuit Alignment of the Receivers: (All receivers must be connected to the antenna.)

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 a headset into any "A TEL" jack.
4. Set the gain control knob to maximum gain position.
5. Tune the receiver to the highest frequency.

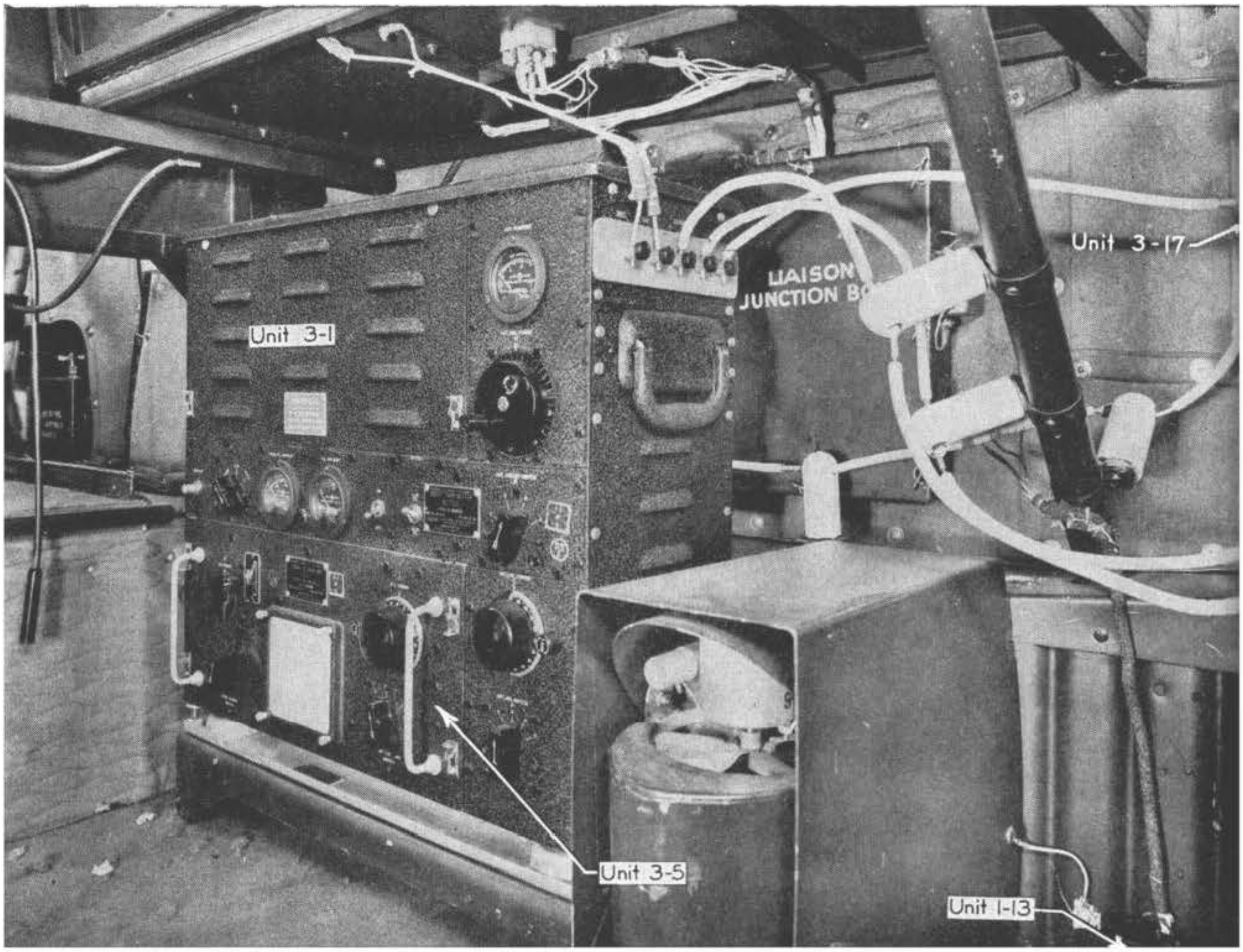


Figure 35. Equipment under Radio Table

Unit 1-13—Interphone Dynamotor
Unit 3-1—Liaison Transmitter
Unit 3-5—TU-6B Transmitter Tuning Unit
Unit 3-17—X41-B10A16 Antenna Transfer Switch

6. Trim 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 Up the Transmitters—There are three controls on the front of each transmitter: (1) the frequency control knob in the lower right corner marked "FREQUENCY," (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 to Antenna Relay Unit BC-442-A (Unit 2-7, Figure 32), and the antenna connected thereto, before the transmitters are tuned up. **Transmitters must be tuned up with the selector switch of the Radio Control Box BC-451-A (Figure 34) in the "CW" position, and must not be retrimmed 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.

Tune Up a Transmitter:

1. Set "FREQUENCY" control dial to the desired transmitting frequency, if the calibration accuracy of this transmitter has not been checked, read Item 17 of this group before continuing.
2. Set "ANT. COUPLING" control to about "3" on its scale.
3. Throw toggle switch on Antenna Relay Unit BC-442-A to "LOCAL."
4. Set Radio Control Box BC-451-A selector switch to "CW."
5. Set Radio Control Box BC-451-A transmitter selector switch to No. 1 or No. 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." Dynamotor DM-33-A should start.
7. Allow 15 seconds for tubes to heat up.
8. Lock the key on top of Radio Control Box BC-451-A by rotating it clockwise.
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.**
10. Vary the "ANT. COUPLING" until maximum antenna current is obtained. This setting must be made carefully.
11. Retrim the "ANT. INDUCTANCE" tuning.
12. Check 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 should read right side up.
15. If desired, mark the frequency to which each transmitter has been tuned, in soft pencil, in the appropriate blank spaces on the plate above the "TRANSMITTER SELECTION" switch. Record the transmitter tuning data on the "write-in" plate on the front of each transmitter.
16. Check frequency after operation No. 14 as this usually changes frequency slightly.
17. Each transmitter is supplied with a special frequency-checking circuit which includes a plug-in crystal resonator. This crystal circuit is used for checking the frequency at

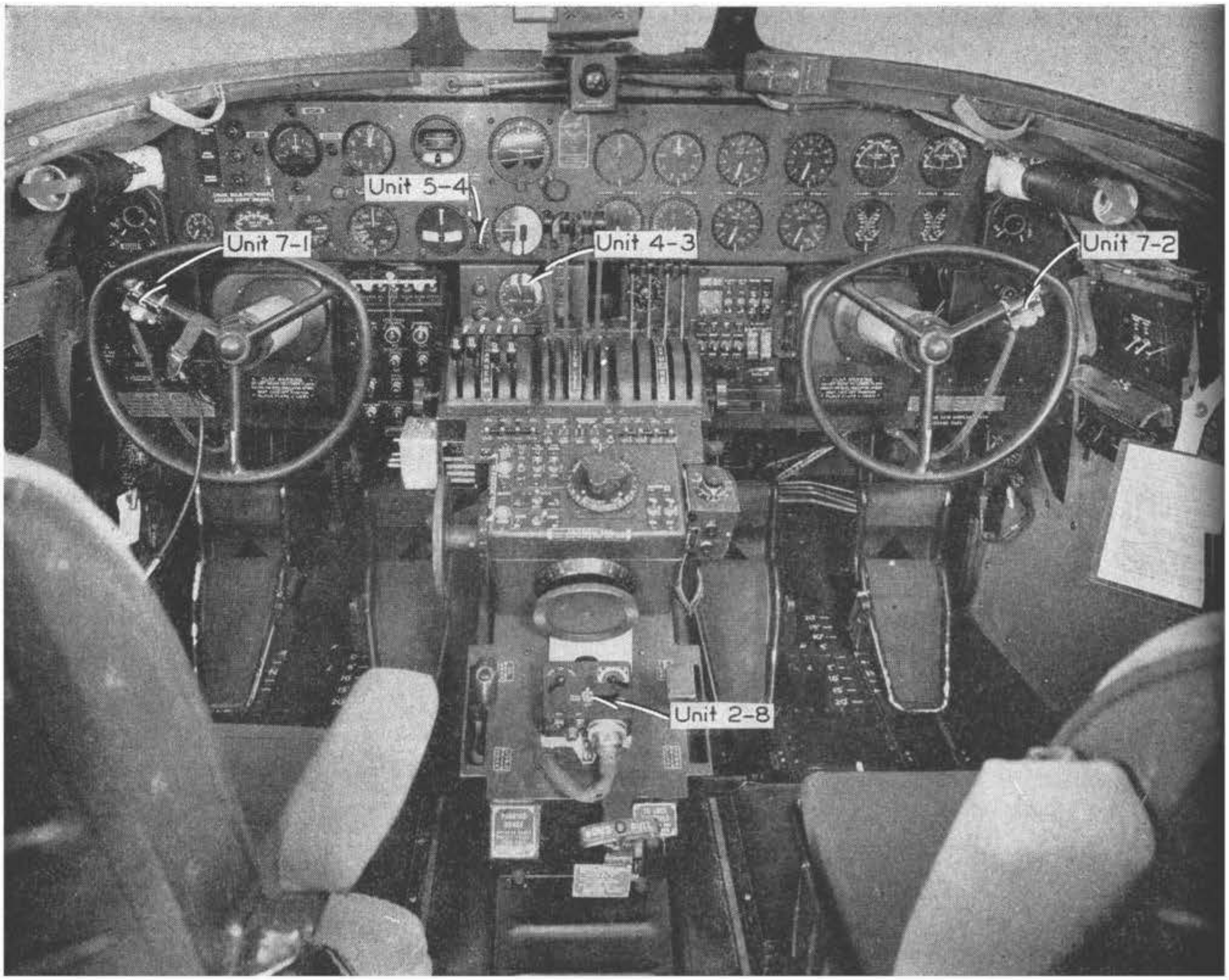


Figure 36. Radio Equipment—Pilot's and Co-Pilot's Positions

Unit 2-8—BC-451-A Command Transmitter and Interphone Power Control Box—Pedestal
Unit 4-3—Radio Compass Indicator
Unit 5-4—Marker Beacon Indicator
Unit 7-1—Pilot's push button microphone switch
Unit 7-2—Co-Pilot's push button microphone switch

one point on the dial; **it does not control the frequency.** The frequencies of the crystals supplied with the different radio transmitters are as follows:

Radio Transmitter	Crystal Frequency
BC-458-A (5.3-7 mc.) Unit 2-1	6.2 MC.
BC-459-A (7-9.1 mc.) Unit 2-2	8.0 MC.

Tube VT-138 in each transmitter is used as an indicator of a 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 of Tube VT-138. This shadow "opens" 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 of Tube VT-138 may be seen.

2. Tune the transmitter to the **lowest** frequency which will open the shadow on the resonance indicator. (Spurious responses will sometimes be observed, but they are **always higher than the nominal frequency of the crystal.**) The indicated 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 screwdriver inserted through the hole in the top of the transmitter which is covered with a metal slide. See Item 6 of Figure 41. **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—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 engraved on the frequency dial of transmitter will then be correct at other parts of the dial.

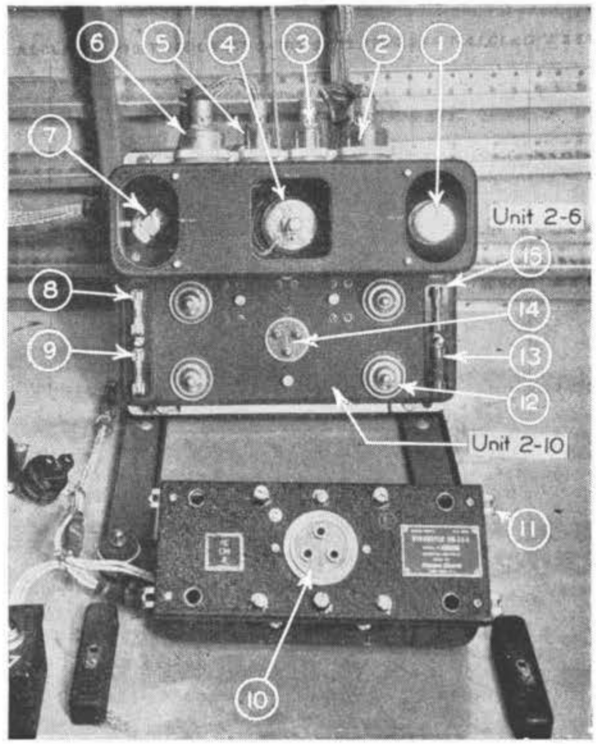


Figure 37. Command Modulator and Dynamotor

Unit 2-6—Command Modulator

(1)—VT139 Voltage regulator
(2)—PL153 to control box BC-451-A
(3)—PL148 to power supply (DC ships supply)
(4)—VT136 Modulator
(5)—PL151 to command receivers
(6)—PL154 to command transmitters
(7)—VT135 Tone Oscillator
(8)—Spare fuses
(9)—Spare fuses
(12)—Slide fastener studs
(13)—Fuse
(14)—Male plug for dynamotor
(15)—Fuse

Unit 2-10—Command Transmitter Dynamotor

(10)—Female receptacle on dynamotor
(11)—Slide fasteners

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 VT-137 is installed.**

OPERATION

OPERATION OF THE RECEIVERS—Accessories are provided for remote control of the three radio receivers as a part of this radio set. The three-unit receiver radio control box is shown in Figure 33. This radio control box provides for control at one location, of all three receivers.

Each command receiver control box contains the following controls: (13) "CW OFF MCW" switch, (15) tuning control, (14) gain control, (12) "TEL" switch. Any one of the three receivers may thus be controlled independently of the other two. Receiver control boxes contain headset jacks (17) marked "A TEL" and "B TEL." These jacks are connected to two separate telephone output lines, for use by two operators, if desired. The audio signal output from any receiver is switched into either the "A TEL" jacks or the "B TEL" jacks, by means of the "TEL" switch (12) controlling that particular receiver. The signals from any receiver may be cut off from the headset lines by turning the "TEL" switch of that particular receiver to its mid position. For example, if the Pilot is using Control Box BC-473-A connected to Receiver BC-453-A, he may turn the switch (12) to "A," connect his headset plug to "A TEL" jack, turn switch (13) to "MCW" and tune in a radio range signal, using the "INCREASE OUTPUT" control (14) to adjust the volume. If, at the same time, the radio operator is using Control Box BC-496-A connected to receivers BC-454-A and BC-455-A, he may switch each of his "A-B" switches to "B," throw the "CW" OFF MCW" switches to "CW" or "MCW" and tune in signals on both receivers simultaneously. The gain controls of these two receivers may then be used to "fade" the signal from one with respect to the signal from the other.

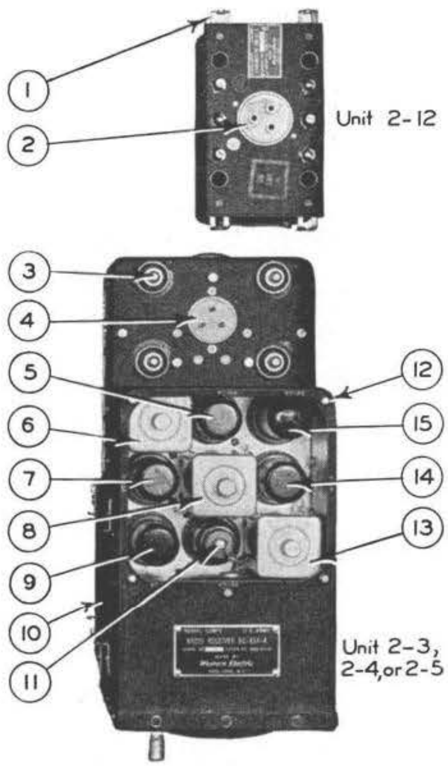


Figure 38. Command Receiver—Open View

Unit 2-12—Command Receiver Dynamotor
- (1)—Slide fasteners
- (2)—Dynamotor receptacle

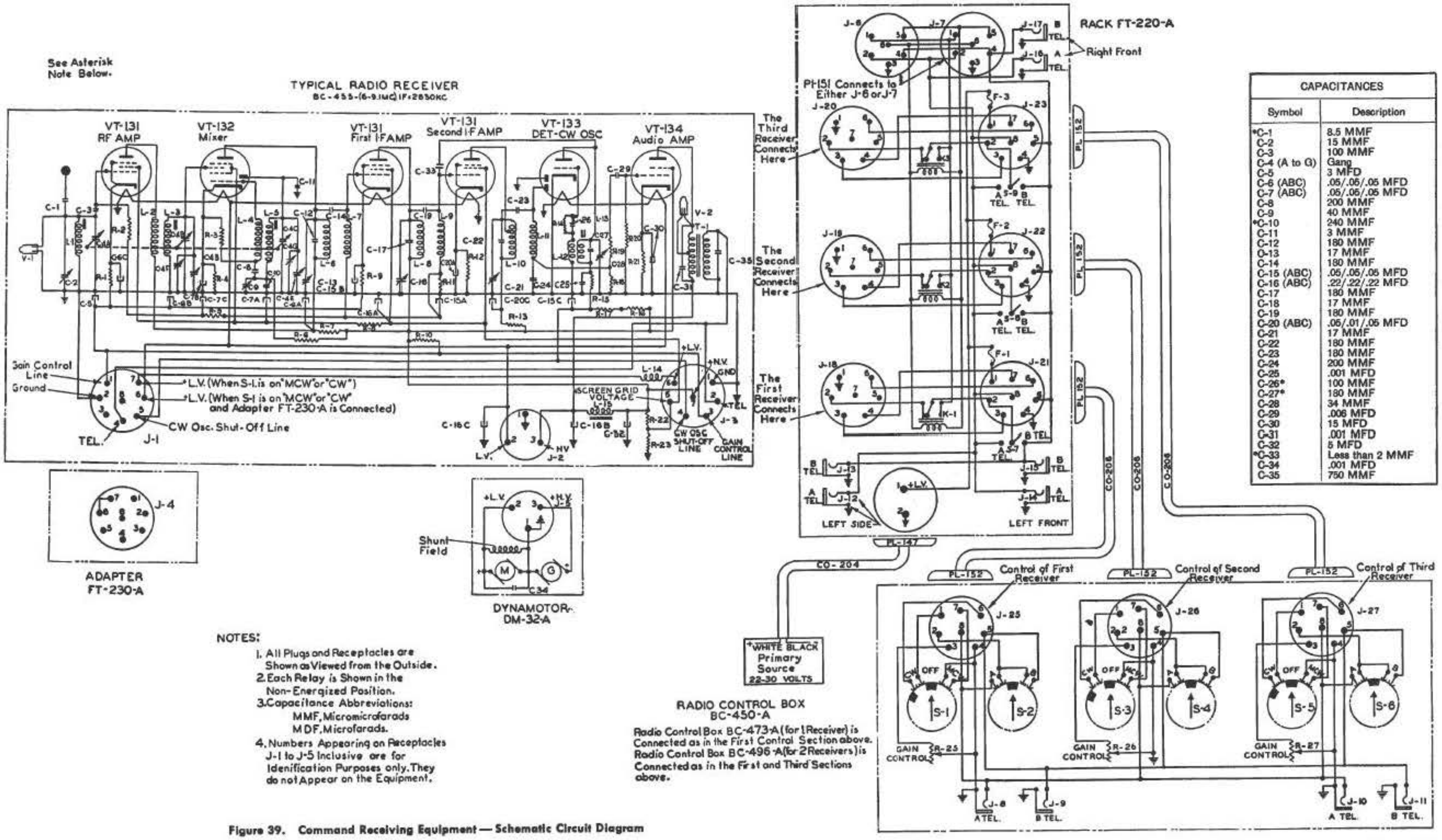
Units 2-3, 2-4, or 2-5—Command Receiver
- (3)—Slide fastener holding studs
- (4)—Dynamotor plug
- (5)—VT133 Detector—CW Oscillator
- (6)—IF transformer
- (7)—VT131 IF Amplifier
- (8)—IF transformer
- (9)—VT 131—RF Amplifier
- (10)—Cover Plate
- (11)—VT 132—Mixer
- (12)—Slide fastener stud
- (13)—IF transformer
- (14)—VT 131 IF Amplifier
- (15)—VT 134 Audio Amplifier

When two or more received frequencies are to be gauged simultaneously, the receivers which are tuned to these frequencies should be "opened up" by advancing their gain controls. If the Pilot wishes to receive the signals being heard by the operator, he must connect his headset plug into his "B TEL" jack, because the output of the other receivers has been connected to the "B" set of jacks.

When the radio set is operated by one individual only, all receivers may be switched to "A" or to "B," and all headset plugs connected to the corresponding jack.

On each control box the "CW OFF MCW" switch performs the functions of: (1) battery power switch, and (2) a heterodyne oscillator switch (for the reception of "CW" signals), in the receiver which is controlled by that particular control box. Remote tuning is accomplished for each receiver by a Tuning Shaft MC-215. Tuning dials on the receivers and on the radio control boxes are calibrated in kilocycles (kc.) or megacycles (mc.). The gain control (with knob marked "INCREASE OUTPUT") is a variable resistor in the cathode-to-ground circuits of the RF. and first IF. amplifier tubes of each receiver; its setting determines the sensitivity of the receiver. The design of the receivers is such that signals strong enough to produce as much as 2 volts in the antenna circuit will not overload the RF. of IF. amplifier. For reception of airways radio signals, it is important that the "volume" be kept well below the maximum.

See Asterisk Note Below.



RADIO CONTROL BOX
BC-450-A

Radio Control Box BC-473-A (for 1 Receiver) is Connected as in the First Control Section above. Radio Control Box BC-496-A (for 2 Receivers) is Connected as in the First and Third Sections above.

NOTES:

1. All Plugs and Receptacles are Shown as Viewed from the Outside.
2. Each Relay is Shown in the Non-Energized Position.
3. Capacitance Abbreviations:
   MMF, Micromicrofarads
   MDF, Microfarads.
4. Numbers Appearing on Receptacles J-1 to J-5 Inclusive are for Idenification Purposes only. They do not Appear on the Equipment.

Figure 39. Command Receiving Equipment — Schematic Circuit Diagram

CAPACITANCES	
Symbol	Description
*C-1	8.5 MMF
C-2	15 MMF
C-3	100 MMF
C-4 (A to G)	Gang
C-5	3 MFD
C-6 (ABC)	.05/.05/.05 MFD
C-7 (ABC)	.05/.05/.05 MFD
C-8	200 MMF
C-9	40 MMF
*C-10	240 MMF
C-11	3 MMF
C-12	180 MMF
C-13	17 MMF
C-14	180 MMF
C-15 (ABC)	.05/.05/.05 MFD
C-16 (ABC)	.22/.22/.22 MFD
C-17	180 MMF
C-18	17 MMF
C-19	180 MMF
C-20 (ABC)	.05/.01/.05 MFD
C-21	17 MMF
C-22	180 MMF
C-23	180 MMF
C-24	200 MMF
C-25	.001 MFD
C-26*	100 MMF
C-27*	180 MMF
C-28	34 MMF
C-29	.006 MFD
C-30	15 MFD
C-31	.001 MFD
C-32	5 MFD
*C-33	Less than 2 MMF
C-34	.001 MFD
C-35	750 MMF

INDUCTANCES	
Symbol	Description
L-1	Ant. Input
L-2, L-3	RF Amp.
L-4, L-5	RF Osc.
L-6, L-7	In 1st IF
L-8, L-9	In 2nd IF
L-10, L-11	In 3rd IF
L-12, L-13	CW OSC
L-14	RF Choke, 112 H
L-15	AF Choke 3 H

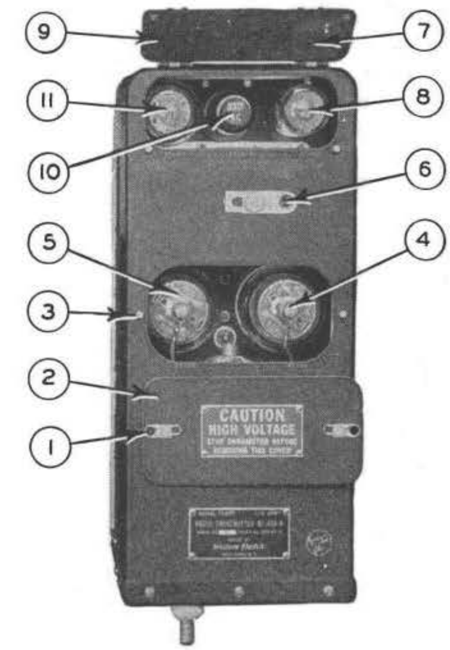
RESISTANCES	
Symbol	Ohms
R-1	620
R-2	2,000,000
R-3	51,000
R-4	620
R-5	150,000
R-6*	150,000
R-7	200
R-8	200
R-9	620
R-10	360,000
R-11	100,000
R-12	510
R-13	200
R-14*	100,000
*R-15	5,100
*R-16	51,000
*R-17	51,000
R-18	510,000
R-19	100,000
R-20	2,000,000
R-21	1,500
R-22	7,000
R-23	7,000
R-25	0-50,000
R-26	0-50,000
R-27	0-50,000

MISCELLANEOUS	
Symbol	Description
T-1	2.2 to 1 Output Transformer
V-1, V-2	Neon Tubes
K-1, K-2, K-3	Rec. Output—Trans. Sidetone Relays
F-1,F-2,F-3	10A Fuses

* Values shown with an asterisk vary with the Radio Receiver. Those shown in this table apply to Radio Receiver BC-455-A (6-9.1 MC) only.

OPERATION OF THE TRANSMITTERS—Accessories are provided for the remote operation of the two transmitters. One transmitter is preset on one 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" for the signals to be transmitted on either of the two frequencies. All transmitter controls are associated with Radio Control Box BC-451-A. Assuming that the equipment has been installed, tested, and tuned up, according to instructions, the operator need learn only the following few directions:

1. Set the "TRANSMITTER SELECTOR" switch to the desired preset transmitting frequency indicated on the "write-in" plate.
2. Set the signal selector 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 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. Antenna current will be indicated on Ammeter I-71-B, located in the box, housing the antenna relay BC-442-A, whenever the "press-to-talk" button is closed. Side tone should be heard distinctly whenever transmitting.



Unit 2-1 or 2-2

Figure 41. Command Transmitter —Open View

Unit 2-1 or 2-2—Command Transmitter
(1)—Cover plate slide fastener
(2)—Cover plate
(3)—Slide fastener holding stud
(4)—VT136 RF Amp. tubes
(5)—VT136 RF Amp. tubes
(6)—Master Oscillator Trimmer
(7)—Mirror for viewing resonance indicator
(8)—VT 138 Resonance indicator tube
(9)—Cover
(10)—Crystal
(11)—VT 137 Master Oscillator Tube

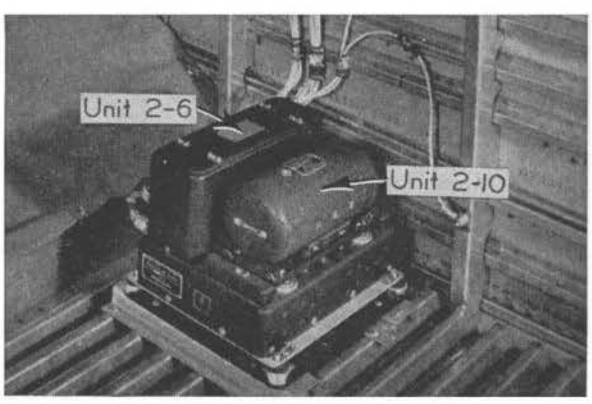


Figure 40. Command Modulator and Dynamotor Prior to 41-23640

Installation Above Right Aft Bomb Bay
Unit 2-6—Command Modulator

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 Radio Control Box BC-451-A, 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.

CAPACITANCES	
Symbol	Microfarads
C-50	.006
C-51 (A, B, C)	.05/.05/.05
C-52	.006
C-53	1.2
C-54 (A, B)	5/20
C-55	1.2
C-56 (A, B)	5/5
C-57	.05
C-58 (A, B, C)	.05/.05/.05
C-59	.00018
C-60	Mo. Padding
C-61	.006
C-62	Fixed Neutr.
C-63	Mo. Tuning
C-64	.002
C-65	Pa Tuning
C-66	.01
C-67	Pa. Padding
C-68	.000003
C-69	.00005

RELAYS	
Symbol	Description
K-50	Dynamotor Input
K-51	Sidetone Voice and Tone
K-52	Dynamotor High Voltage (Keying)
K-53	Transmitter Selector
K-54	Transmitter Output
K-55	Antenna Switching. Rec. to Trans.

INDUCTANCES	
Symbol	Description
L-50	RF Choke Approx. 15 Microhenries
L-51	1.7 Henries
L-52	Ant. Tuning Inductor

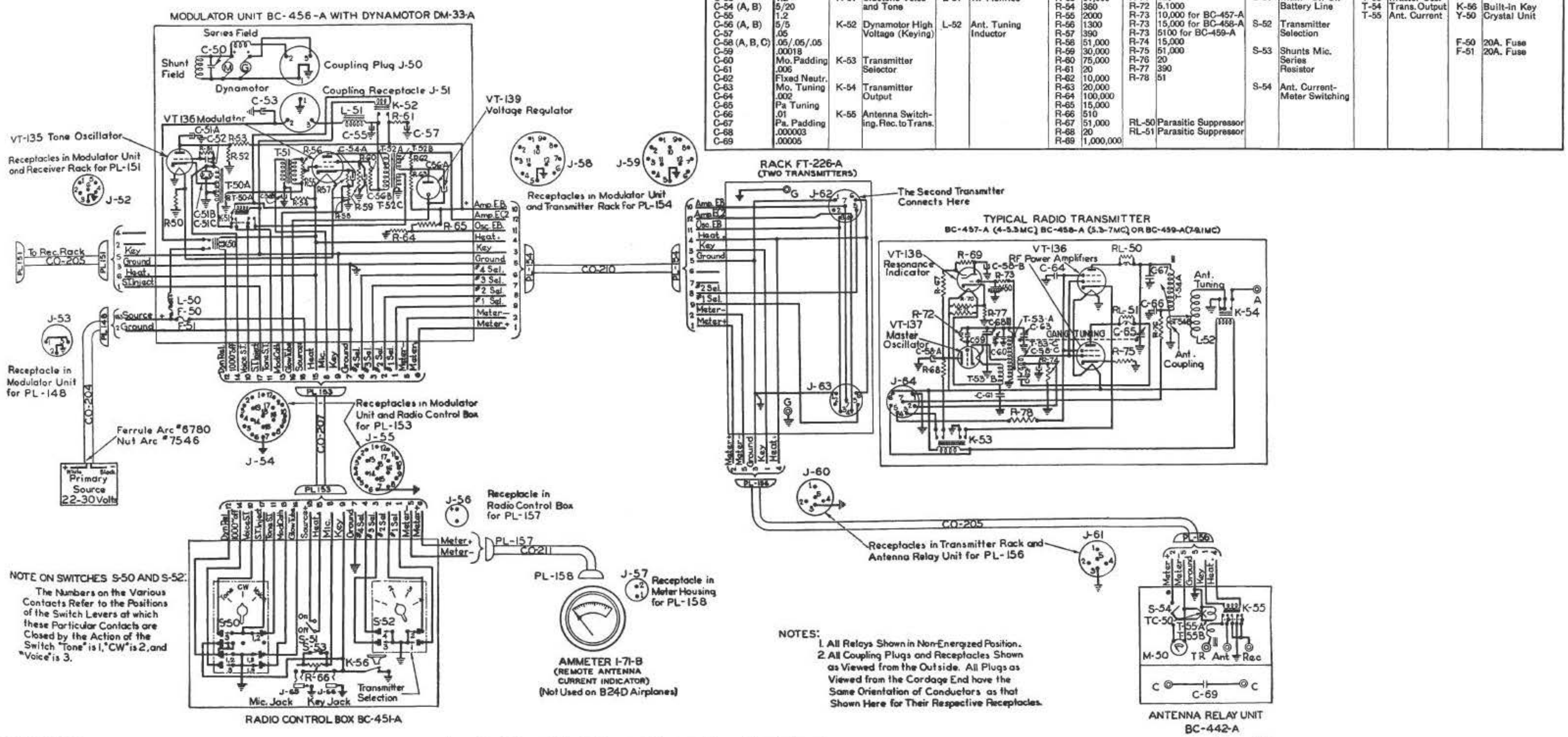
RESISTANCES	
Symbol	Ohms
R-50	42
R-51	100,000
R-52	300,000
R-53	91,000
R-54	360
R-55	2000
R-56	1300
R-57	390
R-58	51,000
R-59	30,000
R-60	75,000
R-61	20
R-62	10,000
R-63	20,000
R-64	100,000
R-65	15,000
R-66	510
R-67	51,000
R-68	20
R-69	1,000,000

RESISTANCES CONT.	
Symbol	Description
R-70	1000 for BC-457-A
R-70	1000 for BC-458-A
R-70	1500 for BC-459-A
R-71	126
R-72	5.1000
R-73	10,000 for BC-457-A
R-73	15,000 for BC-458-A
R-73	5100 for BC-459-A
R-74	15,000
R-75	51,000
R-76	20
R-77	390
R-78	51
RL-50	Parasitic Suppressor
RL-51	Parasitic Suppressor

SWITCHES	
Symbol	Description
S-50	Choice of Emission
S-51	Main "On-Off" Battery Line
S-52	Transmitter Selection
S-53	Shunts Mic. Series Resistor
S-54	Ant. Current-Meter Switching

TRANSFORMERS	
Symbol	Description
T-50	Tone Osc.
T-51	Microphone
T-52	Modulation
T-53	Master Osc.
T-54	Trans. Output
T-55	Ant. Current

MISCELLANEOUS	
Symbol	Description
TC-50	Thermocouple
M-50	Ant. Current Indicator (Local)
K-56	Built-in Key
Y-50	Crystal Unit
F-50	20A. Fuse
F-51	20A. Fuse



NOTE ON SWITCHES S-50 AND S-52:
The Numbers on the Various Contacts Refer to the Positions of the Switch Levers at which these Particular Contacts are Closed by the Action of the Switch "Tone" is 1, "CW" is 2, and "Voice" is 3.

NOTES:
1. All Relays Shown in Non-Energized Position.
2. All Coupling Plugs and Receptacles Shown as Viewed from the Outside. All Plugs as Viewed from the Cordage End have the Same Orientation of Conductors as that Shown Here for Their Respective Receptacles.

Figure 42. Schematic Circuit Diagram of Command Transmitting Equipment

6. To transmit on "TONE" or "CW" turn the signal selector switch to the appropriate position. Dynamotor DM-33-A 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. 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 signal selector switch should be left on "VOICE," unless continued use on "TONE" or "CW" is expected.

NOTE: In case of tube failure in any one unit, either transmitter or receiver, if no spare tubes are carried, substitute a like tube from one of the unused units. This is accomplished by removing the tops of the units which are held in place by slide fasteners (see Figures 38 and 41) and interchanging tubes.

CAUTION: Be sure that **POWER** supply is **turned off** when making this change.

Receiver dynamotors are identical and may be interchanged by loosening slide fasteners (see Figure 38) and unplugging (lifting up) these units.

TABLE 1

UNITS SUPPLIED AS PART OF RADIO SET SCR-274-N ON ORDER 1509-NY-41

(COMMAND EQUIPMENT)

Quantity per Radio Set	Name of Major Unit or Accessory	Western Elec. Co. Drawing Number
1	Ammeter I-71-B	7550
1	Antenna Relay Unit BC-442-A	5017
1	Book, Instruction, for Radio Set SCR-274-N	
**	Cordage CO-204 (2-conductor)	6712
**	Cordage CO-205 (6-conductor)	6794
**	Cordage CO-206 (8-conductor)	6711
**	Cordage CO-207 (18-conductor)	6796
**	Cordage CO-210 (12-conductor)	6795
**	Cordage CO-211 (2-conductor)	3251
3	Coupling MC-211-A (right angled)	6357
3	Dynamotor DM-32-A (receiver)	7351
1	Dynamotor DM-33-A (transmitter modulator)	5168
2	Ferrule (used on primary power supply cords)	6780
1	Modulator Unit BC-456-A	7591
1	Mounting FT-221-A (for Rack FT-220-A)	7060
*	Mounting FT-222-A (for Radio Control Box BC-450-A)	7054

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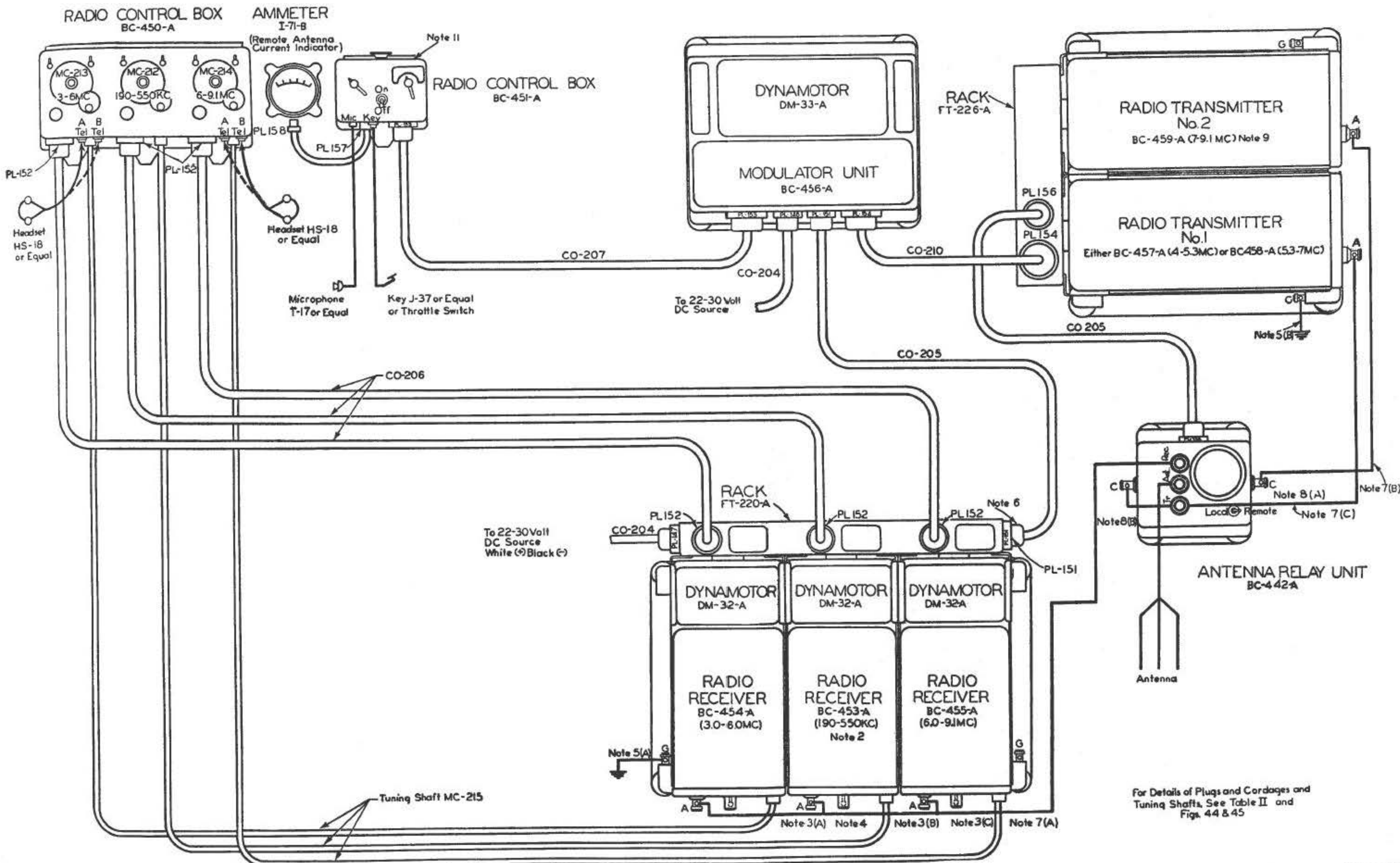
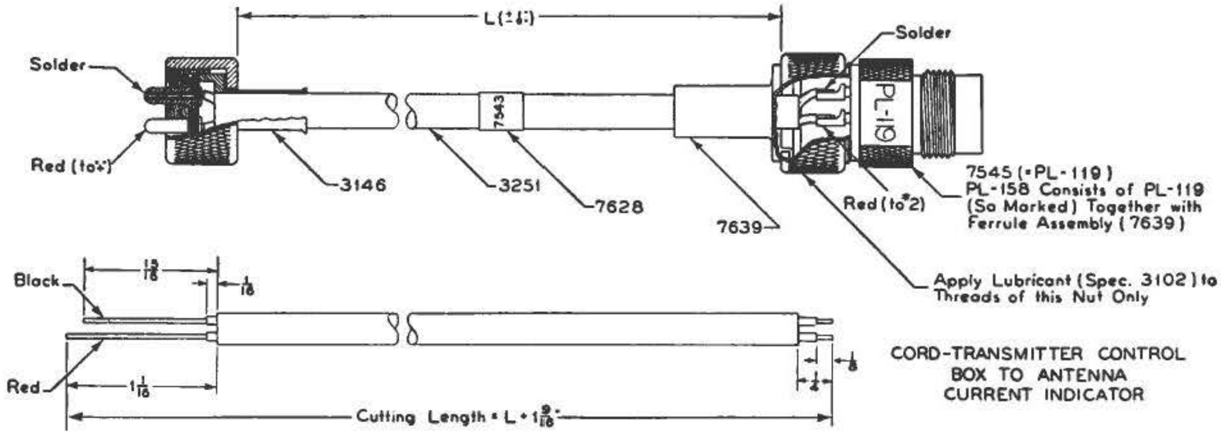
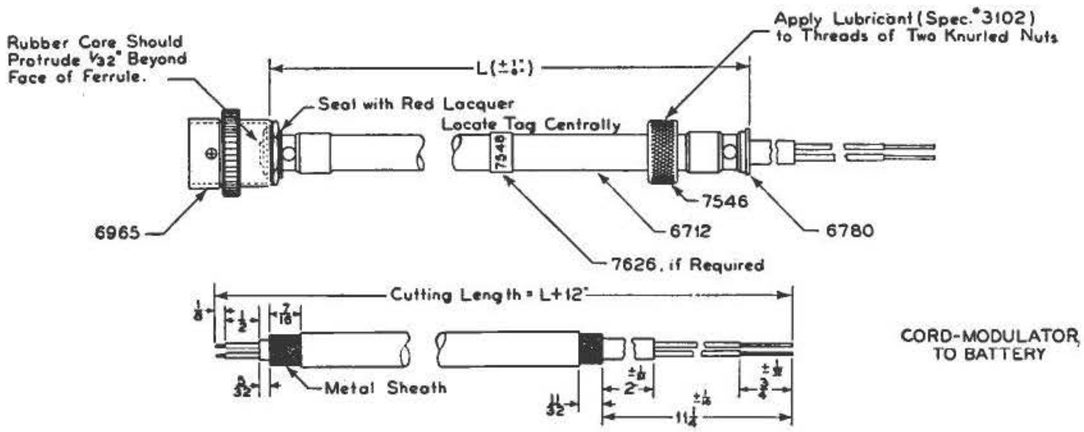


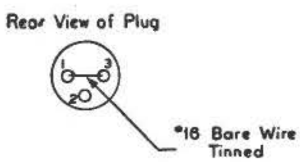
Figure 43. Command Equipment Cording Diagram



CORD-TRANSMITTER CONTROL BOX TO ANTENNA CURRENT INDICATOR

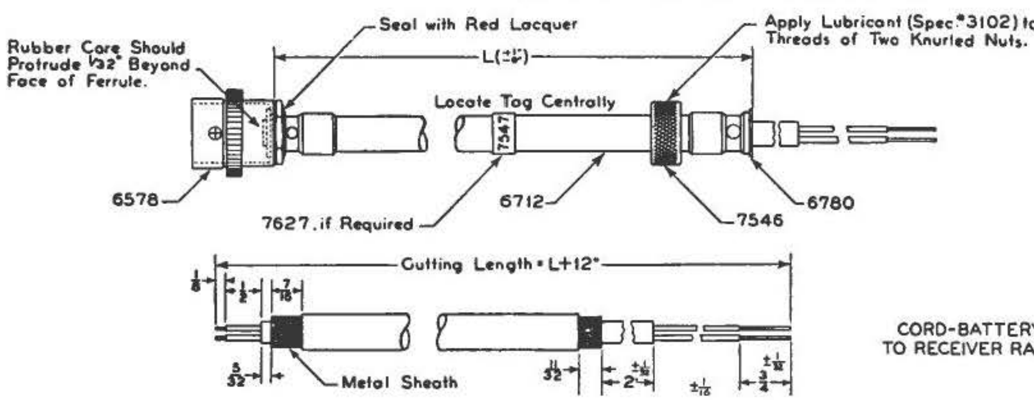


CORD-MODULATOR TO BATTERY

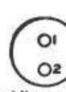


Assembly Procedure:

A. Strip Cable Ends to Dimensions Indicated.
B. Tin Ends of Conductors.
C. Insert Cable into Plug Assembly and Ferrule.
D. Back off Nuts, Washer, and Shell.
E. Solder Wires to Respective Jacks per Wiring Color Code.
F. Solder Ferrules Thoroughly to Sheath Through 8 Side Holes. Ferrule Pin of Plug 6965 Should Be in Line with Jack *2.
G. Assemble Insulator Assembly into Shell with Screw; Bring Pin into Slot in Shell; then Tighten and Seal Nut.



CORD-BATTERY TO RECEIVER RACK



Assembly Procedure:

A. Strip Cable Ends to Dimensions Indicated.
B. Tin Ends of Conductors.
C. Insert Cable into Plug Assembly and Ferrule.
D. Back off Nuts, Washer, and Shell.
E. Solder Wires to Respective Jacks per Wiring Color Code.
F. Solder Ferrules Thoroughly to Sheath Through 8 Side Holes. Ferrule Pin of Plug 6578 Should Be in Line with Jack*2.
G. Assemble Insulator Assembly into Shell with Screw; Bring Pin into Slot in Shell; then Tighten and Seal Nut.

Figure 44. Command Equipment Cording Diagrams

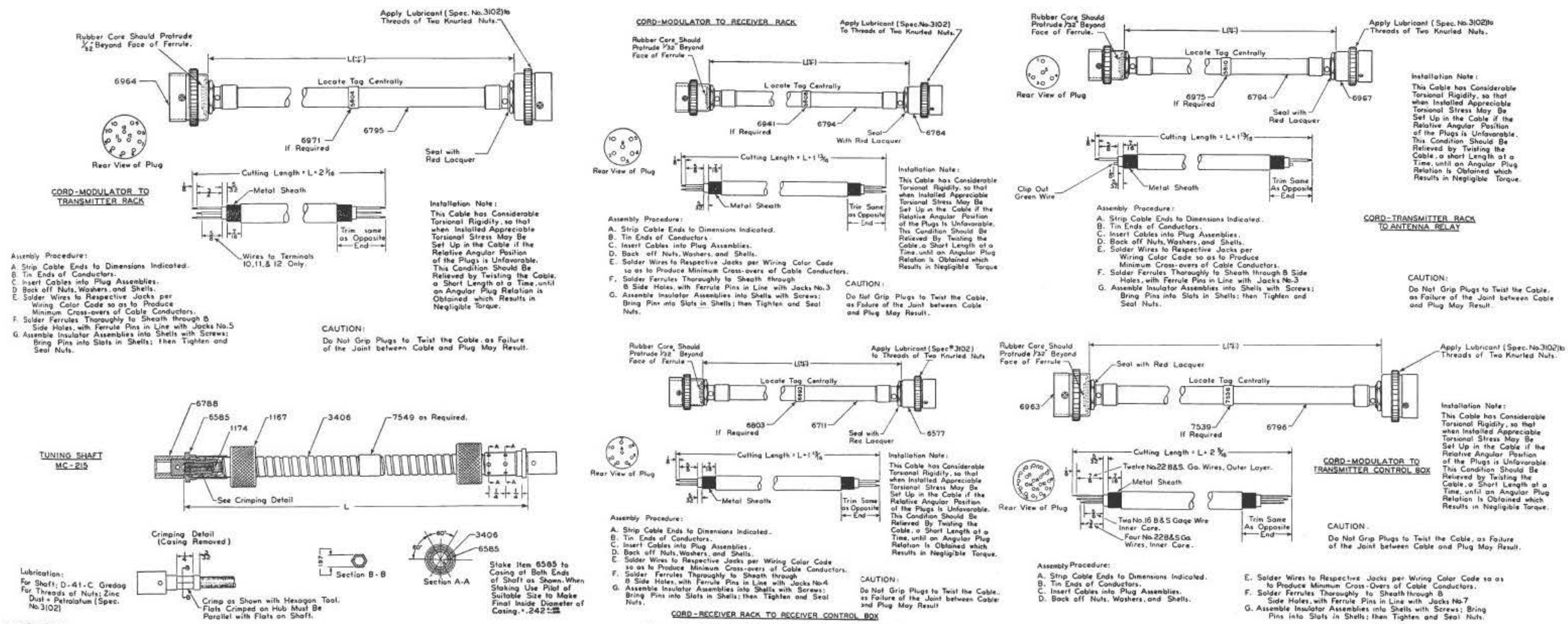


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Figure 45. Cords and Tuning Shafts for Command Equipment

TABLE 1—Continued

UNITS SUPPLIED AS PART OF RADIO SET SCR-274-N ON ORDER 1509-NY-41
(COMMAND EQUIPMENT)

(Continued from page 36)

Quantity per Radio Set	Name of Major Unit or Accessory	Western Elec. Co. Drawing Number
1	Mounting FT-225-A (for Modulator Unit BC-456-A)	7058
1	Mounting FT-227-A (for Rack FT-226-A)	7062
1	Mounting FT-228-A (for Radio Control Box BC-451-A)	7083
1	Mounting FT-229-A (for Antenna Relay Unit BC-442-A)	7056
2	Nut (used on primary power supply cords)	7546
1	Plug PL-147 (2-contact)	6578
1	Plug PL-148 (2-contact)	6965
2	Plug PL-151 (6-contact)	6784
6	Plug PL-152 (8-contact)	6577
2	Plug PL-153 (18-contact)	6963
2	Plug PL-154 (12-contact)	6964
2	Plug PL-156 (5-contact)	6967
1	Plug PL-157 (2-contact)	3146
1	Plug PL-158 (2-contact)	7543
1	Rack FT-220-A (for 3 radio receivers)	7537
1	Rack FT-226-A (for 2 radio transmitters)	5020
*	Radio Control Box BC-450-A (for 3 receivers) Includes: 1 Dial MC-212 (190-550 kc) 1 Dial MC-213 (3.0-6.0 mc) 1 Dial MC-214 (6.0-9.1 mc)	5014
1	Radio Control Box BC-451-A (1 to 4 transmitters)	7095
1	Radio Receiver BC-453-A (190-550 kc) Includes: 1 Adapter FT-230-A (Remote Control)	7594
1	Radio Receiver BC-454-A (3.0-6.0 mc) Includes: 1 Adapter FT-230-A (Remote Control)	7595
1	Radio Receiver BC-455-A (6.1-9.1 mc) Includes: 1 Adapter FT-230-A (Remote Control)	7596
*	Radio Transmitter BC-458-A (5.3-7.0 mc)	7633
*	Radio Transmitter BC-459-A (7.0-9.1 mc)	7634
1	Tube Set (for Modulator Unit BC-456-A) Includes: 1 Tube VT-135 (RMA 12J5FT) 1 Tube VT-136 (RMA 1625) 1 Tube VT-139 (RMA VR-150-30)	

TABLE 1—Continued

UNITS SUPPLIED AS PART OF RADIO SET SCR-274-N ON ORDER 1509-NY-41

(COMMAND EQUIPMENT)

Quantity per Radio Set	Name of Major Unit or Accessory	Western Elect. Co. Drawing Number
3	Tube Set (for a receiver) Includes: 3 Tube VT-131 (RMA 12SK7) 1 Tube VT-132 (RMA 12K8) 1 Tube VT-133 (RMA 12SR7) 1 Tube VT-134 (RMA 12A6)	
2	Tube Set (for a transmitter) Includes: 2 Tube VT-136 (RMA 1625) 1 Tube VT-137 (RMA 1626) 1 Tube VT-138 (RMA 1629)	
**	Tuning Shaft MC-215	6151

Test Set RC-54-A (for receiver testing) (Used with but not part of Radio Set SCR-274-N) consists of Test Unit I-84-A, Rack FT-233-A, Mounting FT-231-A, one kit of special tools including 3 each of: Tube Extractor No. 7489, Bristo Wrench No. 8021, Phillips Screwdriver No. 8020; Cord 7547 assembled, Cord 6693 assembled, and Cord 7392 assembled. (Cord numbers shown are Western Electric drawing numbers of the cord assemblies.)

Test Set RC-55-A (for transmitter testing) (Used with but not part of Radio Set SCR-274-N) consists of Test Unit I-85-A, Rack FT-234-A Mounting FT-232-A, Modulator Unit BC-456-A, Mounting FT-225-A, Dynamotor DM-33-A, Radio Control Box BC-451-A, Mounting FT-228-A, Antenna A-61-A, one kit of special tools including 3 each of: Tube Extractor No. 7489, Bristo Wrench No. 8021, Phillips Screwdriver No. 8020; 2 Cords, 5804 assembled, Cord 7548 assembled, Cord 7538 assembled. (Cord Numbers shown are Western Electric drawing numbers of the cord assemblies.)

*Variable, depending upon operating requirements.

**Cordage and Tuning Shaft are supplied in variable quantities.

TABLE II

PLUGS AND CORDAGES REQUIRED TO ASSEMBLE CORDS FOR USE WITH RADIO SET SCR-274-N
(COMMAND EQUIPMENT)

Cord	Plugs	Western Electric Part No.	Cordage	Western Electric Part No.	For Details of Assembly and Wiring, See Western Elec. Dwg. No. *
Primary power supply to Rack FT-220-A (1 req.)	PL-147 Nut Ferrule (1 req. perCord)	6578 7546 6780	CO-204	6712	7547-2-B
Primary power supply to Modulator Unit BC-456-A (1 req.)	PL-148 Nut Ferrule (1 req. perCord)	6965 7546 6780	CO-204	6712	7548-2-B
Modulator Unit BC-456-A to Rack FT-220-A (1 req.)	PL-151 (2 req. perCord)	6784	CO-205	6794	5808-2-C
Receiver radio control box to Rack FT-220-A (3 Req. for 3 Rec.)	PL-152 (2 req. perCord)	6577	CO-206	6711	6693-2-C
Modulator Unit BC-456-A to Radio Control Box BC-451-A (1 req.)	PL-153 (2 req. perCord)	6963	CO-207	6796	7538-2-B
Modulator Unit BC-456-A to Rack FT-226-A (1 req. for 2-Trans. Installation)	PL-154 (2 req. perCord)	6964	CO-210	6795	5804-2-C
Rack FT-226-A to Antenna Relay Unit BC-442-A (1 req.)	PL-156 (2 req. perCord)	6967	CO-205	6794	5810-2-C
Radio Control Box BC-451-A to Ammeter I-71-B (1 req.)	PL-157 (1 req. perCord) and PL-158 (1 req. perCord)	3146 7545 and 7639	CO-211	3251	7543-2-B *Numbers appearing Figures

An Assembly Drawing of Tuning Shaft MC-215 is shown in Western Electric Drawing No. 6151-2-B, Figure 45. Three tuning shafts MC-215 are required for remotely tuning three receivers.

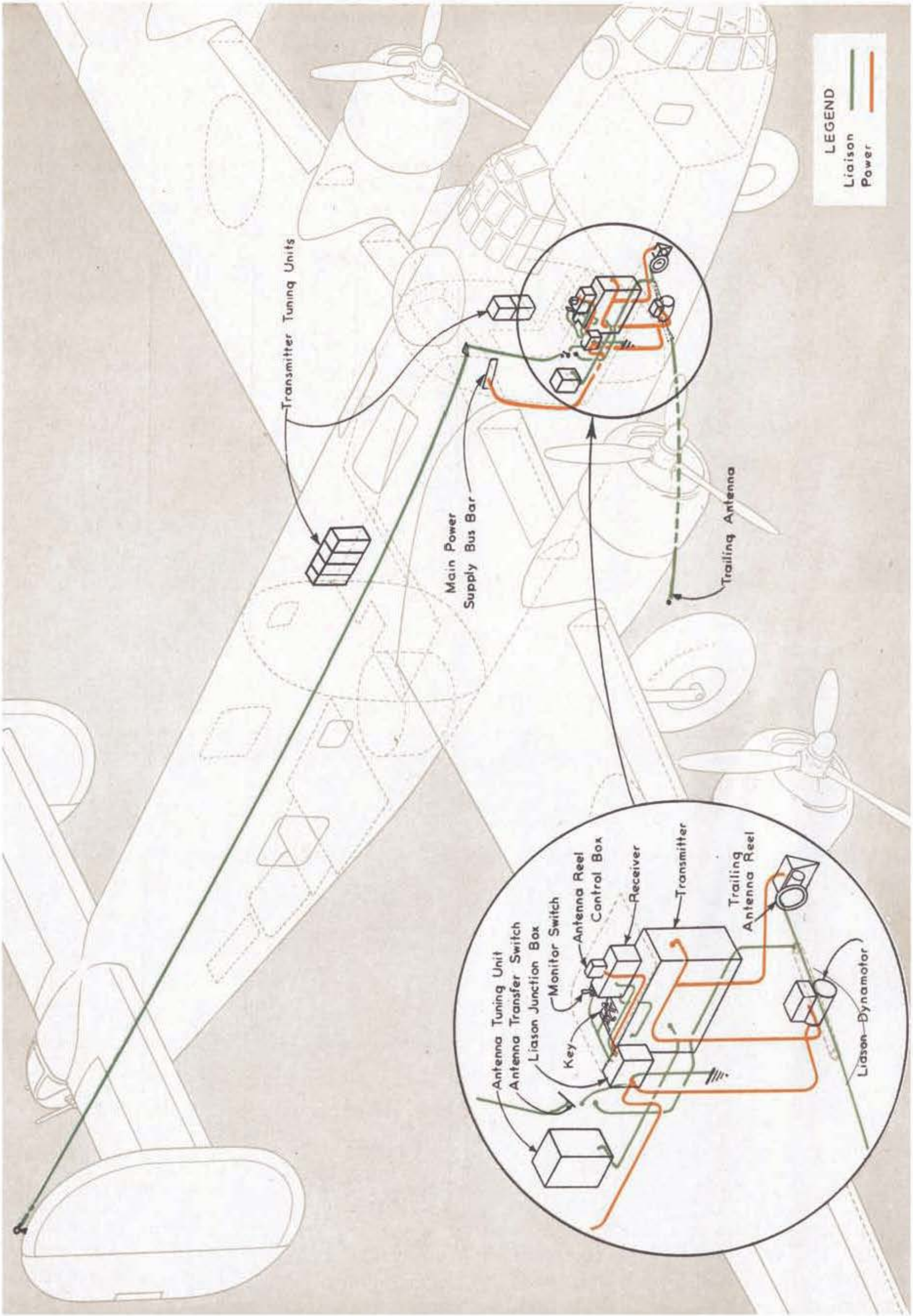
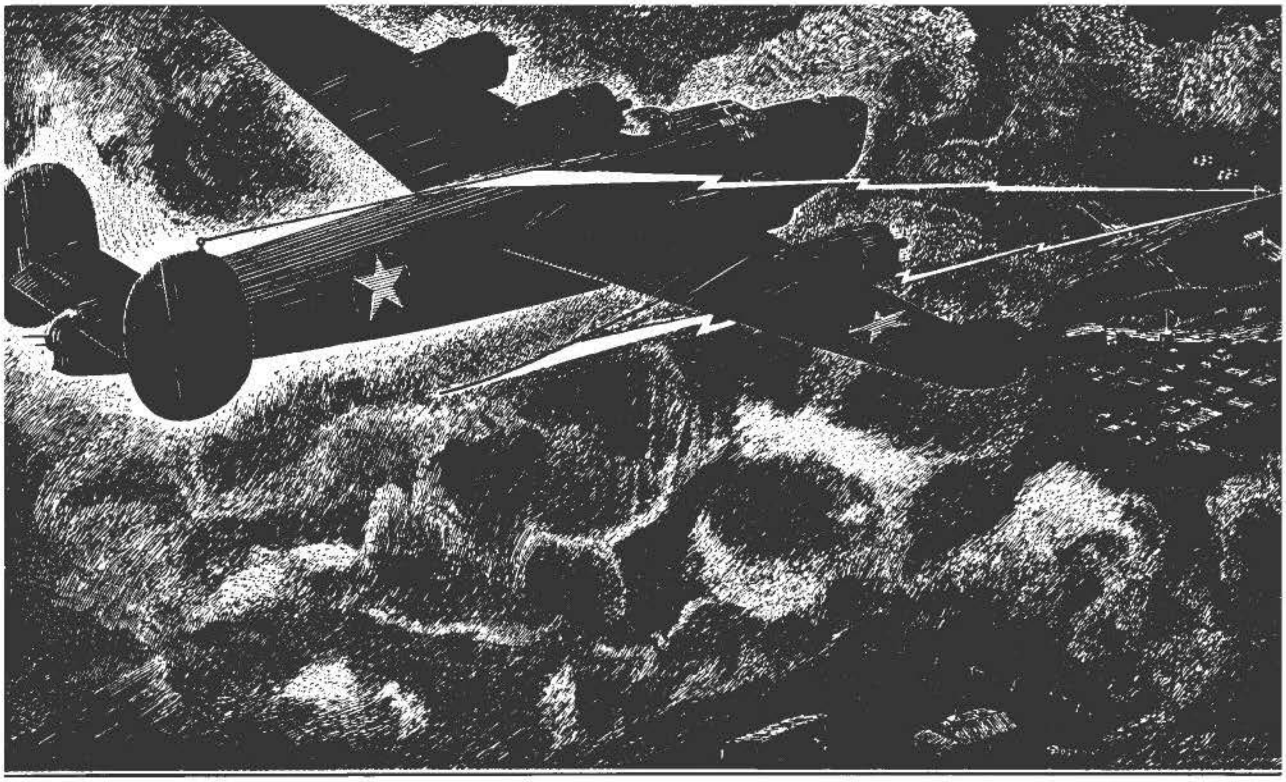


Figure 46. General Location of Liaison Equipment and Main Cable Routing



Chapter IV

LIAISON RADIO EQUIPMENT

LIAISON RADIO EQUIPMENT—Unit 3—The Liaison Radio Equipment is identified as SCR-287-A equipment and includes the following units:

Unit 3-1	One BC-375-D Transmitter. Figures 50 and 51.			
3-2	One BC-348-H Receiver. Tuning Range 1,500 KC. to 18,000 KC. Figure 47.			
*3-3	One TU-26	Transmitter Tuning Unit Frequency Range	200 to	500 KC.†
3-4	One TU-5B	Transmitter Tuning Unit Frequency Range	1,500 to	3,000 KC.†
3-5	One TU-6B	Transmitter Tuning Unit Frequency Range	3,000 to	4,500 KC.†
3-6	One TU-7B	Transmitter Tuning Unit Frequency Range	4,500 to	6,200 KC.†
3-7	One TU-8B	Transmitter Tuning Unit Frequency Range	6,200 to	7,700 KC.†
3-8	One TU-9B	Transmitter Tuning Unit Frequency Range	7,700 to	10,000 KC.†
3-9	One TU-10B	Transmitter Tuning Unit Frequency Range	10,000 to	12,500 KC.†

NOTE: Units 3-3 to 3-9 inclusive are removable units installed in Units 3-1 to change frequency range.

* In case of shortage, Unit TU-26 may be replaced with Unit TU-22B (350-650 KC.).

† Figures 48, 50, 51, and 52.

Six CS-48 Stowage cases for transmitter tuning units.

3-10 One PE-73-C Dynamotor (Liaison). Figure 63.

3-11 One BC-306-A Antenna tuning unit. Figure 55.

3-12 SCR-211-D Frequency meter. Figure 129.

3-13 One J-37 Transmitting Key. Figure 47.

3-14 One RL-42 Antenna Reel. Figure 49.

3-15 One MC-163 Antenna Fairlead. Figure 49.

3-16 One F-10 Trailing Antenna. Figure 49.
One W-T-7A, SC-D-3338 Antenna Weight.

3-17 One X41-B10A16 Antenna Transfer Switch. Figure 55.

3-18 One BC-461 Antenna Reel Control Box. Figure 47.

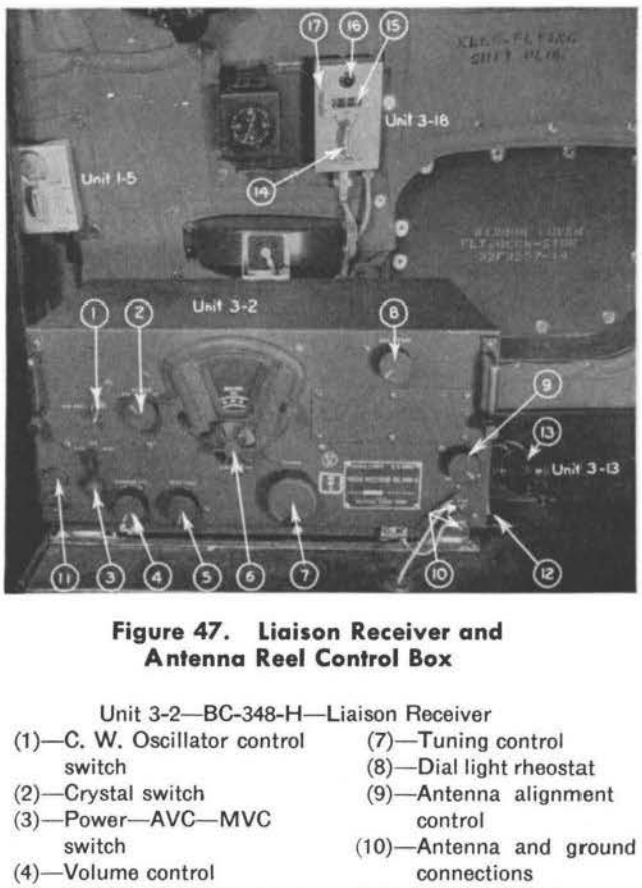


Figure 47. Liaison Receiver and Antenna Reel Control Box

Unit 3-2—BC-348-H—Liaison Receiver

(1)—C. W. Oscillator control switch
(2)—Crystal switch
(3)—Power—AVC—MVC switch
(4)—Volume control
(5)—C. W. Oscillator beat frequency control
(6)—Band change switch and dial
(7)—Tuning control
(8)—Dial light rheostat
(9)—Antenna alignment control
(10)—Antenna and ground connections
(11)—Telephone jacks
(12)—Monitor switch

Unit 3-13

(13)—Transmission key

Unit 3-18—BC-461—Antenna Reel Control Box

(14)—Reel control switch
(15)—Reel footage indicator
(16)—Reel indicating light
(17)—Indicator re-set

These units are located through the airplane as follows:

BC-375-D Transmitter Unit 3-1—Under radio table, right side of flight deck behind Co-Pilot.

Two CS-48 Stowage Boxes for transmitter tuning units—Left rear of flight deck.

Two TU Tuning Units in flight deck stowage.

Four CS-48 Stowage Boxes — Above bomb bay, left side, aft of wing center section.

Four TU units in stowage above bomb bay.

One BC-348-H receiver Unit 3-2—On operator's table behind Co-Pilot.

One PE-73-C Dynamotor Unit 3-10–Under flight deck, forward of anti-icer motors.

One J-37 Key Unit 3-13—On operating table.

One RL-42 Antenna Reel—Under flight deck, forward of dynamotor on flight deck floor brace.

One MC-163 and F10 Antenna Fairlead and Trailing Antenna—Under flight deck, right side.

One BC-306-A Antenna Tuning Unit—Right rear of flight deck, aft of radio table.

One SCR-211-D Frequency Meter—Right rear section of flight deck. Portable equipment used for frequency checking.

BC-461 Antenna Reel Control Box—Right wall of cabin above radio table.

X41-B10A16 Antenna Switch—Right wall of cabin, aft of radio table.

The liaison equipment is used generally for long distance communication between the airplane and base or airplane and ground stations. It is used primarily for reporting ship position or flight progress. Control of liaison equipment is held by the Radio Operator.

Liaison Equipment Operation—The liaison receiver face contains nine controls, as follows (see Figure 47):

1. C. W. Oscillator—"OFF" and "ON" Switch—upper left.
2. Crystal "IN" and "OUT" Switch—to the right of C. W. Oscillator switch.
3. Power Switch ("A.V.C.") or ("M.V. C,")—below oscillator switch.
4. Volume Control—lower left side of face.
5. Beat frequency pitch control—to the right of volume control.
6. Band Change Switch—lower portion of dial.
7. Tuning Control—below and to the right of dial assembly.
8. Dial Light Rheostat—upper right.
9. Antenna Alignment—extreme right center.

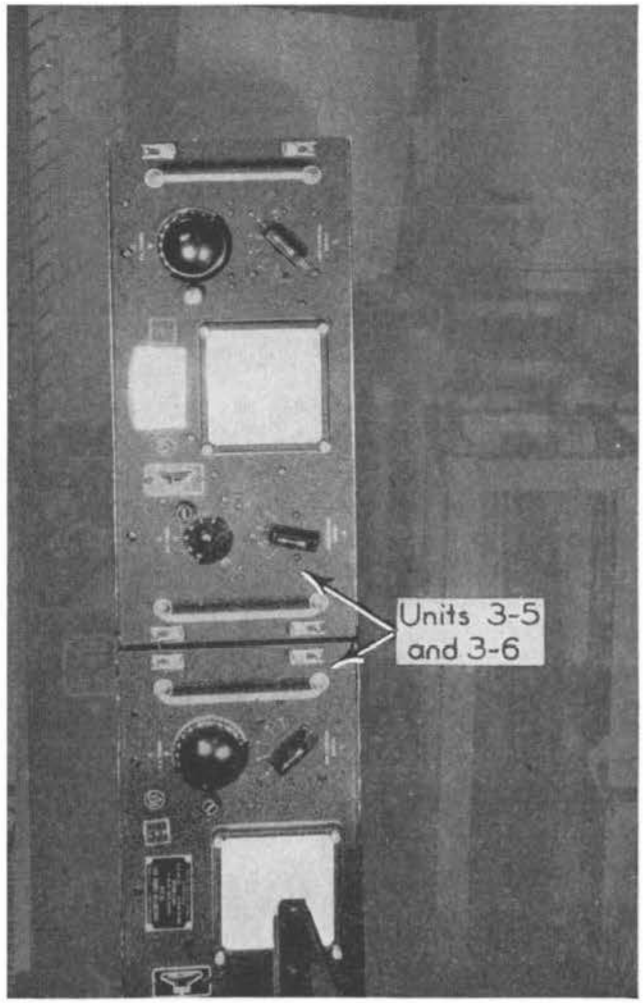


Figure 48. Antenna Tuning Units for Liaison Transmitter
Units 3-5 & 3-6—Transmitter Tuning Units Stowed on Flight Deck

In addition to the above nine controls, there are four connectors located on the face of the receiver. At the extreme right in the lower corner are the terminals for the antenna and ground (10). At the extreme lower left are two jacks for headset attachment plugs PL-55 (11).

The liaison receiver is in operation when the switch (3) is in either "AVC" or "MVC" position. The tuning control is operated with the power switch in the "MVC" position. After location of the desired signal, adjust volume to desired intensity and throw power switch to "AVC" for automatic maintenance of desired volume. **For reception with the liaison receiver, the "Monitor Switch"** (12) mounted on the

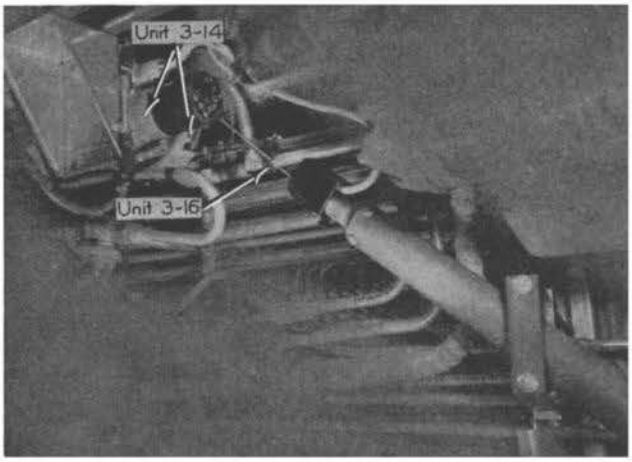


Figure 49. Liaison Trailing Antenna Installation

Unit 3-14—RL-42—Antenna Reel
Unit 3-16—F-10—Trailing Antenna

The receiver dynamotor is contained within the receiver and is only accessible by removing the receiver from its case.

Liaison receiver output is available at any interphone junction box in the airplane.

For CW reception the beat frequency oscillator with its manual pitch control may be used either with or without the crystal filter at the option of the operator.

LIAISON TRANSMITTER—The liaison transmitter Unit 3-1, Figures 50 and 51, has the following controls and indicators on the front of the panel:

1. Power Switch.
2. Filament Voltmeter.
3. Voltmeter Switch.
4. Master Oscillator Tuning Controls.
5. Test Key.
6. Output Control Switch.
7. Plate Current Meter.
8. Antenna Current Meter.
9. Antenna Tuning Control (Inductance).

operator's table between the J-37 key (3-13) and the receiver, **must be in the "Normal"** position. The "Monitor" position is used when it is desired to operate the liaison receiver for a check on the liaison transmitter tuning or adjustment. For further details on this check, see "Liaison Transmitter Operation" which follows.

Band switching is accomplished by turning of the control knob (6). The band in use is indicated through the dial mask.

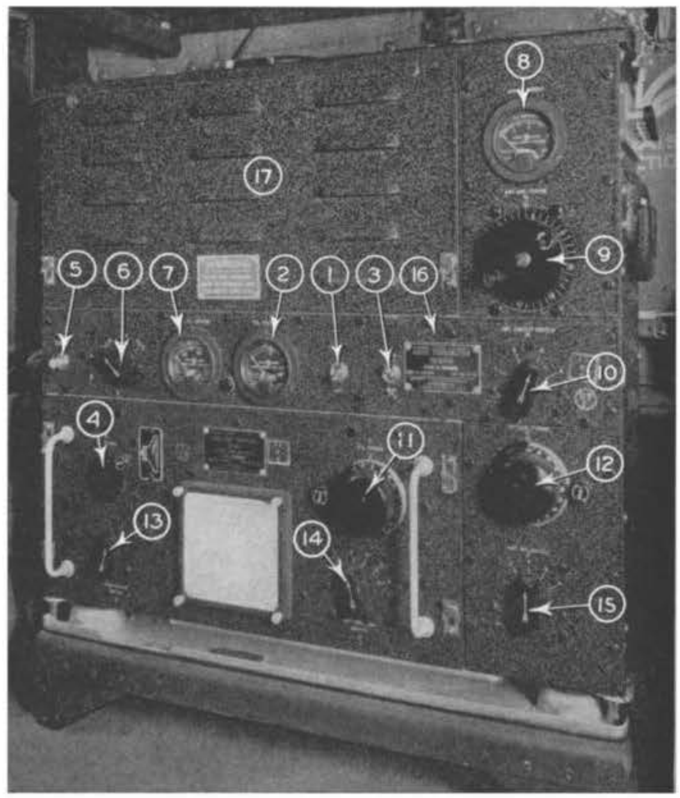


Figure 50. Liaison Transmitter

Unit 3-1—Liaison Transmitter

(1)—Power switch
(2)—Filament Voltmeter
(3)—Voltmeter switch
(4)—Master Oscillator Tuning Controls
(5)—Test Key
(6)—Output control switch
(7)—Plate Current Meter
(8)—Antenna Current Meter
(9)—Antenna Tuning Control (Inductance)
(10)—Antenna Circuit Switch
(11)—Power Amplifier Tuning Dial
(12)—Antenna Tuning Control (Capacity)
(13)—Band change switch
(14)—Antenna coupling switch
(15)—Antenna Inductance Selector Switch
(16)—Calibration re-set port
(17)—Tube shield

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10. Antenna Circuit Switch.
11. Power Amplifier Tuning Dial.
12. Antenna Tuning Control (Capacity).
13. Band Change Switch.
14. Antenna Coupling Switch.
15. Antenna Inductance Selector Switch.
16. Calibration reset port.
17. Tube shield.

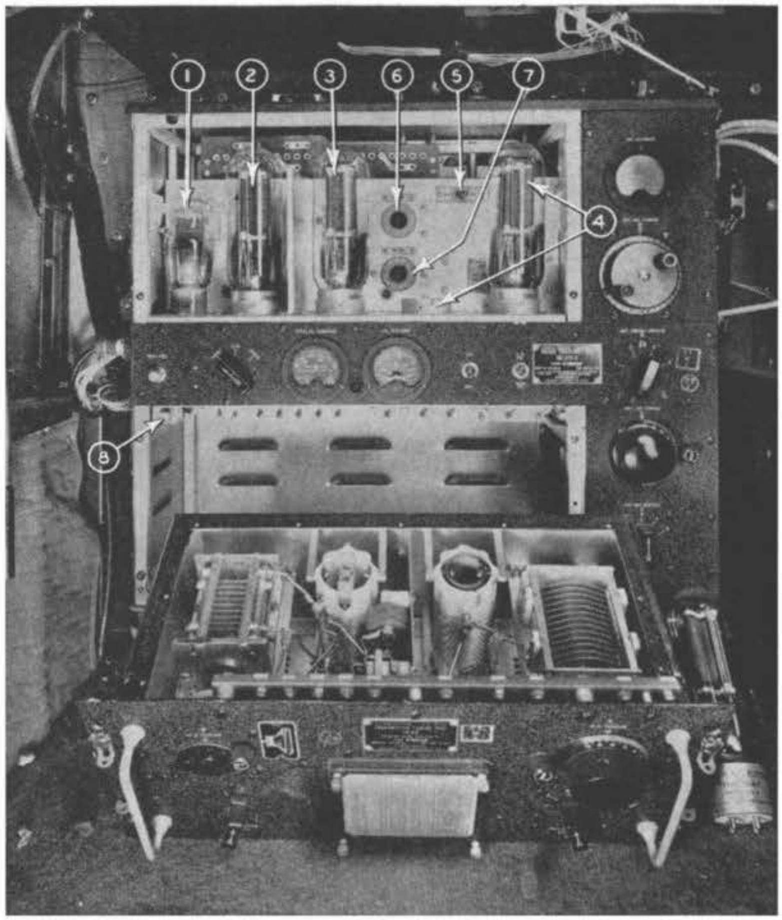


Figure 51. Liaison Transmitter—Open View

The Liaison Transmitter Dynamotor Unit 3-10 (Figure 63) is mounted under the flight deck right side, and supplies high D.C. plate voltage to the transmitter.

The Liaison transmitter Unit 3-1 Figure 50 is turned "ON" and "OFF" by the power switch (1) mounted on the face of the transmitter. **When the transmitter is "ON" it is important that the filament voltage be closely maintained at 10 volts** as indicated on the voltmeter (2). The C.W. and Modulator filaments are checked individually by means of a selector switch (3).

If it is found that the filament voltage must be raised or lowered to maintain the 10 volts needed, turn off the power switch (1) Figure 50 and remove the cover over the tube section. Varying the placement of the metal links on the terminal strip behind the VT25 and VT-4-C in the left compartment will correct the trouble. See Figure 51. This adjustment must only be made if proper voltage is not obtained with switch (5) in the 28 volt position and the engine running with engine generators on.

When the airplane is on the ground, if it is desired to operate the equipment **from the 24 volt batteries only,** switch (5) should be thrown to the 24 volt position.

CAUTION: Do not leave the ship with switch (5) in the 24 volt position. To do so will cause damage to the equipment if the Liaison Equipment is operated with the engine generators turned on, since excessive voltage will be fed to parts of the apparatus.

Each tuning unit, Figures 48 and 52 contains the necessary tuned or tunable circuits to permit operation on a frequency band within the limits as specified on the calibration

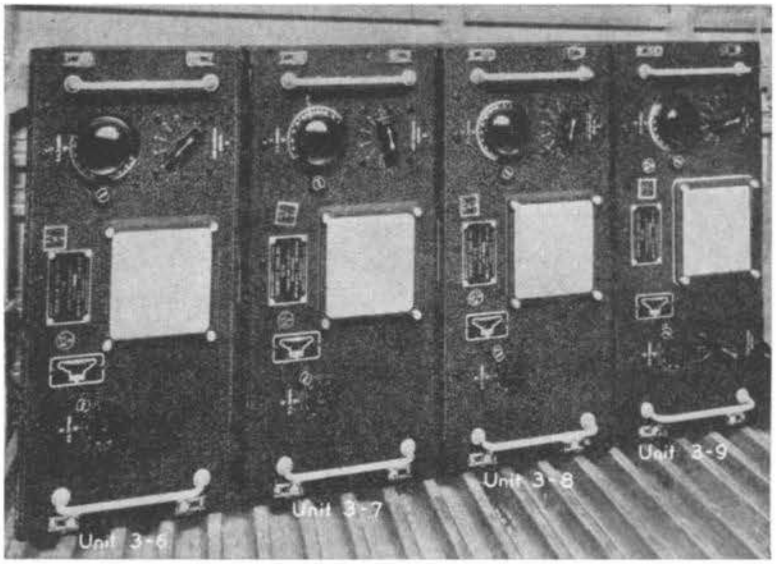


Figure 52. Antenna Tuning Units for Liaison Transmitter —Stowage at Station

chart attached to the front of the tuning unit. The settings as shown on this chart are very close with regard to accuracy but with the Monitor switch (12), Figure 47, thrown to the "Monitor" position the side tone of the transmitter is cut off and the output frequency can be tuned to exactly match (zero beat) with the desired frequency setting on the liaison receiver (Unit 3-2). During this tuning, the receiver should be "ON" and the C.W. switch (1) also thrown to the "ON" position. With both transmitter and receiver "ON" in the above positions and the monitor switch (12) Figure 47 in the "Monitor" position, press the transmitter key Unit 3-13 and tune the transmitter oscillator frequency dial (4) Figure 50 until the transmitter output is heard in the receiver. Trim the transmitter adjustments for maximum output and recheck on the receiver. Transmitter is now adjusted for operation and standing by, ready for break-in operation on the station or frequency to which it has been adjusted.

CAUTION: DO NOT MAKE AN INTERNAL ADJUSTMENT OR REPLACEMENT WITH TRANSMITTER DYNAMOTOR RUNNING.

In order to tune the antenna for transmission on the lower frequencies (below 800 KC) a BC-306-A antenna tuning unit, Figure 55, has been provided and installed at the rear of the flight deck right side, with its connections close to those of the liaison transmitter.

BC-375-D LIAISON TRANSMITTER

Transmitter Adjustment:

WARNING: 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. Do Not Change Tubes or Make Adjustments Inside Equipment With High Voltage Supply On. Do Not Complete or Maintain Any Connection Between Radio Transmitter and Dynamotor Unit Unless All Shields on the Transmitter Are in Place.

At High Altitudes:

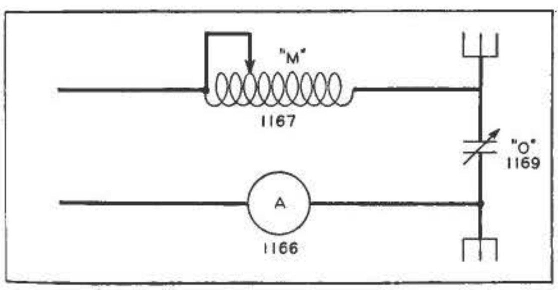
OPERATION: Radio Transmitter BC-375-D and associated equipment may be expected to give satisfactory service on CW at all altitudes up to 27,000 feet. On TONE and VOICE however, insulation breakdown may be experienced with Transmitter Tuning Unit TU-8-B (6200-7700) KC above 25,000 feet and with Transmitter Tuning Unit TU-9-B (7700-10,000 KC) above 19,000 feet. These altitude limitations may be exceeded slightly by care in tuning and by carefully guarding against accumulation of dust and other foreign matter in the equipment. Complete assurance of effective operation between 6200 and 10,000 kilocycles at altitudes between 19,000 and 27,000 feet may be had on CW alone. Transmitter Tuning Unit TU-22-B may be expected to give satisfactory service at all altitudes up to 15,000 feet.

Assuming that the installation and preliminary adjustments have been made, the following operating procedure is recommended. Some of these adjustments need be made only at the time of installation.

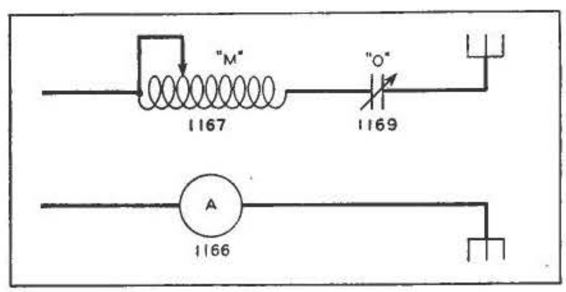
Under no conditions should any of the switches on the radio transmitter or tuning unit be changed with the key or microphone button depressed. Insure that all switches position correctly; do not attempt to leave switches between points. Failure to observe this procedure causes undue arcing of the switch and severe strain on the vacuum tubes.

CW Operation: Select the transmitter tuning unit for the desired frequency and install it in position in the transmitter. CW operation may then be obtained as follows:

1. Place the signal switch on CW.
2. From the calibration chart on the front of the transmitter tuning unit, set the BAND CHANGE SWITCH, the M-O TUNING control and the P-A TUNING control for the desired frequency, and set the ANT. COUPLING SWITCH on Point 1. (Remember that the band change switch does not appear on Transmitter Tuning Units TU-7-B to TU-10-B inclusive.)
3. Place the OFF-ON switch in the ON position. The dynamotor should now start and the M-O (master-oscillator) and P-A (Power amplifier) filaments will light. In case

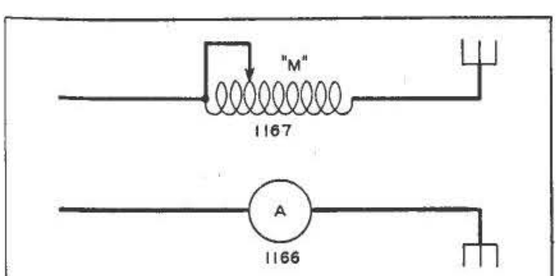


View showing internal connections for No. 1 position in which the BC-306-A is not effective

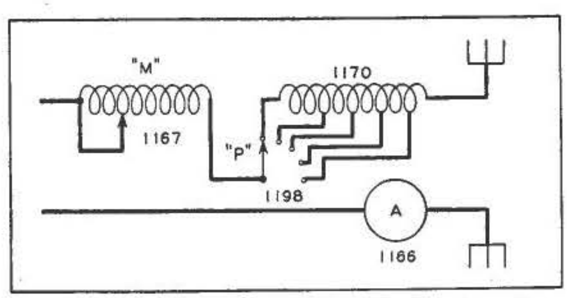


View showing internal connections for No. 2 position. Use below 800 KC as needed

Figure 53. Antenna Inductance Selector Switches



View showing internal connections for No. 3 position. Use below 800 KC as needed



View showing internal connections for No. 4 position. Use below 800 KC as needed

Figure 54. Antenna Inductance Selector Switches

repeated failures of Fuse FU-22 (located in the PE-73-C Liaison Dynamotor) are encountered and if such failures persist after compliance with instructions pertaining to Dynamotor Unit PE-73-C, it is recommended that Fuse FU-22 be removed from the relay-fuse box and one extra fuse Link M-168 inserted in the fuse cartridge. Fuse FU-22 will then have two fuse links in it and should be replaced in the relay-fuse box of the dynamotor unit. In no case should the use of more than two fuse links be attempted. The voltage at the input terminals of the Dynamotor unit must be 28 volts in order to obtain rated power output from the liaison transmitting equipment.

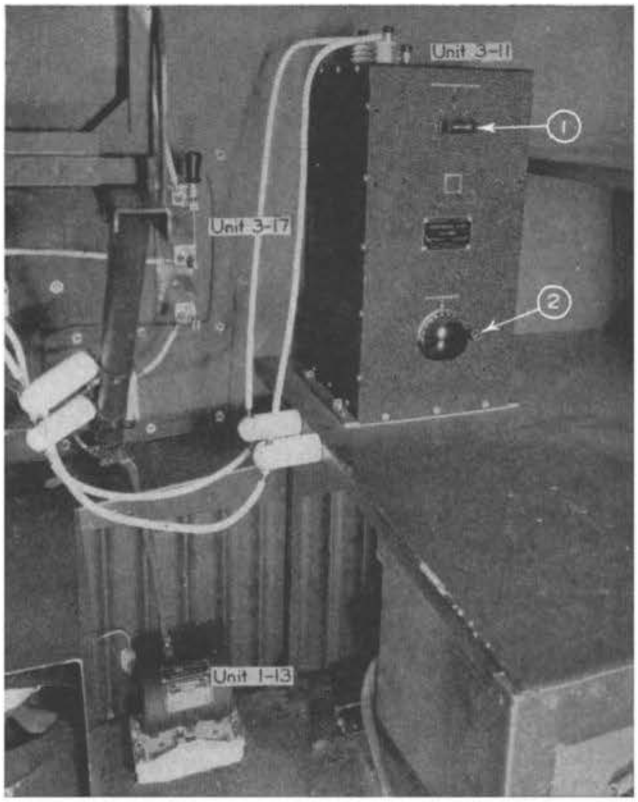


Figure 55. Right Aft Corner of Flight Deck

4. Press the TEST KEY or the transmitting key. The vacuum tubes will now draw plate current as indicated by the TOTAL PLATE CURRENT meter. The P-A tuning should be checked immediately for resonance by varying the control slightly until a minimum total plate current is indicated. When the P-A circuit is properly resonated, the total plate current will be from 80 to 110 milliamperes, depending on the tuning unit in use.

5. The antenna should next be tuned to resonance by means of the controls provided on the radio transmitter, and on the antenna tuning unit whenever the latter is in use. The subject of ANTENNA CIRCUITS is considered more in detail on Page 52 of this Manual and should be referred to in preparation for operation of the equipment.

6. Antenna resonance is indicated by a reading of current on the ANT. CURRENT meter and by an increase in total plate current. The increase in plate current is the more sensitive indication of approaching antenna resonance. When the antenna is tuned to resonance, the total plate current reading will be somewhat higher than the off-resonance value. If the plate current is below 200 to 220 milliamperes, the coupling to the antenna should be increased by placing antenna coupling, control D on a higher point and the antenna circuit retuned. When finally adjusted the total plate current should read from 200 to 220 milliamperes. If necessary, detune the antenna circuit slightly keeping the P-A dial, control C, in resonance to keep within the plate current Limits.

7. The equipment is now delivering rated power output, and the transmission may be carried on by operating the transmitting key. In order to shut down the equipment it is necessary only to place the OFF-ON switch in the OFF position.

Voice Operation: Assuming that the equipment has been placed in operation on CW, the following procedure is recommended for obtaining VOICE operation. Note the value of total plate current for CW operation. Then place the signal switch in the VOICE position and by means of the MOD. BIAS adjustment (7) Figure 40, in the tube compartment, adjust until the total plate current with the microphone switch depressed is approximately 20 to 35 milliamperes higher than for CW. The modulator tubes are now biased nearly to cutoff for proper Class B operation, and radiophone communication may be carried on by speaking into the microphone. It will be noted that the total plate current increases when the microphone is spoken into. This increase is due to current drawn by the modulator tubes. With sustained normal level of speech impressed on the microphone the plate current should rise to an average of 300 milliamperes.

If this value is not obtained, the INPUT LEVEL control in the tube compartment can be adjusted until the proper amount of modulation, as indicated by the correct plate current, is obtained.

Tone Operation: After the equipment has been adjusted for VOICE operation it is necessary only to place the signal switch on TONE for proper tone telegraph operation. The total plate current on TONE will be between 300 and 350 milliamperes.

Speech-amplifier Bias: The correct speech-amplifier bias will usually be found between 6.0 and 7.5 on the S.A. BIAS adjustment dial. See Figure 70. Settings in this range will normally give the proper speech-amplifier plate current and optimum side-tone frequency on all tuning units. It will usually be found that the speech-amplifier bias settings on radio transmitters received from the factory will require no adjustment.

Side-Tone in Aircraft Set: If the receiver circuits have been properly co-ordinated with the radio transmitter, the receiver control circuit will operate each time the transmitting key or microphone switch is closed, and the radio transmitter side-tone will be supplied to the headset.

When the key or the switch is opened, the receiver again becomes operative, thus allowing break-in operation. The SIDE-TONE level control, Figure 70, located in the tube compartment, is used to adjust side-tone to a suitable volume for any particular installation. It will probably be noted that a higher level is desirable on VOICE position than on the CW and TONE positions.

Calibration Reset: Due to necessary manufacturing tolerances, the inter-electrode capacity of a vacuum tube varies between limits fixed for each particular type of tube. Since the tube capacitance is an appreciable part of any master-oscillator circuit, it is impossible to make up a calibration chart which will be exactly accurate for all tubes whose capacitances are within the allowable limits. For this reason Radio Transmitter BC-375-D is provided with a calibration reset capacitor which enables the operator to reset the transmitter frequency to correspond with the calibration chart when the set is first placed in operation and thereafter whenever the master-oscillator tube is changed. A heterodyne frequency meter or other standard of frequency is required.

The procedure is as follows:

1. Allow radio transmitter to warm up. The operator will obtain the most accurate results by allowing the transmitter to "warm up" on key locked "CW" for a period of at least 20 to 30 minutes before setting the calibrated transmitter frequency.

2. With the transmitter tuning unit for the **highest available working frequency** placed in the radio transmitter, tune the radio transmitter for CW operation on one of the calibrated frequencies at the high frequency end of the band. (Approach the calibrated point by proceeding from a lower dial reading to a higher one.)

3. Place the frequency meter in operation and adjust it to the frequency indicated on the transmitter calibration in accordance with the operating instructions and calibration chart furnished with the frequency meter. The calibration accuracy of this frequency meter should be 0.01 per cent, or better.

4. Open the calibration reset port, Item 16, Figure 50, located on the front panel, between the TEST KEY and TONE-CW-VOICE switch, insert a screwdriver, and rotate the calibration reset capacitor until the transmitter frequency coincides with that of the frequency meter.

5. Close the calibration reset port.

The radio transmitter calibration is now reset for any tuning unit of the same order number and serial number as the radio transmitter and the accuracy of calibration will be within 0.05 per cent plus the accuracy of the standard. The calibration must be checked in this manner each time the M-O tube is changed.

Antenna Circuits: The antenna is, in general, a system of conductors which when excited by a radio-frequency voltage, sets up electromagnetic and electrostatic fields. A component of this field travels away from the antenna with the velocity of light.

The radiation characteristics of antennae, directivity and radiation efficiencies are determined by their physical shape and location with respect to other bodies in aircraft, since there is no wide latitude in physical design of fixed antennae, the problem becomes mainly one of determining the best methods of operating available designs.

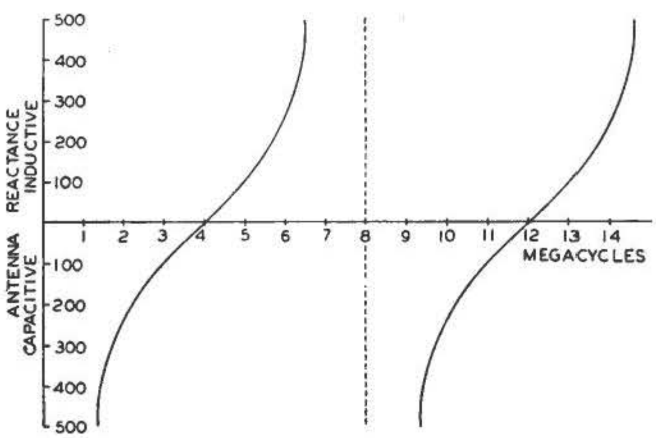


Figure 56. Antenna Reactance Curve

It is necessary first to determine how the antenna impedances vary at the operating frequencies in order that the loading facilities may be properly used. The reactance of an antenna may be approximated from the theory of transmission lines in which uniformly distributed inductance and capacitance are assumed, resistance and insulator leakage being neglected.

Selecting a certain length of antenna and plotting its reactance variation with frequency, we obtain repeating cotangent curves. It may be seen that at certain frequencies the reactance becomes zero. Under these conditions, the antenna is "resonant, "analogous to simple-series circuit tuned to resonance.

Note that the "series" resonant points occur at all odd multiples of the first resonant frequency, which is called the fundamental frequency. The fundamental frequency, the third harmonic, and the fifth harmonic, all points of zero reactance, correspond to a voltage distribution along a simple vertical wire of "quarter-wave," "three-quarters wave," and "five-quarters wave." Antennae of this type, operated at zero or low reactances, are commonly called "current fed," that is, they require low driving voltages for their operation.

At even multiples of the fundamental frequency, it may be seen that the antenna reactance is very high. Operations at the second and fourth harmonics corresponds to "half-wave," and "full-wave" operation. Under these conditions, antennae are "voltage fed," that is, they require high driving voltages.

The resistance component of the antenna impedance is made of two parts; radiation resistance which represents the radiation of power or waves away from the antenna and which is productive of a useful result; and loss resistance which is a combination of losses due to conductor and ground resistance, and to dielectric hysteresis. Loss resistance performs no useful function and every effort should be made to maintain it very small in comparison with the radiation resistance. The **efficiency of an antenna with respect to radiation of power** may be expressed as the **ratio of radiation resistance to total antenna resistance.**

Antenna resistance varies over wide limits with frequency. The resistance approachcs very high values at the **even** harmonics, and minimum values at the **odd** harmonics. Thus is seen that the operation of a transmitter over a wide frequency band requires that the radio transmitter be capable of providing a considerable range of output voltages. This is accomplished in each transmitter tuning unit by a six point ANT. COUPLING SWITCH, control D. In order that the voltage range required be kept a minimum, antennae are usually "resonated," that is, they are series tuned by either inductance or capacitance, as may be necessary, so that the required output voltage range depends only on the antenna resistance variation over the desired frequency range. Transmitter Tuning Unit TU-22-B has a series capacitor in use when control D is on position 6 for resonating when operating into a pure resistance approximating 40 ohms. Do not operate position 6 into low resistances as the large amount of resonant current will overload this series capacitor.

When operating antennae at frequencies lower than their fundamental, or odd harmonics, they appear to the antenna tuning equipment as a capacitance in series with a resistance. In order to balance out this capacitive reactance, it is necessary to load the antenna bymeans of an inductance, the reactance of which is made equal to that of the apparent antenna capacitance. For operation of antennae at frequencies higher than their fundamental and odd harmonics the converse is true, a capacitance in series with the antenna being necessary in order to balance the apparent antenna inductive reactance.

In most cases, except where ¾ and 5/4 wave trailing wires are used for high frequencies, antenna operation will be around the fundamenal frequency.

In general, it may be said that if antennae are operated so that their effective length is an appreciable percentage of the operating wave length, they will have marked directive properties. This corresponds to operation near to and higher than the fundamental frequency. When antennae are operated at frequencies much lower than the fundamental, the ratio of radiation to total resistance is less favorable, but the directive properties are not nearly so evident. The fundamental frequency of an antenna depends mainly on its effective length including the ground lead. Fundamental frequencies in the range 2500-7000 kilocycles will be the most common with the fixed antenna, while fundamentals as low as 1500 kilocycles will be obtained with the 200-foot trailing-wire antenna.

Antenna Tuning—Liaison Transmitter:

The antenna tuning equipment in the radio transmitter is designed to feed antennae at any frequency from 800 to 12,500 kilocycles. Since this band of frequencies extends above, and below the fundamental frequency, the circuit and circuit constants are so selected as to permit both current and voltage feed. A rotating inductor and a tapped inductance provide the inductive reactance variation. A variable capacitor provides the variation in capacitive reactance and also serves as coupling impedance for voltage feed. Controls governing the variation in inductive or capacitive reactance are so arranged that inductance or capacitance, with the ANT. CIRCUIT SWITCH N (10 figure 50) on **position 1,** the radio transmitter works into a simple series resonant circuit, in which the high voltage built up across the antenna tuning capacitor is used to "voltage feed" the antenna.

This circuit is generally used for high frequencies and fairly long fixed antennae. The antennae feed circuit is maintained at resonance by means of ANT. IND. TUNING, M, (9 figure 50) while the voltage fed to the antenna is varied by means of ANT. CAP. TUNING, O, (12 Figure 50) and ANT. COUPLING SWITCH D, (14 figure 50). Feed circuit resonance is indicated by the ANT. CURRENT meter, (8 figure 50). The current in the feed circuit is adjusted by control D and should not exceed 6 amperes. The step by step tuning procedure is as follows:

1. Set control O at some arbitrary scale reading.
2. Resonate circuit by means of control M for a maximum reading on ANT. CURRENT meter.
3. Adjust control D so that antenna ammeter, (8 figure 50) reads below 6 amperes.
4. Re-resonate circuit as in step (2).

Repeat the above procedure until the proper loading (200-220 ma CW) is indicated on the plate ammeter (7 figure 50). The lower the dial reading on control M and the lower the reading on the ANT. CURRENT meter that it is possible to obtain at a given frequency, the more power will actually be delivered to a given antenna. The lower the reading on control M and the lower the ANT. CURRENT meter readings, the less the tuning circuit losses and thus more useful power is delivered to the antenna for radiation purposes.

With ANT. CIRCUIT SWITCH N (10 figure 50) on **position 2,** the radio transmitter works into a series resonant circuit where the antenna is **"current fed."** The antenna circuit is resonated by means of ANT. IND. TUNING M and ANT. CAP. TUNING O, as indicated by the ANT. CURRENT meter. **This circuit is used generally for operation near the fundamental frequency of the antenna.**

With control N on **position 3,** the radio transmitter works into a series resonant circuit providing "current feed" and inductive loading. The antenna circuit is resonated by means of a continuously variable rotating inductor.

M. **This circuit is used for operating below the fundamental frequency of the antenna.**

With control N on **position 4,** the antenna circuit is identical with that obtained on position 3 except that an additional tapped inductance, controlled by ANT. IND. SWITCH P, (15 Figure 50) is added in series with the rotating inductor. **This circuit is used when**

the operating frequency is relatively far below the fundamental frequency of the antenna.

It is recommended that the operator check the possible resonance of coil, item 1170, (controlled by Ant. Ind. Switch P), at operating frequencies above 4500 kilocycles. Although this coil is not connected in the antenna circuit, at these frequencies, the inherent capacitive coupling may cause absorption of useful radio-frequency power. Absorption may be easily determined by placing control switch P at several points while watching the antenna current. Control P must not be allowed to remain at a point which indicates a decrease in antenna current. In general, it will be found that no difficulty will occur if the following points are used.

Transmitter Tuning Unit	"P" Switch Position
TU-7-B	2
TU-8-B	5
TU-9-B	5
TU-10-B	5

The antenna resonance is then made in the usual manner using controls M, N, and possibly O.

For operation in the frequency range of 150 to 800 kilocycles, the externally connected Antenna Tuning Unit BC-306-A, (Figure 55) is used. This unit contains the necessary inductive reactance to resonate specified antennae at frequencies well below their fundamental. The variation in inductive reactance is provided by the ANTENNA VARIOMETER SWITCH, control E (1) and the ANTENNA VARIOMETER control F (2).

In general, it will be necessary to use Antenna Tuning Unit BC-306-A with Transmitter Tuning Unit TU-22-B or TU-26-Item 3-3, i.e. 350 kc. to 650 kc. The antenna loading equipment contained in the radio transmitter will resonate a 400 micromicrofarad antenna to approximately 650 kilocycles. Therefore, when the minimum inductance is reached on the BC-306-A (E — 2, F — 0), place control E in position 1 which disconnects this unit. Proceed to resonate the antenna circuit with control N, (10 Figure 50) on position 4. Control M, (9 Figure 50) is the continuously variable inductance between inductance steps on control F, (2 Figure 55).

Under some conditions, it may be found that one coupling tap will not give sufficient loading while the next higher tap will give overloading of the radio transmitter. In this case use the higher coupling tap by slightly detuning the antenna circuit and keeping the P-A dial, control C, (11 Figure 50) tuned to a minimum plate current until the normal transmitter loading of 210 to 220 milliamperes total plate current is obtained.

When operating into an antenna of the trailing wire type, it is advisable that the antenna circuit be resonated by adjusting its length as close as possible to the ¼ or ¾ wave point. This type of operation results in the removal of all transmitter tuning equipment from the antenna circuit and results in greatly increased antenna power. For this type of operation the antenna circuit switch, control N, (10 Figure 50) should be placed on position 3 and the antenna loading coil, control M, (9 Figure 50) set at zero. The antenna is then resonated by adjusting its length to a point that results in a maximum of antenna current.

Coupling control D, (14 Figure 50) should be set so as to give normal plate loading and control C, (11 Figure 50) should be tuned for minimum plate current. The approximate length of wire required for various operating frequencies is given in the following table.

Table giving the approximate antenna length for various frequencies as well as the approximate counter reading when 250 feet of Wire W-106 is wound on the spool.

KC	½ Wave		¾ Wave	
	Length (Ft.)	**Counter Reading**	**Length (Ft.)**	**Counter Reading**
2000	123	108		
3000	82	72		
4000	62	54		
5000	49	44	147	130
6000	41	36	123	108
7000	35	30	105	92
8000	31	28	93	82
9000	27	24	81	72
10000	24	22	73	64

NOTE: These counter reading figures apply only to the hand operated antenna spool of reel.

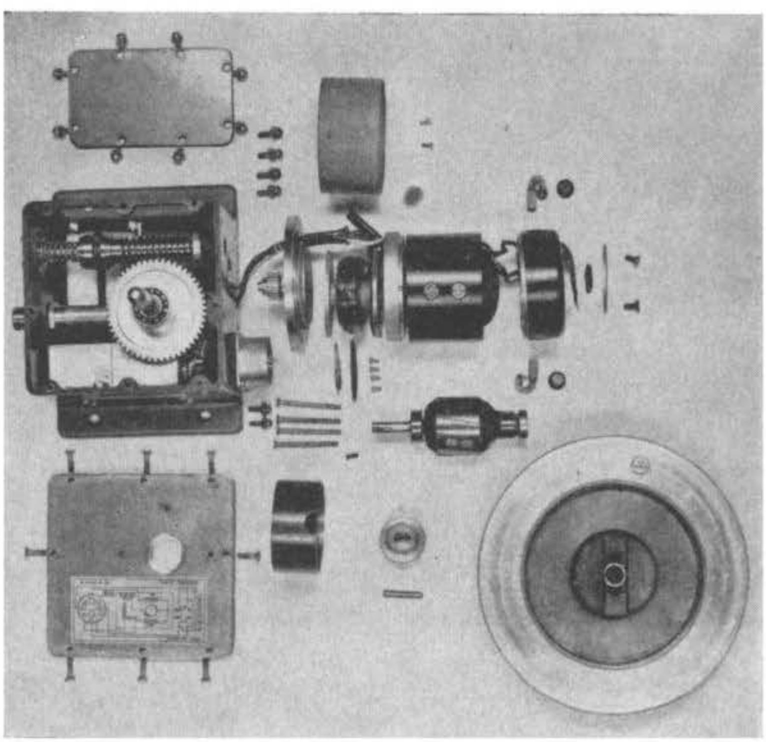


Figure 57. Antenna Reel. Partial Disassembly Detail

Hand Operated Reel RL-30-B: Braking, locking and winding operations are controlled from the crank on the reel. Normally the reel is in the locked position such that the wire will not unwind from the spool. Reeling-in is accomplished by rotating the crank in a clockwise direction, as indicated by the direction arrow "Wind" on the nameplate at the center of the reel spool. A ratchet mechanism on the spool prevents the wire from unreeling when the crank is released. By rotating the crank in a counterclockwise direction the braking mechanism is released, thereby permitting the wire to be reeled out.

Braking force decreases gradually as the handle is rotated through approximately the first 40 degrees of its motion. Beyond this point and up to the extreme limit of its motion the brake is completely released and the spool is free to spin. The speed of unwinding can be readily controlled by regulating the braking effect with the crank. A spring return on the crank automatically resets the brake to the normal or locked position when it is released.

Tuning the antenna by adjusting its length should be accomplished by allowing slightly more wire than is necessary to run from the reel and then reeling in slowly to obtain the proper length by observing the resonant condition. During the reeling out operation, care should be taken that all of the wire is not unreeled. The speed with which the reeling takes place would be sufficient to snap the wire if it reached its ultimate length, causing a loss of both the weight and wire.

CAUTION: When unreeling wire, never allow the crank to snap into the locking position when the spool is rotating rapidly. The sudden stop which would result may break the antenna wire and place undue stress on the reel mechanism.

Electrical Antenna Reel RL42 & RL42-A: The electrically operated antenna reel RL-42-A is essentially a two field, reversible type, series wound motor incorporating an electrical solenoid operated clutch and two automatic stop switches to control the maximum limits of travel. Direction of motor rotation is controlled by the double throw Reel Control Switch (14) Figure 101 which supplies current to the proper field for reel rotation in the desired direction.

Motion is transmitted from the armature (1), Figure 58, through the clutch (2A and 2B) to a pinion gear (3) keyed to the clutch shaft (4). This pinion gear (3) meshes with a second pinion gear (5) on a jack shaft (6). Also mounted on this jack shaft (6) is a spring loaded worm gear (7), one end of which is flared (8) to operate one of the limit switches (9). When the direction of rotation is such that the limit of clockwise travel is reached, the worm is forced outward and presses against the loading spring, finally moving

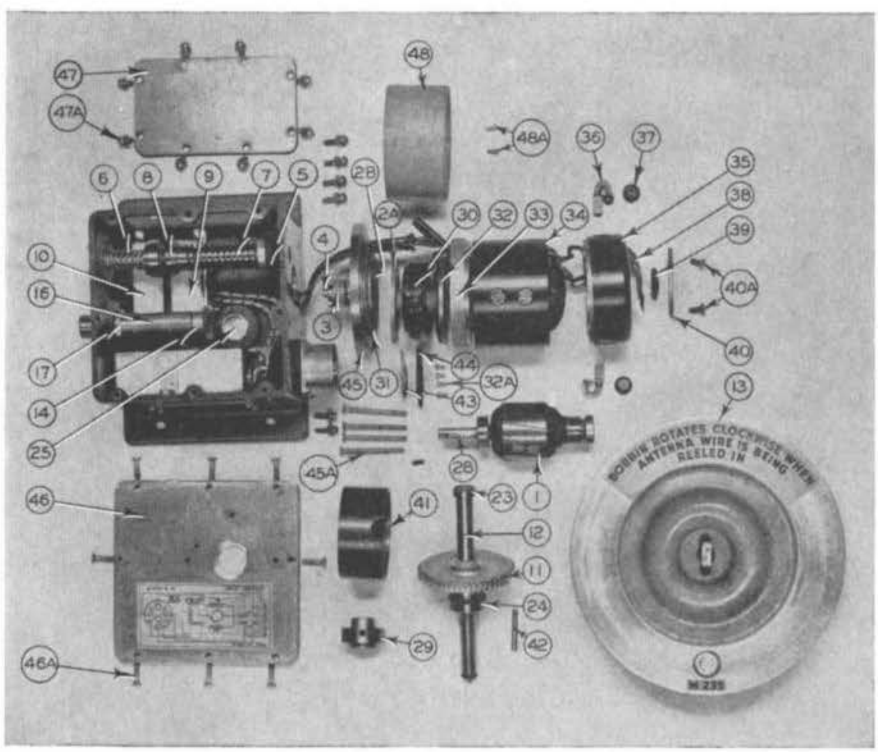


Figure 58. Antenna Reel. Complete Disassembly Detail

to such a position that the limit switch (10) for "Ant. In" is thrown, breaking the circuit and stopping the motor. Capacitors are placed across the limit switches to control arcing and radio interference. The worm gear (7) on the jack shaft (6) meshes with the reel drive gear (11) which is pinned to the reel drive shaft (12) and rotates antenna reel (13) by means of drive caller (29), in the desired direction according to armature rotation.

On the under side of gear (11) is a small bevel gear (part of gear 11) which drives the counter shaft drive gear (14) and counter drive shaft (15), Figure 60, in drive shaft housing (16), Figure 58, meshing of drive gear (14) and (11) is controlled by inward or outward movement of drive shaft housing (16) which is locked in place with lock nuts (17 and 18). Roller bearings (19) and 20) are used on jack shaft (6) with adjustment screw (21) and lock nut (22) used to adjust end play and bearing clearance of shaft (6). Roller bearings (23 and 24) are used on reel drive shaft (12), end play and bearing clearance adjustment being taken care of by screw (25) and lock (26). Clutch plate (2A) is held on Armature shaft (28) with allen head lock screw (27).

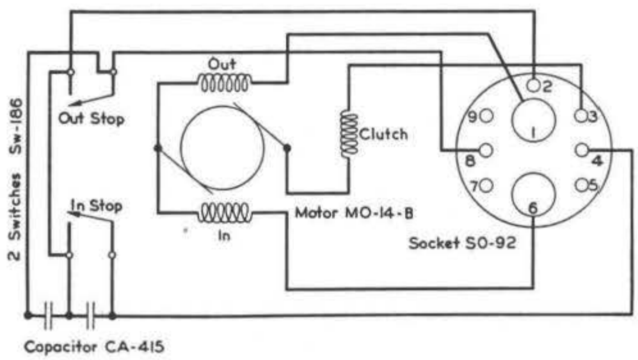


Figure 59. Wiring Diagram of Antenna Reel RL-42A

When current is applied to either field, the series clutch solenoid winding (30) magnetizes clutch plate (2A) which attracts clutch plate (2B) and draws it away from the cork brake (31) and effectively locks (2B) with (2A) for driving of reel (13) and control (Figure 101).

Dis-Assembly for Motor Overhaul or Parts Replacement.

1. Remove reel (13) by squeezing on locking device in center of reel and pulling reel from shaft (12).
2. Remove drive pin (42) and drive collar (29).
3. Remove screws 46A and cover plate 46 to gain access to gear box.

Removal of Motor.

1. Remove screws 45-A and pull motor assembly from gear box.
2. Remove brush covers (37) and brushes (36).
3. Remove screws 48A and sleeve (48).
4. Remove screws 45A from plate 45 and separate (45) from motor assembly, allowing sleeve (41) to be pulled from around 2A, 43, 44, 30 and 32.
5. Remove set screw (27) from end of armature shaft (28) and pull clutch plate 2A from shaft (28).

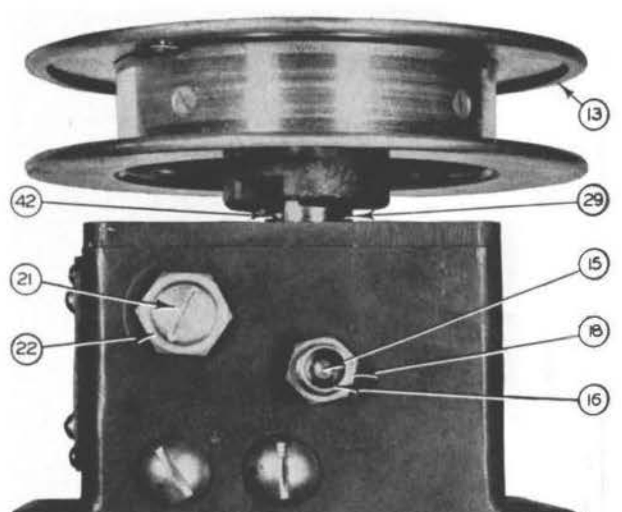


Figure 60. Reel and Box

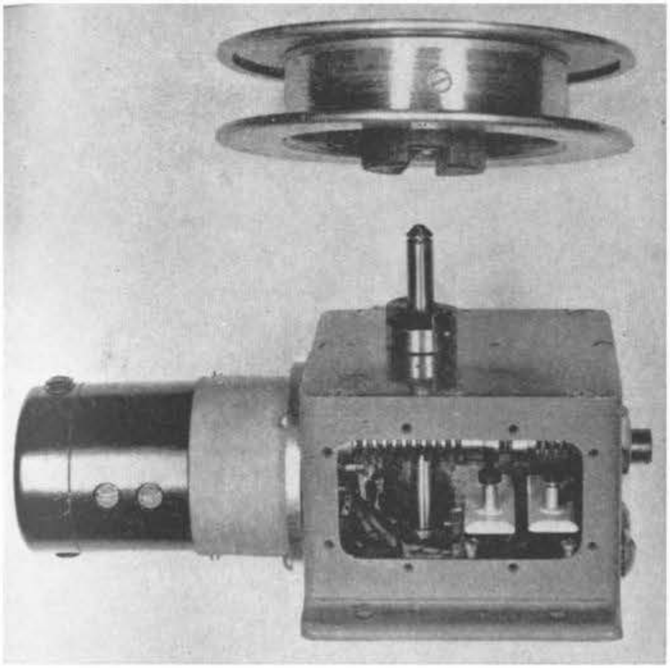


Figure 61. Antenna Reel Box Detail

6. Remove locking (43) spacers (44) and solenoid (30).
7. Remove screws (32A) and plate (32).
8. Remove screws (40A) and plate (40), removing spacers (39) and gasket (38) from end belt (35).
9. Remove screws (33A) from plate (33) and separate 33, 34, 35.
10. This allows removal of armature (1).

See Figures 57, 60, 62.

Assemble in Reverse Order

Dynamotor Unit PE-73-C: Starting and stopping of the dynamotor unit is controlled by the "OFF-ON" switch (1 Figure 50) Radio Transmitter BC-375-D.

When operated at full-rated load continuously for ½ hour, the temperature rise of the dynamotor will not exceed 55 degrees Centigrade. However, if the dynamotor is operated for a greater length of time, even at lighter loads, without being allowed to cool off, its temperature will continue to increase and will ultimately reach values which are injurious to the insulation and may even burn out the windings. This also applies to the starting relay. If it is desired to operate the dynamotor unit continuously at full load for a period greater than ½ hour (such as for testing purposes in the laboratory), the end bells of the dynamotor and the cover of the relay-fuse box should first be removed. The dynamotor unit can then be operated at rated load continuously for any period of time without injurious heating. Care should be exercised to place guards around the dynamotor unit when operated in this manner so that operators cannot come in contact with exposed high voltages. **When operated in conjunction with the radio transmitter** the dynamotor unit operates at practically zero load unless the key or microphone switch is closed. Continuous operation under this condition will not result in over-heating

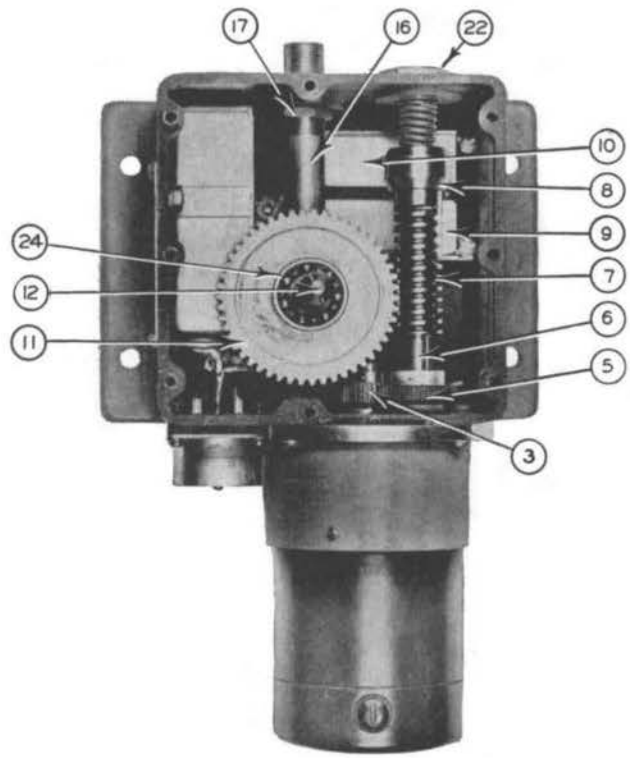


Figure 62. Antenna Reel and Box Detail

although the radio transmitter should be turned off whenever possible between periods of transmission.

a. **BRUSHES:** The brushes can be removed by unscrewing the slotted brush cap on each side of the bearing bracket. It is recommended that each brush be suitably marked to indicate which brush holder it came from, and its relative position in that brush holder in order that the brushes may later be replaced in their original position. THIS IS IMPORTANT. Blow out dust and clean all foreign matter from each brush holder and brush and make certain that the brushes slide freely in their brush holders, dressing the brushes with fine sandpaper, or a file, if necessary. Any brushes which have worn down to a length of less than 3/8 in. (measured from contact surface to near end of spring) should be replaced with new ones. In installing new brushes it may be necessary to "sand-in" the brush in order to make its contact surface fit the contour of the commutator. The brush must slide freely in its holder. "Sanding-in" may be accomplished by using a strip of No. 00 sandpaper about 5 in. by 1 in. for L-V brushes and 8 in. by 5/8 in. for H-V brushes. Wrap the strip of sandpaper around the commutator with the sand surface out. Insert the brushes in the brush holders and replace the brush caps so that the brushes are pressed tightly against the sandpaper. Holding the ends of the sandpaper so as to stretch it tightly against the commutator, rotate the armature back and forth until the full width of the brush face is making contact against the sandpaper as indicated by the sanding marks or scratches on the contact surface of the brush when it is withdrawn. Sand the side of the brush if necessary, for a free fit in the holder. No sanding should be necessary to secure a good brush fit with the original brushes if they are replaced correctly. **Never apply oil, grease or any other lubricant to the brush, commutator or brush holder. Under normal conditions** of operation, it is estimated that the useful **life of brushes is 2,000 hours for low-voltage and 10,000 hours for high-voltage brushes.**

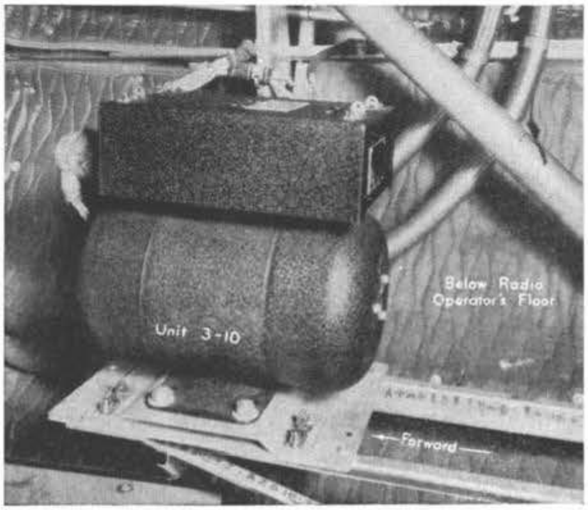


Figure 63. Liaison Transmitter Dynamotor

b. **COMMUTATORS:** Both commutators should be wiped with a clean, lintless cloth. Any scum appearing on the low-voltage commutator should be removed by moistening the cloth in carbon tetrachloride. The normal dark brown polished surface on the high-voltage commutator should not be removed. The type of brush material used in the low-voltage brushes of the dynamotor may, under certain conditions of installation, cause a discoloration of the low-voltage commutator. Under these circumstances the commutator will have a mottled appearance which is caused by the formation of a very thin oxide film on the surface of the commutator bars. This film is normal and is not injurious to the commutator or brushes. Do not try to remove the oxide film described above. A rough or pitted commutator should be smoothed with No. 00

or finer sandpaper. NEVER USE EMERY CLOTH OR A FILE. Under normal conditions of operation the low-voltage and high-voltage commutators should not require turning down before 2,000 hours and 10,000 hours of service, respectively. However, if the commutator bars have worn down flush with the mica, the armature should be removed from the dynamotor to turn down the commutator face and undercut the mica between bars.

c. **BEARINGS.** If the armature does not spin freely when rotated by hand with the brushes removed, the following may be the cause:

Dirt or other foreign matter in a bearing.

Defective ball bearing (cracked race, chipped or flattened ball).

Grease in bearing has become hard and gummy due to oxidation during long periods without actual use.

In any case, the armature should be removed from the frame as described under DISASSEMBLY, below, and the bearings thoroughly cleaned. If, after cleaning, the outer race will not spin smoothly, it is probably due to a cracked race or chipped or flattened ball, and the defective bearing should be removed and replaced with a new one. Always use a bearing puller to remove a defective bearing and never hammer or pry the bearing off since this may bend the shaft and injure the commutator. A new bearing should be pressed on the shaft until the inner race of the bearing rests against the shoulder on the shaft. For this operation always use an arbor press and a metal cylinder or collar which bears only against the inner race of the bearing. **Care must be taken that no force or stress is placed on the outer race of either bearing at any time since this will usually result in a damaged bearing.**

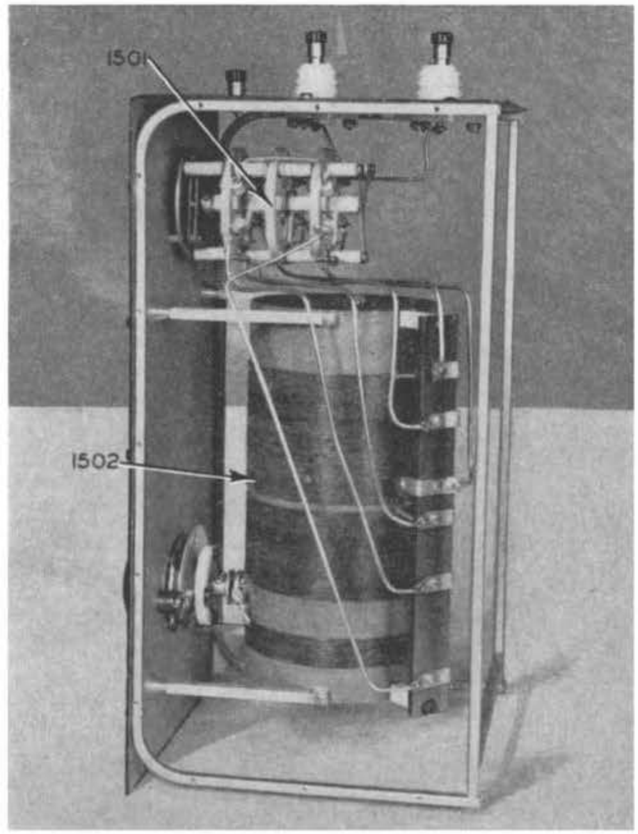


Figure 64. Antenna Tuning Unit BC-306-A Interior View

d. **DISASSEMBLY:** The following procedure is recommended for dis-assembling the dynamotor, for cleaning and replacing the bearings:

(1) Remove the three "safety-wired" screws (1) on each end of the dynamotor and take off the two end bells (2), See Figure 69.

(2) Unscrew the slotted brush cap, (3) Figure 65 in each brush holder and remove all four brushes. Take special care to mark the position of the brushes in their holders such that they may later be replaced in their exact original positions.

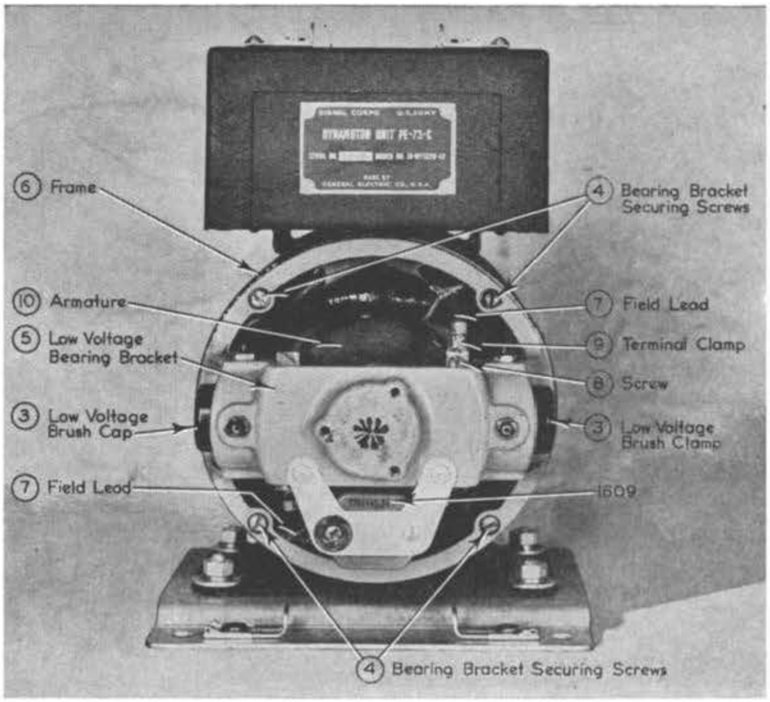


Figure 65. Liaison Dynamotor—Low Voltage End Bell Removed

(3) Unscrew the four slotted screws, (4) Figure 65, located around the rim of the low-voltage bearing bracket (5) Figure 65, and pry the bracket loose from the frame (6) Figure 65. The low-voltage end of the dynamotor can be identified by the long, small diameter commutator and the large copper-graphite brushes.

(4) Detach the two field leads (7) Figure 65, from the terminal clamps on the low-voltage brush holders by unscrewing the screw (8) Figure 65, in each terminal clamp (9) Figure 65. It is not necessary or advisable to remove the terminal clamp from the brush holders.

(5) The bearing bracket (5) Figure 65, can now be taken out of the way and the armature, (10) Figure 65, withdrawn from the frame. Take care not to injure the armature windings or commutator by rubbing against the field poles. Do not lose any shim washers which may be in the bearing housings, or which may stick to the bearings. If any shims are present they must be reassembled in the same housing.

(6) End Play Adjustments: A spanner screw or bearing plug (11) Figure 66, bearing bracket for adjusting end play in the dynamotor. This is properly adjusted at the factory and ordinarily will not need to be changed unless the armature is replaced. Before making any adjustments with this screw, it is necessary that the two set screws, (12) on either side of the bearing be loosened. Then the spanner screw, (17) should be turned out (counter-clockwise) one turn. Operate the dynamotor until it is hot (about 30 minutes). The end play should then be adjusted by turning the spanner screw as required until the end play as shown on an indicator reading to 1/1000 inch, is between approximately 4/1000 to 8/1000 inch.

In case an indicator is not available an alternative method of adjusting the end play is as follows:

Screw the spanner screw in until the bearing starts to growl, then back it off immediately ⅛ turn (45 degrees.) This latter method must be used with extreme care since if the bearings are set up too tight or allowed to remain tight for any period of time they may be damaged. The set screws should then be tightened to hold the spanner nut in position.

(7) In cleaning the ball bearings it is not necessary to remove them from the armature shaft. Simply immerse the bearing in a shallow pan of clean carbon tetrachloride and wash all of the grease from the bearing. The use of a small camel's-hair brush will greatly aid the thorough cleaning of the bearing. Change the cleaning solvent in the pan as soon as it becomes dirty. Always use clean solvent for the final rinsing of the bearings. DO NOT ALLOW THE CLEANING SOLVENT TO COME IN CONTACT WITH THE COMMUTATORS OR WINDINGS. In case the cleaning fluid is accidentally splashed on these parts, wipe it off immediately. Make certain the bearing is thoroughly clean and dry before repacking with new grease. If the bearing is not to be repacked with grease within a few minutes after cleaning, flush it with a clean, light mineral oil to protect the polished balls and races from rusting.

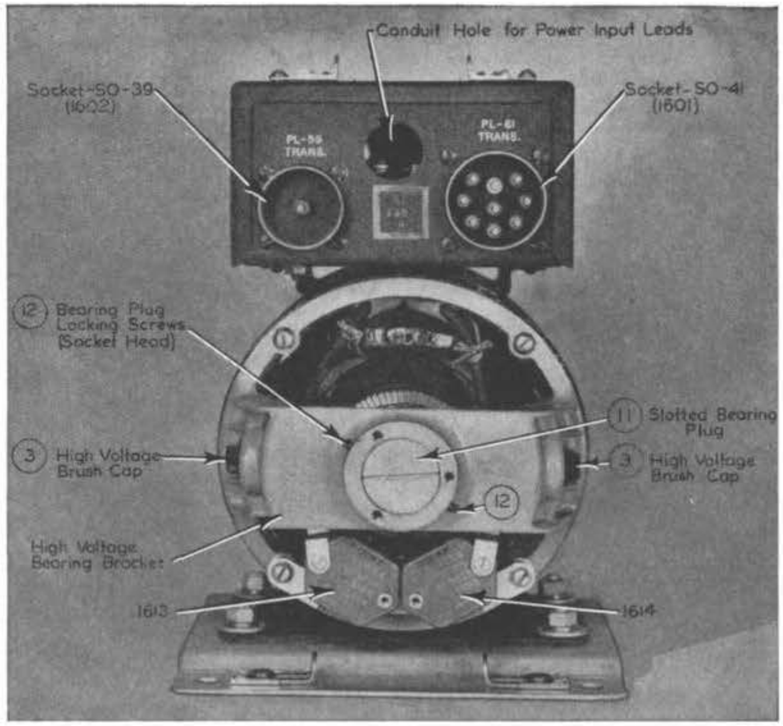


Figure 66. Liaison Dynamotor High Voltage End Bell Removed

e. **REASSEMBLY:** In reassembling the dynamotor, follow in reverse order the procedure for disassembly. Make certain that the two field leads are securely attached to the proper terminal clamps on the low-voltage brush holders and that the "slack" or "loop" in these leads is "tucked" back of the field coils. Do not loosen or remove the brush holders from the bearing brackets. If a brush holder is loosened or removed for any reason, replace it securely in exactly its original position and check to make certain the contact surface of the brush fits the commutator perfectly. If necessary, sand-in

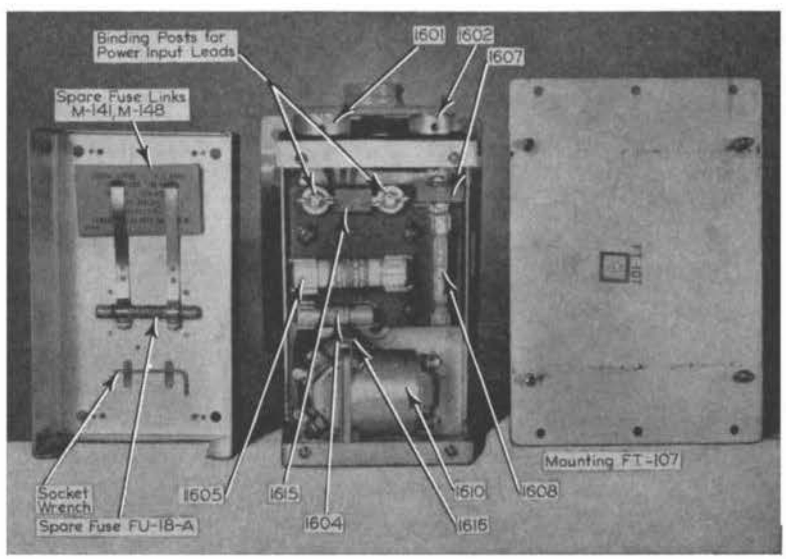


Figure 67. Liaison Dynamotor Fuse and Relay Cover Removed

the brush to secure a good fit against the commutator. When inserting the grease filler plug (13) Figure 66, in the top of the bearing bracket, start the screw threads by hand before using a screw driver. Take care not to cross thread this screw. If the screw is cross threaded, metal particles may be dropped into the bearing, causing roughness and probably bearing failure.

Operating Routine:

The operating routine and type of transmission to be used will be governed by tactical requirements.

The following recommendations are given, however, to assist in routine operation of equipment:

1. Complete equipment operation should be checked before the start of any mission.
2. Make certain that spare fuseholders are filled with good fuses, and that spare tubes (if carried) are in good condition.
3. The transmission range of the equipment on CW is considerably greater than on VOICE. If distance, atmospheric noise, etc., make voice communication difficult, changing to TONE or CW will probably improve communication.
4. In case of failure of one or two tubes VT-4-C with no spares on hand, CW communication can be carried on by inserting the good tubes in the m-o and p-a sockets (2), and (3) Figure 51. CW operation can also be maintained when Tube VT-25 (1) Figure 51 is removed, although no sidetone will be supplied in this event.

SUMMARY COVERING NORMAL OPERATION

Although the normal operation of this equipment is extremely simple after the correct installation has been made, it is well to study the proper sequence of various equipment procedure as summarized in the following paragraphs. It is assumed that the installation has been tested and all circuits are normal.

DO NOT CHANGE ANY SWITCHES WITH THE KEY OR MICROPHONE BUTTON DEPRESSED.

1. To start the equipment: Snap the OFF-ON switch (1 Figure 50) to ON. The dynamotor will start and the filaments will light. Unless the TONE and VOICE emissions have been adjusted, start up initially as given below. To control carrier depress the key.
2. To stop the equipment: Open the key then place the OFF-ON switch in OFF.
3. To change frequencies: Select the required tuning unit and place in the radio transmitter. Place the M-O dial, (4 Figure 50) BAND SWITCH (13 Figure 50), (if any), and the PA dial, (11 Figure 50) on the desired calibrated frequency as given on the calibration chart. Place the emission, (6 Figure 50) on CW, start up the radio transmitter and immediately check the PA dial, (11 Figure 50) for minimum plate current as indicated on the TOTAL PLATE CURRENT meter, (7 Figure 50). Resonate the antenna circuit and load to a total plate current of 210 to 220 milliamperes with the PA dial resonated, i.e., always tuned to a minimum plate current. Proceed to key the carrier on CW or select the other types of emission as given below.

4. To select any available type of emission: Start up the radio transmitter and tune for CW transmission first as given under 3; then open the key and place the TONE-CW-VOICE switch (6 Figure 50) on VOICE. Remove the tube shield (17 Figure 50) and adjust the MOD. BIAS control (7 Figure 51) after key is depressed until the total plate current reads 20 to 30 milliamperes above the CW value. Proceed to control carrier by microphone button and modulate by voice. Adjust the side tone signal to the desired level by means of the SIDETONE control (6 Figure 51) located in the tube compartment. Adjust the voice level by the INPUT LEVEL control, located behind M-O tube (2 Figure 51) so the total plate current reaches 300 to 350 milliamperes on peaks of sustained voice.
5. For tone transmission: The operator must always adjust radio transmitter for VOICE, first. Then open the key, place the selector switch on TONE and proceed to key carrier as in CW.

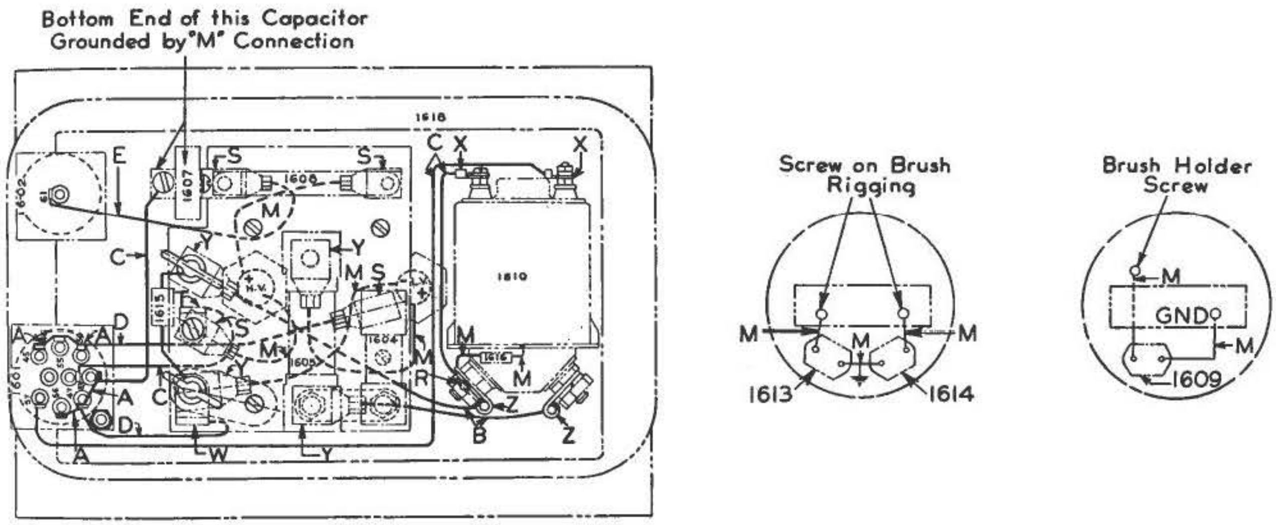


Figure 68. Dynamotor Connection Diagram

6. To increase power output: Go to a higher number on the ANTENNA COUPLING SWITCH, control D, (14 Figure 50) at the same time keeping the PA dial (11 Figure 50) control C, and the antenna circuit in resonance. Power may be increased until a CW plate current of 220 ma. at 28 volts input is reached.
7. To decrease power: Go to a lower number on ANTENNA COUPLING SWITCH, control D, at the same time keeping the PA dial, control C, and the antenna circuit in resonance.
8. It should be noted that the CW power output may be increased or decreased in the above manner from the value of plate current with the antenna circuit open to the full load rating of 220 milliamperes. However, the TONE and VOICE carriers are adjusted as given under steps 4, and 5, distortions will result. Also, the misadjustment may cause arc-overs which would damage the equipment.
9. To reset to the calibration chart after changing of the M-O tube (2 Figure 51), etc., start the radio transmitter on the highest frequency of the highest frequency tuning unit available. Warm up the radio transmitter on CW key locked for 25 to 30 minutes.

The tube shield must be in place. Listen to the calibrated frequency on a suitable accurate heterodyne frequency meter and adjust the radio transmitter to zero beat by means of a screw driver inserted into the reset port (16 Figure 50) on the left front of the radio transmitter panel. This should bring the radio transmitter back to calibration and all other frequencies should be within 0.05 per cent. For greater accuracies reset as above to the exact frequency desired.

INSPECTION: The inspection of installed radio equipment is covered by various Air Corps Circulars and Technical Orders. Instructions contained in those circulars and Technical Orders shall govern over any instructions contained herein. The following instructions are meant to cover, in detail, the points of inspection which are applicable to this particular equipment. The times at which the various inspections are to be made shall be governed by the applicable Circulars and Technical Orders.

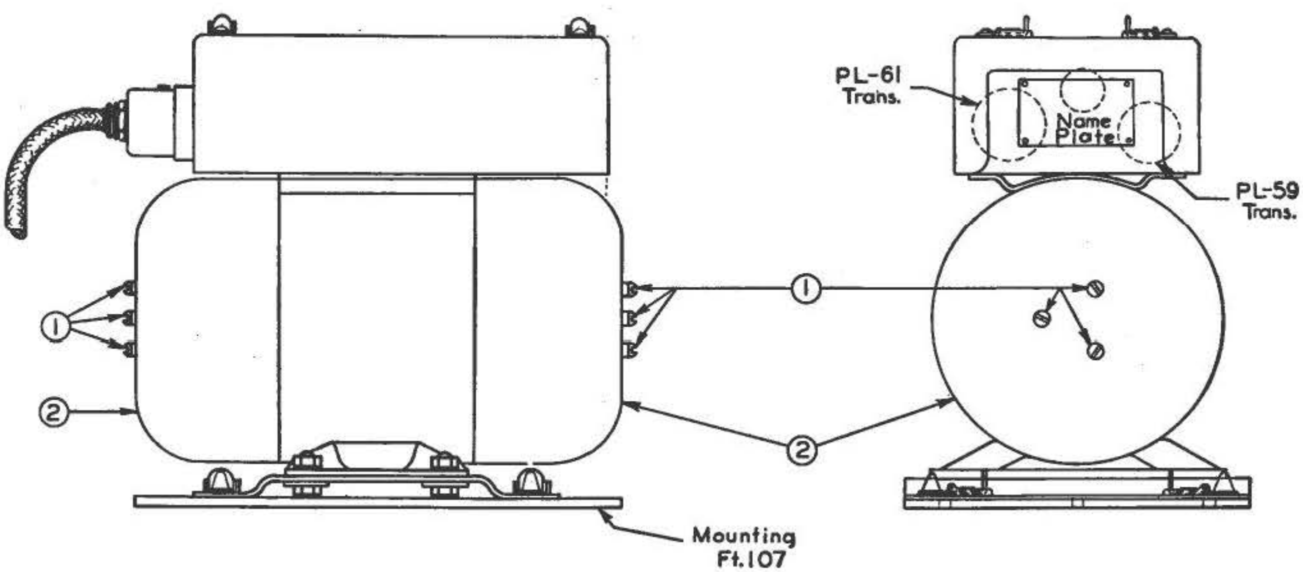


Figure 69. Liaison Dynamotor

Daily Operating Inspection—In order that a quick check on the condition of the transmitting equipment may be made prior to each day's flight, the following procedure is recommended.

1. Determine that the storage battery is at the proper gravity and that the charging generator and regulator are adjusted so as to keep the battery fully charged.
2. Make certain that all safety wiring is in place, that all mounting brackets and supports are rigidly fastened, and that all nuts and machine screws are supplied with lockwashers and are tight.
3. Determine that no cords have broken shielding and that all grounding and bonding is in place.
4. Inspect plugs for proper fit and plug sockets for compressed pin springs. Compressed pin springs which have taken a permanent set, can be restored by a light hammer blow on the end of the pin.

5. Make certain that all fuses are held tightly in their clips. A loosely held fuse should be removed and the clips bent with the fingers until they grip the fuse tightly. The clips and fuse ends should be kept clean and the contact surfaces bright.
6. Antennas should be inspected for broken or frayed leads, and insulators should be wiped clean. Be sure that antenna leads have not been bent close to metal frameworks where high antenna voltages might cause sparkovers
7. Inspect keys and microphones for broken cords and deformed plugs.
8. With the airplane outdoors, check the operation on CW, Tone, and Voice. Check the setting of all controls against the calibration charts and if possible, check the operation frequency by means of an accurate frequency meter. Check the quality of voice transmission by listening in at some suitable receiving station.
9. If the operation of the radio transmitter indicates that any vacuum tube is defective, that tube should be replaced by a tube that is known to be good. **If either the M-O or PA tube is replaced the operating frequency should be rechecked and the M-O calibration reset as described previously.**

Maintenance Inspection—At the time specified for this type of inspection, the following inspection and cleaning should be given.

1. Clean accumulated dust and dirt from all units. Use an air hose or bellows, paying particular attention to the loading coil, Item 1170 in the antenna compartment of the radio transmitter, behind switch P (15 Figure 50). At this time inspect the rotating coil, in this compartment. The winding should be thoroughly cleaned with carbon tetrachloride and a clean cloth.
2. Inspect dynamotor brushes for length. Detailed instructions on care of brushes are given herein, under Dynamotor Unit PE-73-C.
3. Inspect both dynamotor commutators for cleanliness and excessive wear. Information on care of commutators is given in these instructions.
4. Rotate the dynamotor armature by hand to make certain it turns freely and is not rubbing against the field poles or leads. When all four brushes are removed, the armature should spin freely on its bearings. Refer to detailed information on dynamotor bearings.

Yearly Inspection and Overhaul—After each year of service it is desirable that the entire radio equipment be sent to the Signal Corps Radio Section of the proper Air Depot for complete overhaul as follows:

1. Dynamotor Unit PE-73-C should be serviced as described in the paragraphs reading "Lubricants," "Periodic Lubrication Routine," and "Dynamotor PE-73-C."
2. A very complete inspection of all equipment should be made to determine if all assemblies and connections are tight and properly cleaned.
3. The **contacts** of all **switches** (except enclosed switches) should be **cleaned** with **Carbon tetrachloride** and a **light film of white vaseline** applied to the **rubbing surfaces.**
4. All working parts of the equipment should be lubricated as described on Pages 69 and 71.

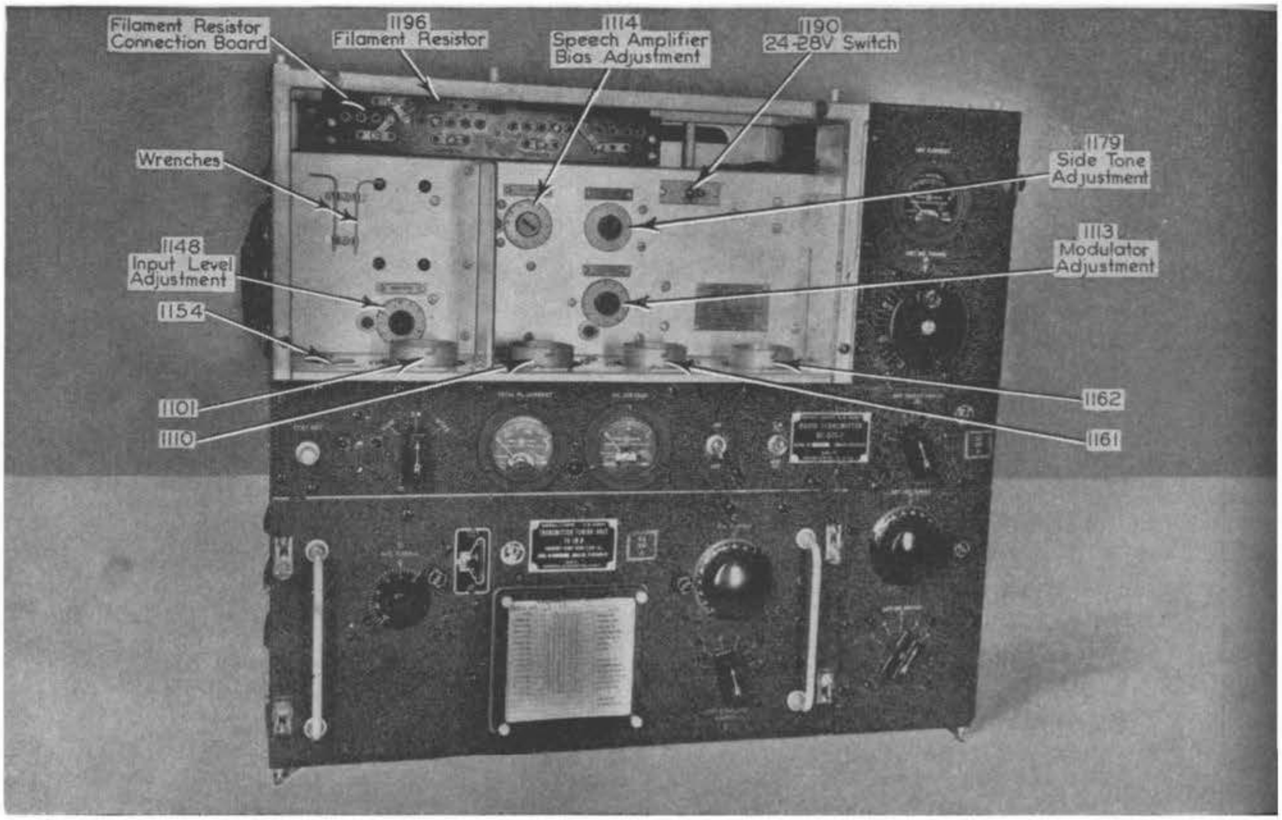


Figure 70. Radio Transmitter BC-375-D, Tube Compartment Shield and Top Cover Off and Transmitter Tuning Unit in Place

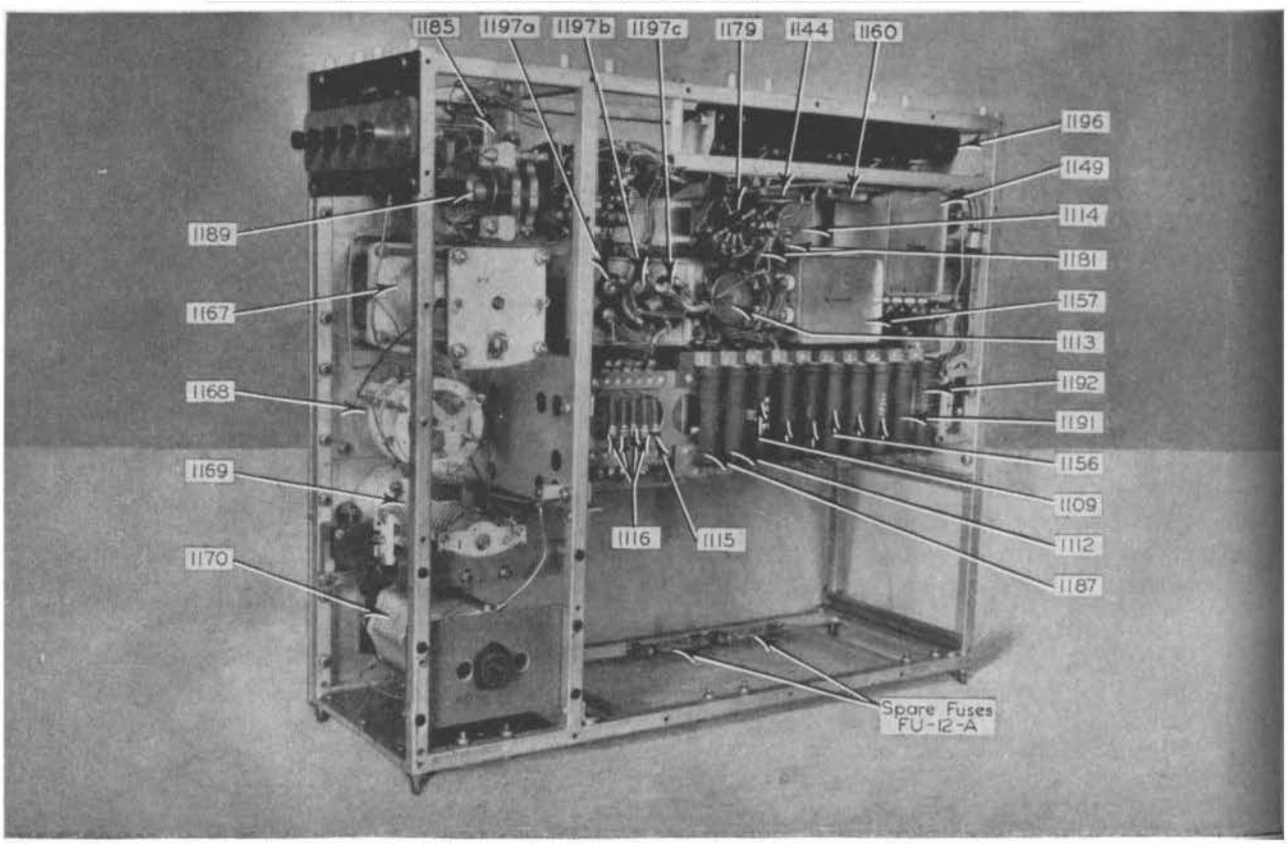


Figure 71. Radio Transmitter BC-375-D, Rear View, Mounting FT-151-A and Shields Removed

5. The electrical performance of the complete equipment should be very thoroughly checked. These checks should include voltage, current and power measurements and an overall test of modulation.

6. Inspect the wire horn gap on the back of the output terminal board.

The setting of this gap for all radio transmitters using frequencies below 1500 Kilocycles is 0.171 inch. Adjustment should be made with the fingers in order that the wire remain smooth and free from nicks.

LUBRICATION

Lubricants: The lubrication of the equipment involves the use of five lubricants and cleaning solvent. These are:

1. Light Oil: A high-grade, low pour test, mineral oil with viscosity rating SAE10.
2. Light Oil: A high-grade, low pour test, mineral oil with viscosity rating SAE20.
3. Light Oil: A high-grade instrument oil such as Type D6B5 as manufactured by the General Electric Company.
4. "Oil Dag" (graphite in oil); Manufactured by Acheson Colloids Corp., Port Huron, Michigan, U.S.A.
5. Grease: Use only high-temperature ball-bearing grease such as Grade 295, Air Corps Specification No. 3560. "Lubrico M-21" as supplied by the Master Lubricants Co., Philadelphia, Pa., or N.Y. & N. J. Lubricant "No. 1572 Special" are recommended for use where the temperature does not drop lower than 31°F. Do not use unauthorized greases as they melt out at high temperatures or oxidize rapidly and become gummy when packed in the bearings.
6. Cleaning Solvent: Carbon tetrachloride is strongly recommended.

PERIODIC LUBRICATION ROUTINE

A. Dynamotor Unit PE-73-C. Under normal operating conditions, the dynamotor bearings should be lubricated in accordance with the following schedule:

1. After every 1000 hours of operation or at intervals of six months, add three drops of SAE20 oil into the small oil hole which is provided in the top of each bearing housing and is closed by a screw plug. Start the threads on this plug by hand in order not to cross thread it.
2. After every 5000 hours of operation or at intervals of one year, add approximately 0.05 cu. in. (⅜ in. cube) of ball bearing grease to each bearing through the oil hole mentioned above.

NOTE: Do not add more oil or grease than specified above, since the excess lubricant will tend to work out of the bearing housing onto the commutators and brushes where it will cause trouble if not wiped off. Too much grease in the bearing will have a tendency to churn and may cause the bearing to overheat. Always make certain that the lubricants used are clean and that no dirt, moisture or foreign matter enters the oil hole when lubricant is added. Tighten screw plugs securely into the holes as soon as lubricant is added.

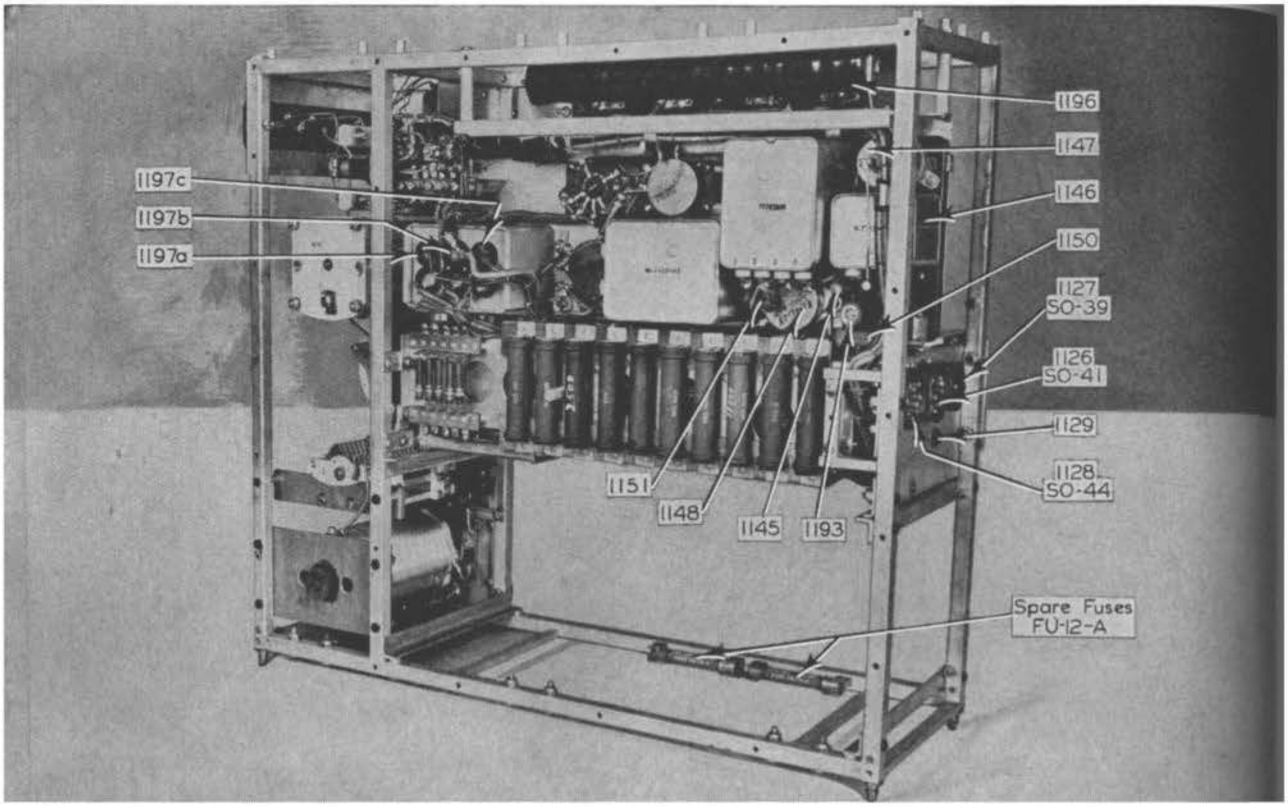


Figure 72. Radio Transmitter BC-375-D, Rear View, Mounting FT-151-A and Shields Removed

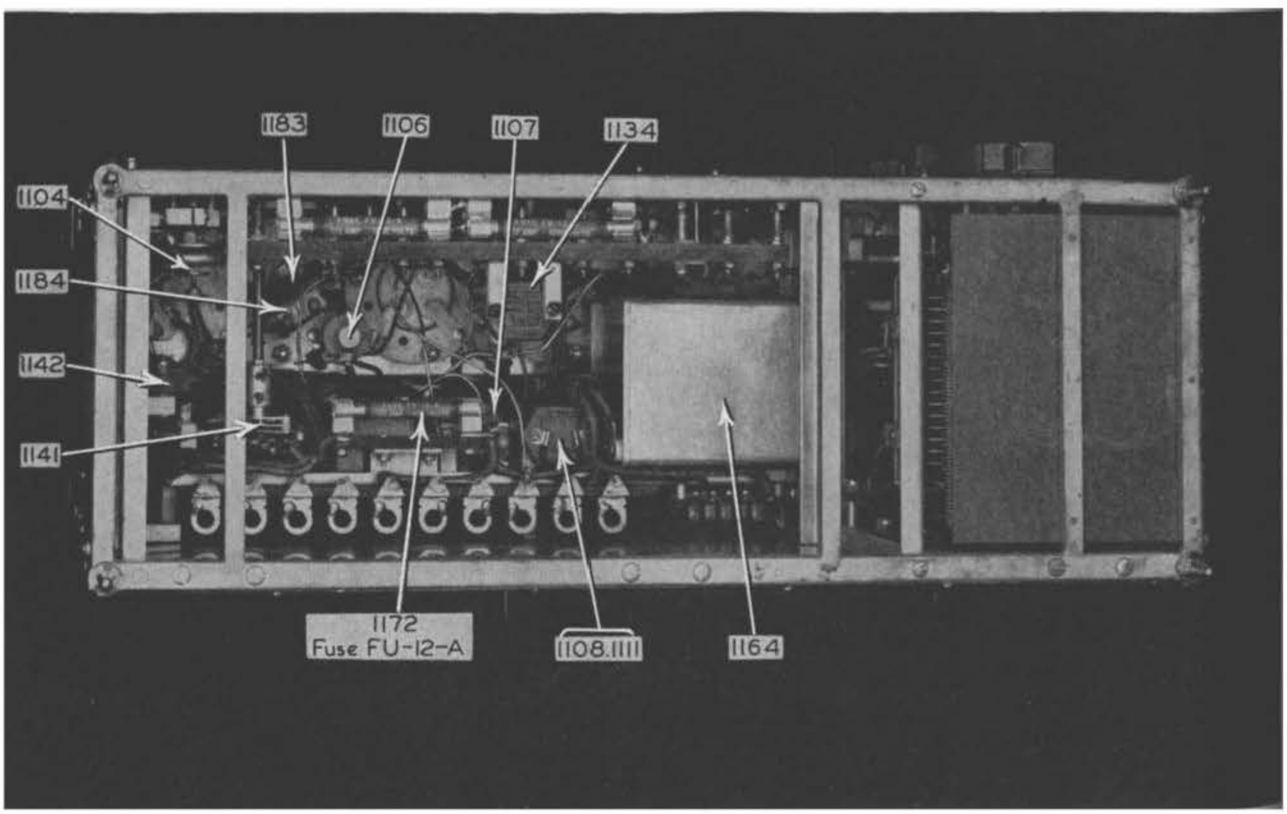


Figure 73. Radio Transmitter BC-375-D, Bottom View, Mounting FT-151-A and Shields Removed

B. Hand Operated Reel RL-30B. The construction of this unit is such that it will require very little attention. The following lubrication routine is recommended to obtain the best operating results:

1. After every 40 hours of flying time apply six drops of SAE10 oil at the oil hole indicated on the hub nameplate.

2. After every 1000 hours of flying time or every six months, whichever comes first, do as follows:

   (1) Remove the three fillister head screws which hold the crank handle lever to the hub and remove the crank.

   (2) Remove the small cotter pin and castle nut on the end of the reel shaft.

   (3) Remove reel spool and hub from the shaft.

   (4) Clean the accumulated dirt from reel shaft and the parts in the mounting base.

Examine the exterior parts of the reel hub and clean off all dirt.

   (5) Lubricate these points using SAE-10 oil:

      (1) Counter gear shaft bearing—1 drop.

      (2) Main shaft—several drops along the bearing surface.

      (3) Rear ball bearing on hub adjacent to ratchet teeth—5 drops.

      (4) Front thrust bearing around the edge of the retaining nut at the front end of the hub—5 drops.

      (5) Front ball bearing around the gap between the outside of the hub and the edge of the piece into which the three screws from the crank handle lever are threaded—5 drops.

   (6) Reassemble the reel as follows:

      (1) Place the reel spool and hub on the shaft. Give the spool a slight spin clockwise until the ratchet engages the pawls.

      (2) Replace the castle nut with the fingers, run it down until snug and then back it off until the hub runs free (at least 1/6 of turn). Replace the cotter pin.

      (3) Assemble the crank handle and tighten the three fillister head screws.

      (4) This completes the operation of servicing the reel.

Miscellaneous Lubrication:

The following miscellaneous lubrication instructions should be followed in connection with the maintenance of other units of the transmitting equipment. Places to oil and grease are listed. **Do this after every 500 hours of service** or at least after every 1000 hours. **Do it oftener if dirt accumulation is excessive.** Clean parts as required.

1. Oil (General Electric Type D6B5)—Ball bearings in antenna switching relay of radio transmitter unit.
2. Oil SAE20—Switch shafts in radio transmitter, transmitter tuning units and antenna tuning unit. Vernier mechanisms in radio transmitter, transmitter tuning unit and antenna tuning unit. Variable capacitor shafts in radio transmitter and transmitter tuning units.

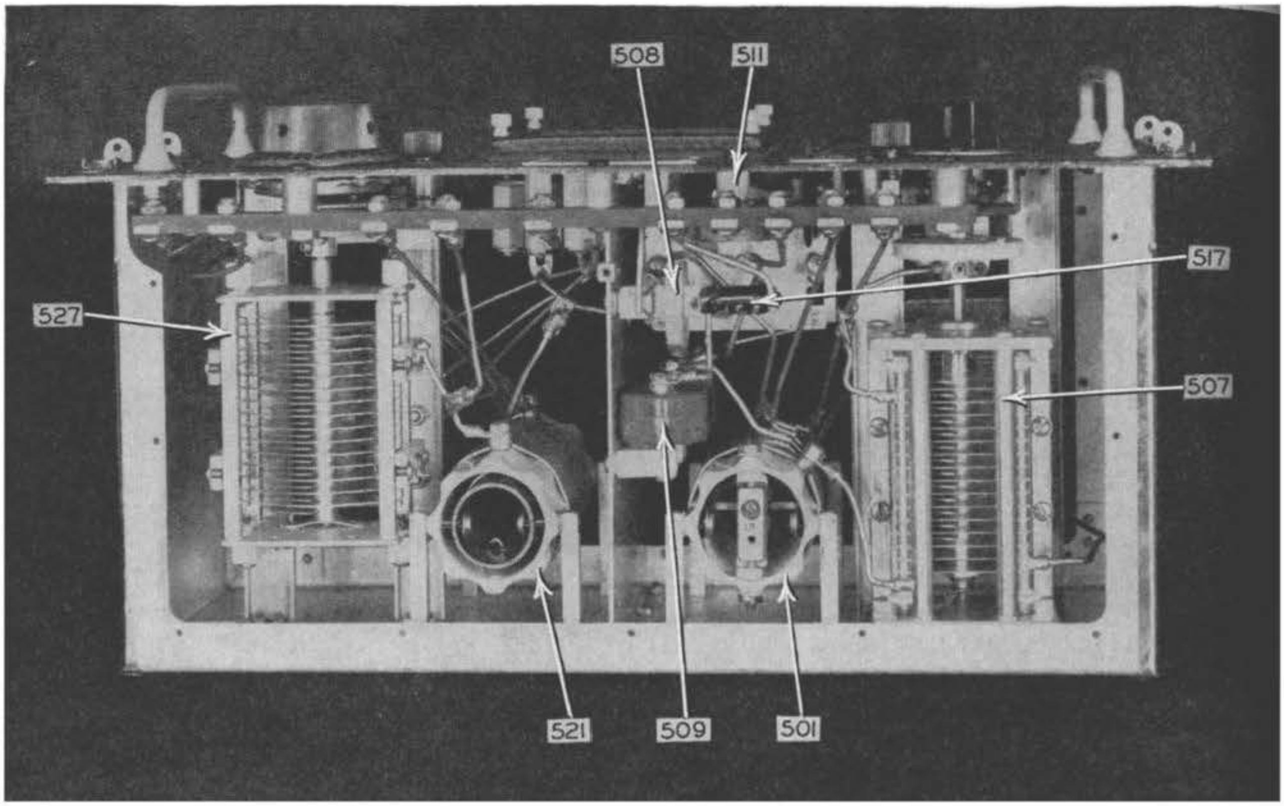


Figure 74. Transmitter Tuning Unit TU-5-B, Top View, Cover Removed

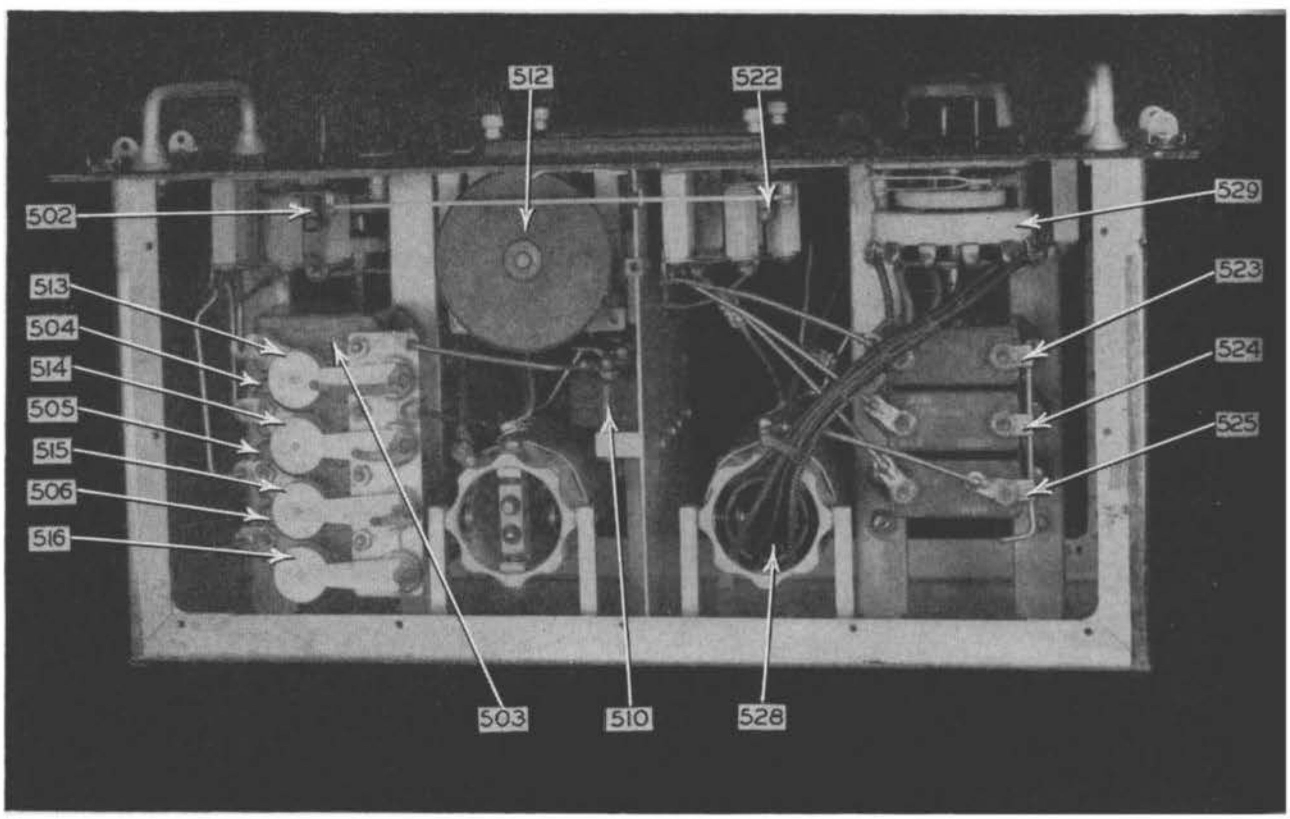


Figure 75. Transmitter Tuning Unit TU-5-B, Bottom View, Cover Removed

3. Grease—Contacts of switches, and switch positioning devices in radio transmitter, transmitter tuning unit and antenna tuning unit.
4. **NEVER lubricate the contact roller or the contact roller shaft of the rotating antenna inductor. These parts should run DRY and should always be kept spotlessly clean. Carbon tetrachloride** should be used to clean these parts.
5. Graphite in Oil—In the transmitter tuning units, apply "Oil Dag" to the bearings and surfaces of the worm and worm gear of the gear of the master-oscillator tuning units.

SERVICE NOTES:

In the servicing and locating of faults in the radio transmitter and associated equipment, it is necessary to remove various shields and covers to make the circuits accessible. Great care must be taken in testing with shields removed, because a great many points of high voltage are thus exposed. Whenever such testing is necessary, the proper procedure is to remove all power from the equipment, make the necessary circuit changes or meter connections and then apply power, keeping clear of all meters which are connected in the "high" sides of circuits where there may exist an appreciable voltage to ground.

ALWAYS REMEMBER THAT WHEN THE DYNAMOTOR IS RUNNING AND THE TRANSMITTING KEY IS OPEN, HIGH VOLTAGE IS PRESENT IN THE RADIO TRANSMITTER EVEN THOUGH THERE IS NO PLATE AMMETER READING.

In checking low voltage and filament circuits the single conductor cord with Plug PL-59 should be disconnected from the radio transmitter, thus removing the high voltage supply.

The following information is supplied to aid in servicing the equipment and locating faults:

a. **Voltage Readings:** (Use a high resistance Voltohmmeter, or Test Set.)

(1) Low-voltage input of 24 to 28 volts, depending on the power-supply voltage, should be obtained from terminal 45 of Socket SO-41 to ground. (See Figure 83).

(2) Speech-amplifier plate voltage of approximately 425 volts should be obtained at the plate connection of the speech-amplifier tube when the radio transmitter is on VOICE, Figure 83.

It is recommended that a tube socket adapter be used which will allow not only readings of voltage but also all currents for Tube VT-25.

(3) Modulator bias voltage of 72 to 75 should be obtained across capacitor 1160 (Figure 71 and 83) the positive side being at ground potential. Selector switch (6 Figure 50) should be on VOICE.

(4) Speech amplifier bias voltage of 35 to 40 should be obtained across capacitor 1144, Figure 71, the positive side being at ground potential. Transmitter switch should be on VOICE.

(5) Plate voltage of 1000 to 1100 volts should be obtained between terminal 61 of Socket SO-39 and ground, Figure 72.

(6) Keying voltage of approximately 200 volts will be obtained across resistor 1115 when keying relay 1189 is open, Figure 71.

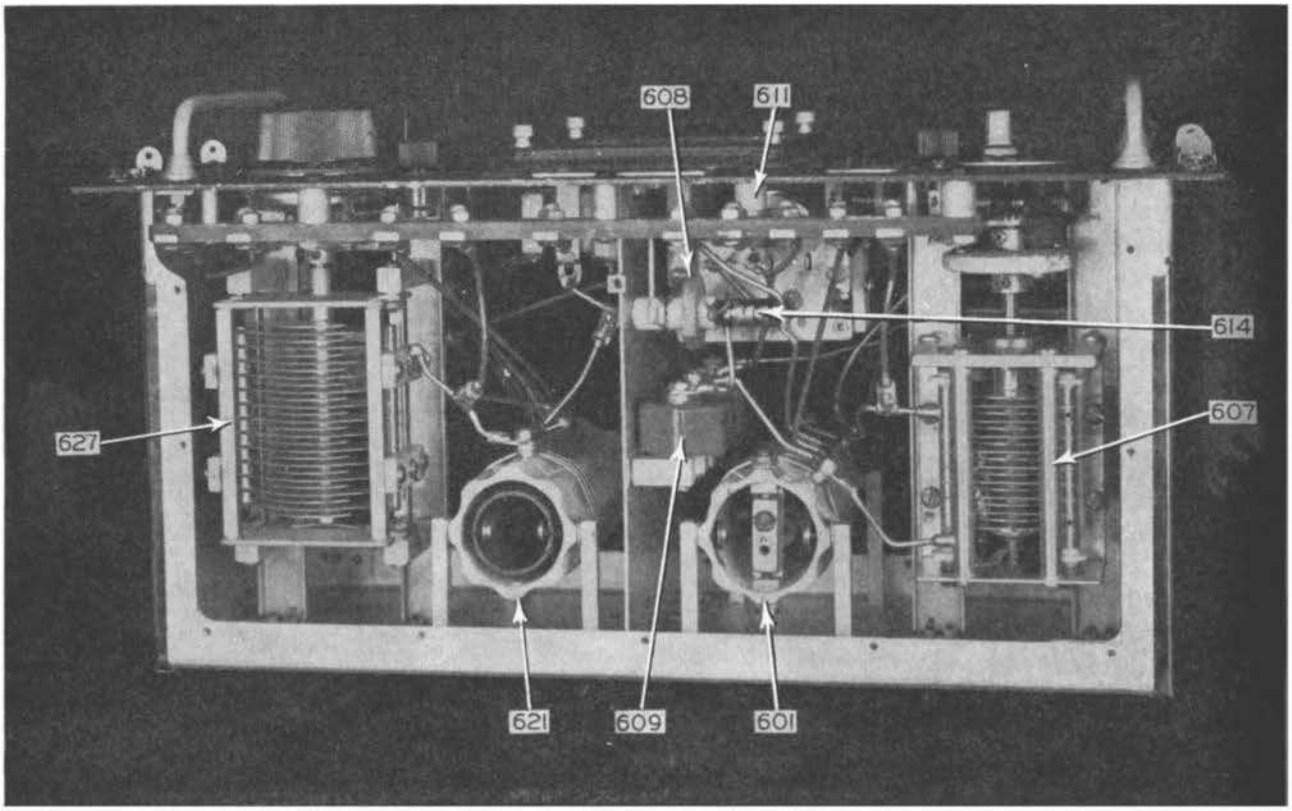


Figure 76. Transmitter Tuning Unit TU-6-B, Top View, Cover Removed

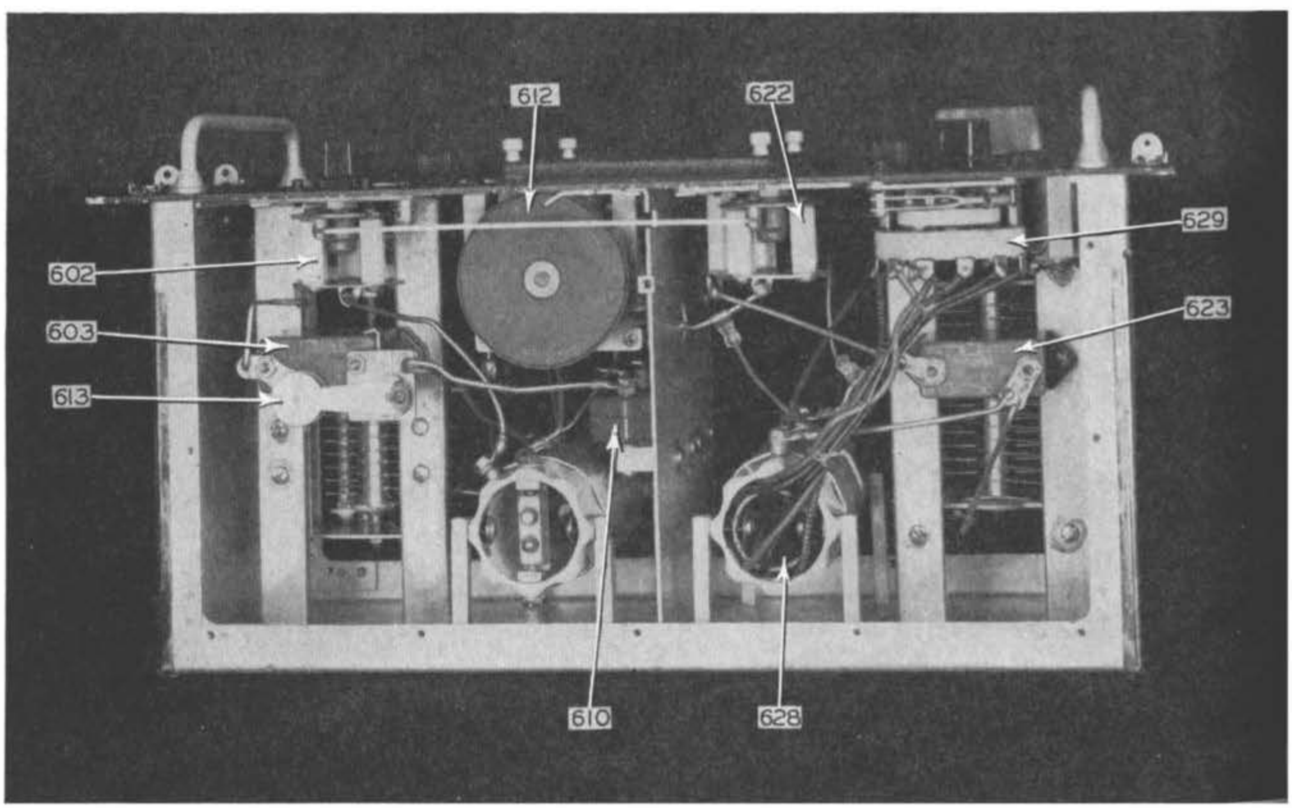


Figure 77. Transmitter Tuning Unit TU-6-B, Bottom View, Cover Removed

(7) Using the output meter of Test Set I-56-A, the side-tone voltage may be measured across an 8000-ohm load resistor. With the SIDE TONE switch on position 4, 17.5 to 30 volts AC should be present at an audio-frequency of 600 to 1200 cycles, depending on the transmitter tuning unit in use.

The SIDE TONE switch on position 1 will give 3 to 9 volts AC. It will be generally found that the CW position will give a higher voltage than the Voice or TONE positions.

(8) Microphone-supply voltage or 4.5 to 5.3 volts DC should be obtained across resistor 1145, Figure 72. For this test, the microphone should be in the circuit.

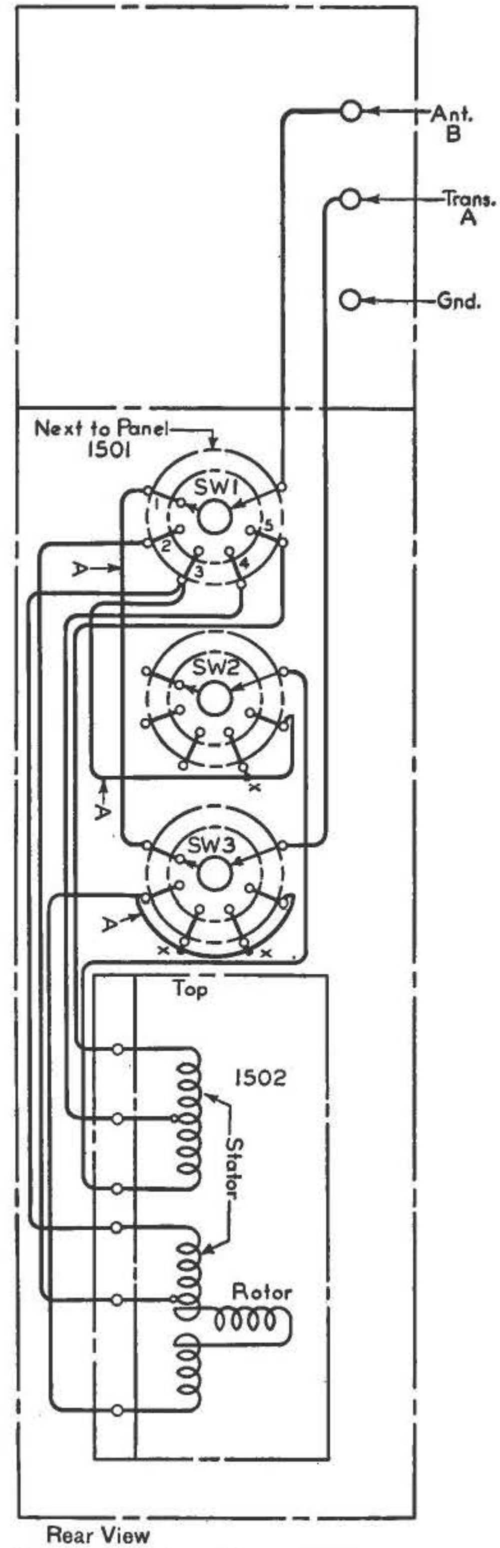
b. **Current Readings:**

(1) Speech-amplifier plate current should be from 17 to 22 milliamperes. Adjustment of the bias voltage to obtain this value is accomplished by potentiometer 1114, Figure 71, which is accessible in the tube compartment.

(2) Modulator plate current may be determined by observing the increase in total plate current reading when changing from CW to VOICE and impressing normal modulation. The modulator plate current should average 100 to 160 milliamperes for sustained tones. A greater or smaller value than this indicates that a readjustment of the input should be made.

(3) Master-oscillator plate current can be determined on the TOTAL PLATE CURRENT meter by removing the power-amplifier and speech-amplifier tubes and placing the radio transmitter on CW. The current indicated should be from 30 to 75 milliamperes, depending on the transmitter tuning unit in use.

(4) Power-amplifier plate current may be determined by subtracting from the total plate current on CW the currents drawn



Connection	Size of Conductor
Unmarked	.102" Dia. Copper Wire Tinned
A	.080" Dia. Copper Wire Tinned

At Points Marked "X" Use Cotter Pin $\frac{1}{16}$" x $\frac{3}{8}$"

Figure 78. Antenna Tuning Unit BC-306-A, Connection Diagram

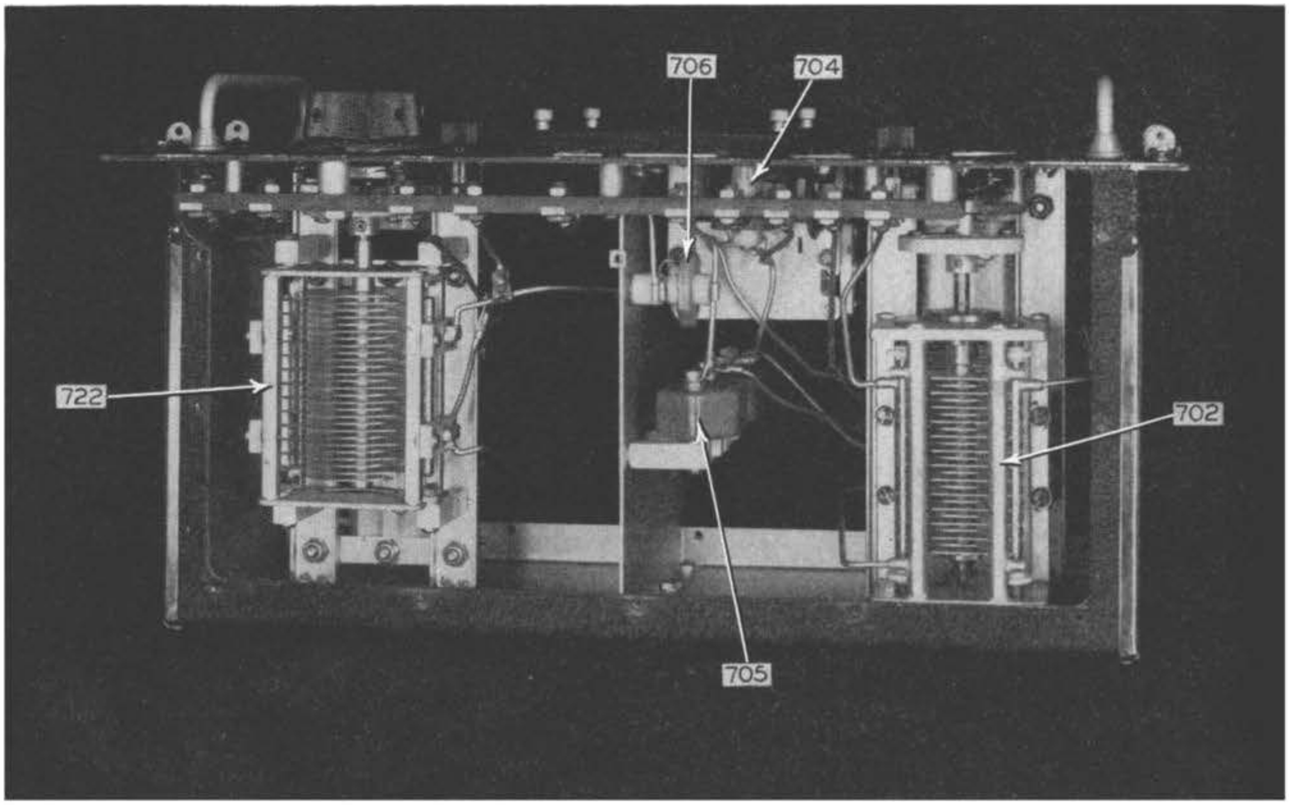


Figure 79. Transmitter Tuning Unit TU-7-B, Top View, Cover Removed

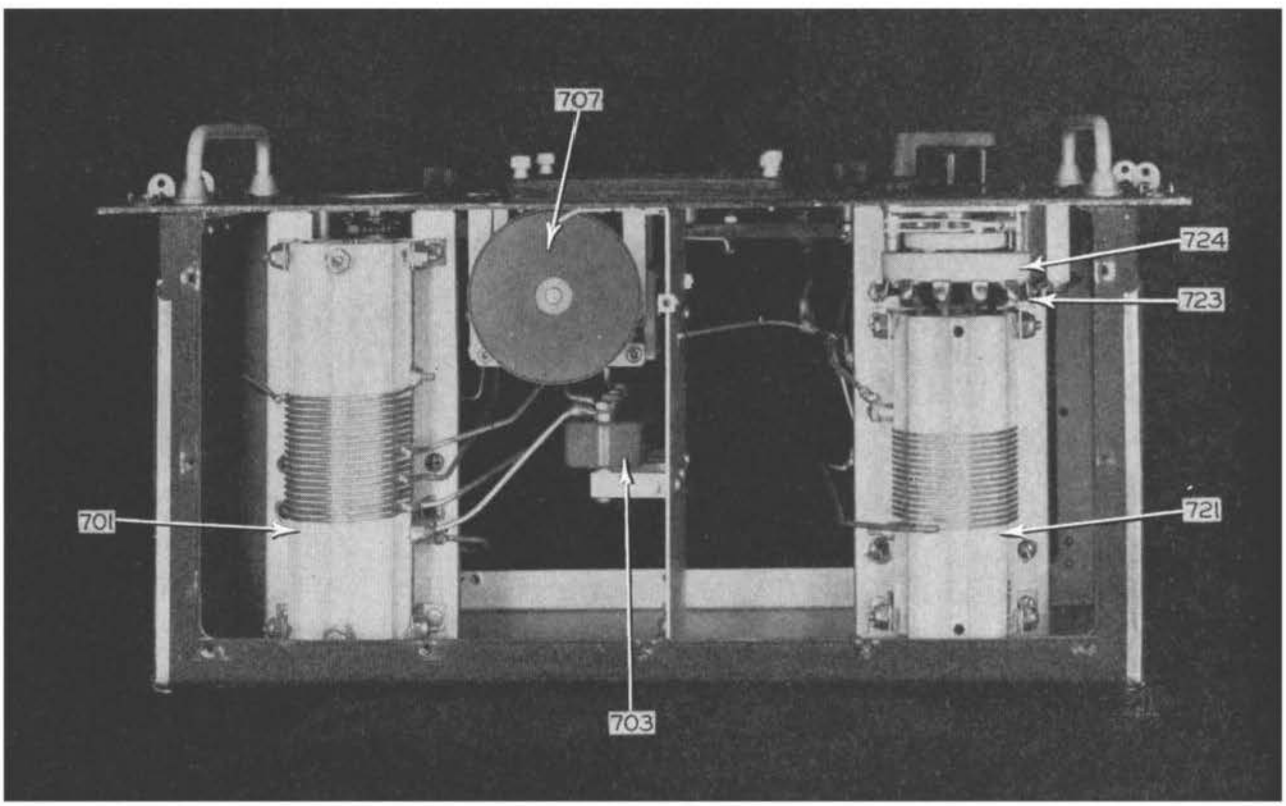


Figure 80. Transmitter Tuning Unit TU-7-B, Bottom View, Cover Removed

by the master oscillator and speech amplifier. Its value should be from 100 to 150 milliamperes at full load.

(5) Master-oscillator grid current can be determined by connecting a DC milliammeter in series with resistor 1109, See Figure 71. Correct value should be from 30 to 50 milliamperes.

(6) Power-amplifier grid current can be determined by inserting a DC milliammeter in series with resistor 1112, See Figure 71. Correct value should be from 15 to 25 milliamperes.

Other circuits may be checked by referrring to the various unit connection diagrams, and the location of the circuit elements may be ascertained.

Typical Dynamotor Performance:

The dynamotor should operate approximately as follows on load test:

Input		Output	
Volts	*Amperes	Volts	Milliamperes
28.0	5—8	1140—1160	0
28.0	14—17	1070—1090	220
28.0	20—22.5	1025—1050	350

*The input current above includes that taken by the starting relay.

Location of Faults: If the operation of the equipment falls below normal, several simple checks listed below may be readily investigated.

Symptoms	Probable Causes and Remedy
No filament voltage	Relay 1610 not operating when OFF-ON switch is placed in ON position. Fuse 1604 open. Normal fuse resistance is not over one ohm. Switch 1135 must be in proper position corresponding to "CW" or "MOD."
Low filament voltage	Resistor 1196 not adjusted properly. High resistance leads between dynamotor unit and transmitter. There should be at least 20 volts between terminals 47 and 54 of Socket SO-41, item 1126. Low input voltage dynamotor.
Key relay inactive	Key Jack not making good contact. Cord open. Energizing coil open.
No plate current	Fuse 1608, See Figure 67 in dynamotor unit or fuse 1172, See Figure 73, in transmitter open. Normal fuse resistance not over 3 ohms. Filaments not lighted. Key relay inactive.

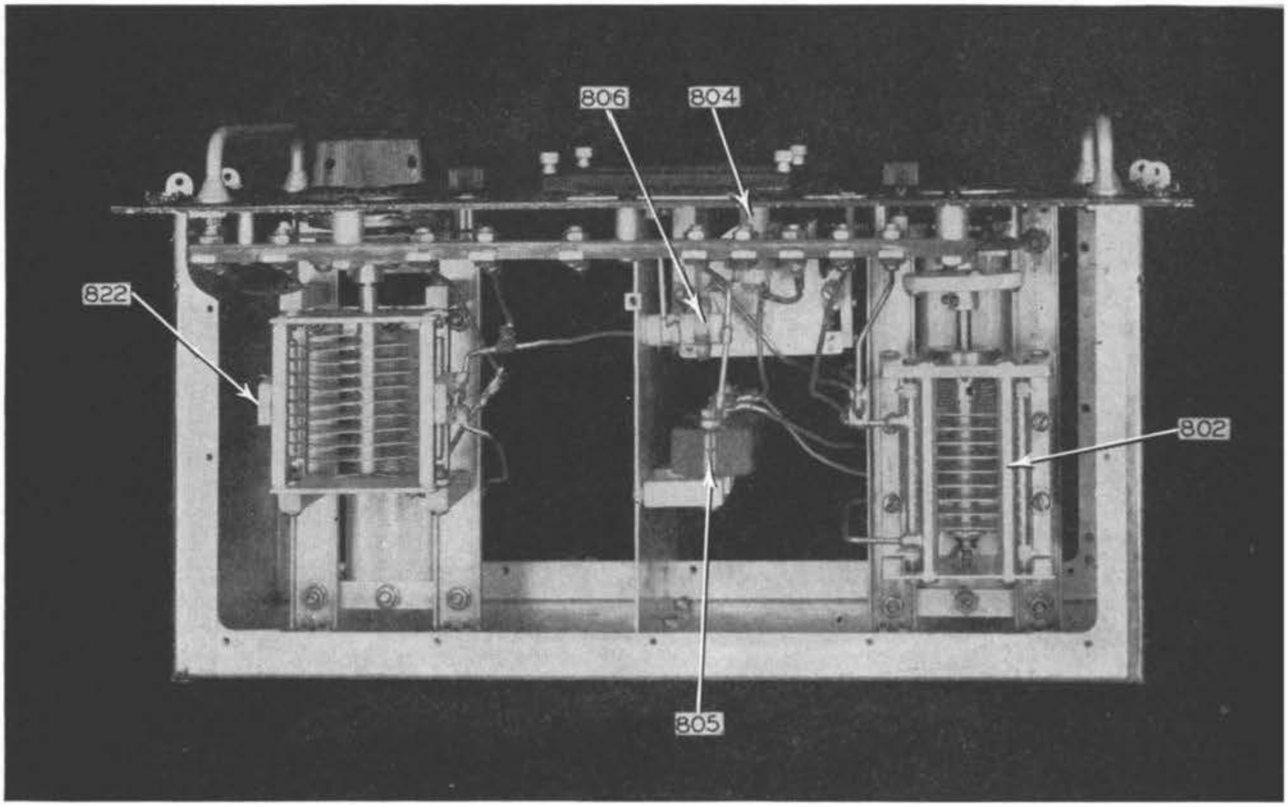


Figure 81. Transmitter Tuning Unit TU-8-B, Top View, Cover Removed

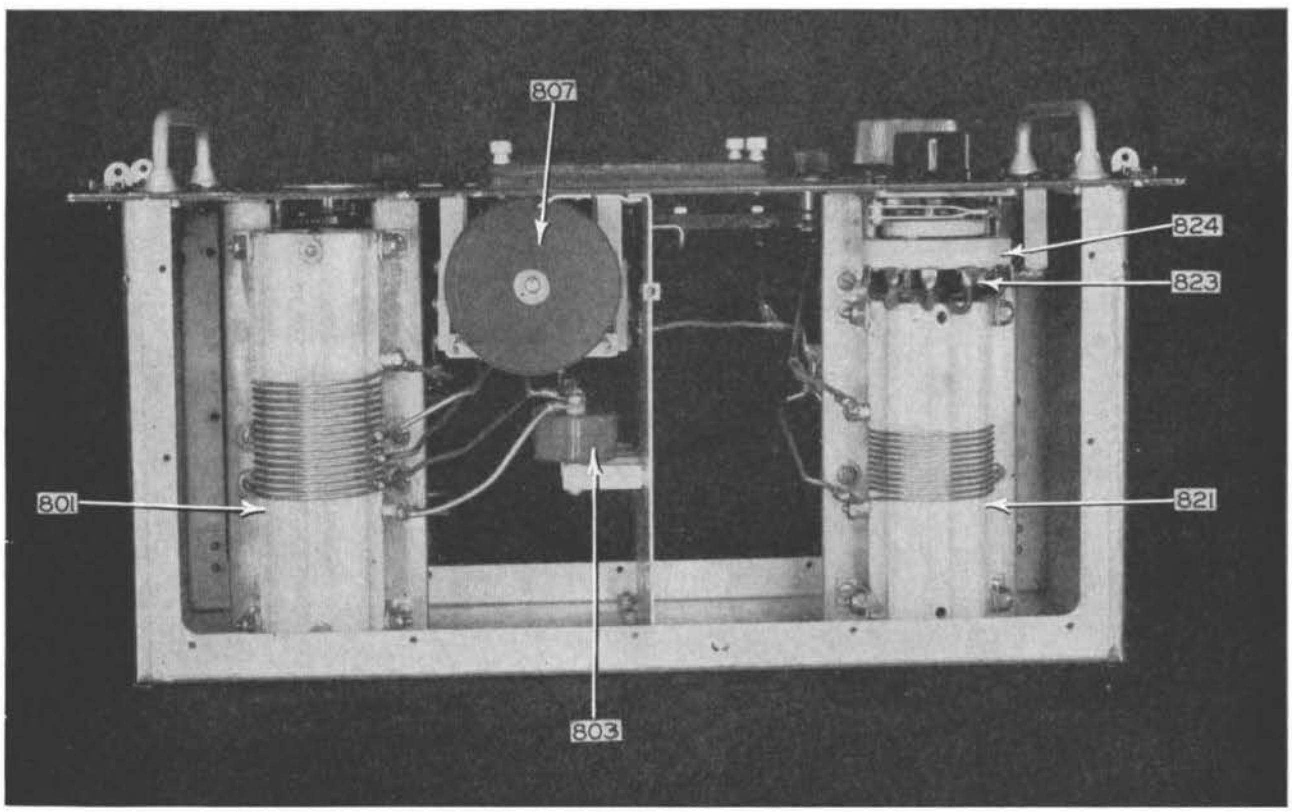


Figure 82. Transmitter Tuning Unit TU-8-B, Bottom View, Cover Removed

Symptoms	Probable Causes and Remedy
Excessive plate current (No antenna load—CW)	PA dial "C" not in tune. M-O tube inoperative.
Excessive plate current (Antenna loaded—CW)	Coupling tap "D" on too high a number. On some tuning units, or with low resistance, it may be necessary to detune the antenna to secure 220 ma. on CW. ALWAYS MAINTAIN THE PA DIAL "C" IN TUNE.
No antenna current	Antenna circuit open. Antenna not properly tuned. Link not in terminal board A to B, Figure 71.
No side tone (Tone—CW)	Tube VT-25 defective. S-A BIAS control not set properly. The correct setting will usually be found between 6.0 and 7.5 on the dial, See Figure 51.
No or low side tone (Voice)	Same as above. Adjustment may be too low. Operator may need to adjust side-tone level to a higher number than for Tone or CW, especially if a low-level voice is used.

Troubles of a more complex nature will require analysis with Test Set I-56-A or equivalent Methods of procedure for some of the more probable troubles are listed below. Operating personnel are warned to use extreme caution in avoiding accidental contact with high-voltage parts while making the following tests. ALWAYS REMEMBER THAT WHEN THE DYNAMOTOR IS RUNNING AND THE TRANSMITTING KEY IS OPEN, HIGH VOLTAGE IS PRESENT IN THE RADIO TRANSMITTER EVEN THOUGH THERE IS NO PLATE AMMETER READING.

Fault	Test Procedure
Dynamotor won't run	Test fuse 1605 (Fuse FU-22) Figure 67 and check voltage (24 or 28) at line input terminals. Remove end bells and disconnect input voltage. Then rotate armature. If armature does not rotate freely, follow instructions for dynamotor under "LUBRICATION."
	If the dynamotor armature turns freely, connect input voltage again and short pin No. 57 of Socket SO-41, Figure 66 to ground. If machine now runs, look for open lead in cord to transmitter. Check to see if tuning unit is firmly in place and interlock 1102 (8 Figure 51)— is closed.
	If the dynamotor does not run when pin No. 57 of Socket SO-41 is grounded, listen for click of starting relay 1610, Figure 67, and check voltage across its terminals. 24 to 28 volts should exist with pin No. 57 grounded.

Fault	Test Procedure
	If dynamotor starts to rotate then stops as Fuse FU-22 blows, replace the single link in Fuse FU-22 with two links (Fuse Link M-168 is parallel.) The instantaneous line current sometimes overheats the fuse on input lines of good regulation while normal running currents would be satisfactory.
	With the input power off, the large relay terminals may be shorted and the dynamotor circuits checked for continuity to the brushes. **CAUTION:** Replace all dynamotor brushes in the same holder with the marking up, exactly as removed. The brushes have been accurately fitted and run-in exactly as shipped.
	A very slight difference between brush holders will cut the effective brush contact area considerably. This will lower the dynamotor efficiency. If after these tests, the dynamotor will not operate, first try a substitute dynamotor if available, then ship the defective unit to the Signal Corps Radio Section of an Air Depot for servicing.
PA TUNING control "C" has no effect on total plate current	First reduce the ANT. COUPLING control "D" (14 Figure 52) to a minimum; switch position 1. If this has no effect, examine and replace the M-O tube, (2 Figure 51). Be sure radio transmitter is on the "CW" position (6 Figure 50) as this entire fault may be caused by an improperly tuned power-amplifier tube and misadjusted modulator tubes when operating in the "VOICE" position. Measure the voltage from the junction of 1111, Figure 71, and 1112, Figure 73 to ground. If the master oscillator is functioning properly, this voltage should be approximately 200 V DC with transmitting key down. Should this voltage be near zero, check the voltages on the master-oscillator tube and continuity of the P-A grid circuits.
	The master-oscillator tube may be checked for operation by holding a neon bulb in the hand in contact with the glass of the master-oscillator tube, (2 figure 51). If the M-O tube is oscillating, the neon tube will glow by substitution of tuning units, one may determine if the trouble is peculiar to the tuning unit or to the radio transmitter.
	If the trouble is in the tuning unit, remove the cover and check continuity of all circuits. Look for chips and shorted turns on the tank coils, dirty capacitors and open choke coils. Capacitor plates may be effectively cleaned with pipe cleaners. If the unit is to be blown out, be sure to use clean dry air.

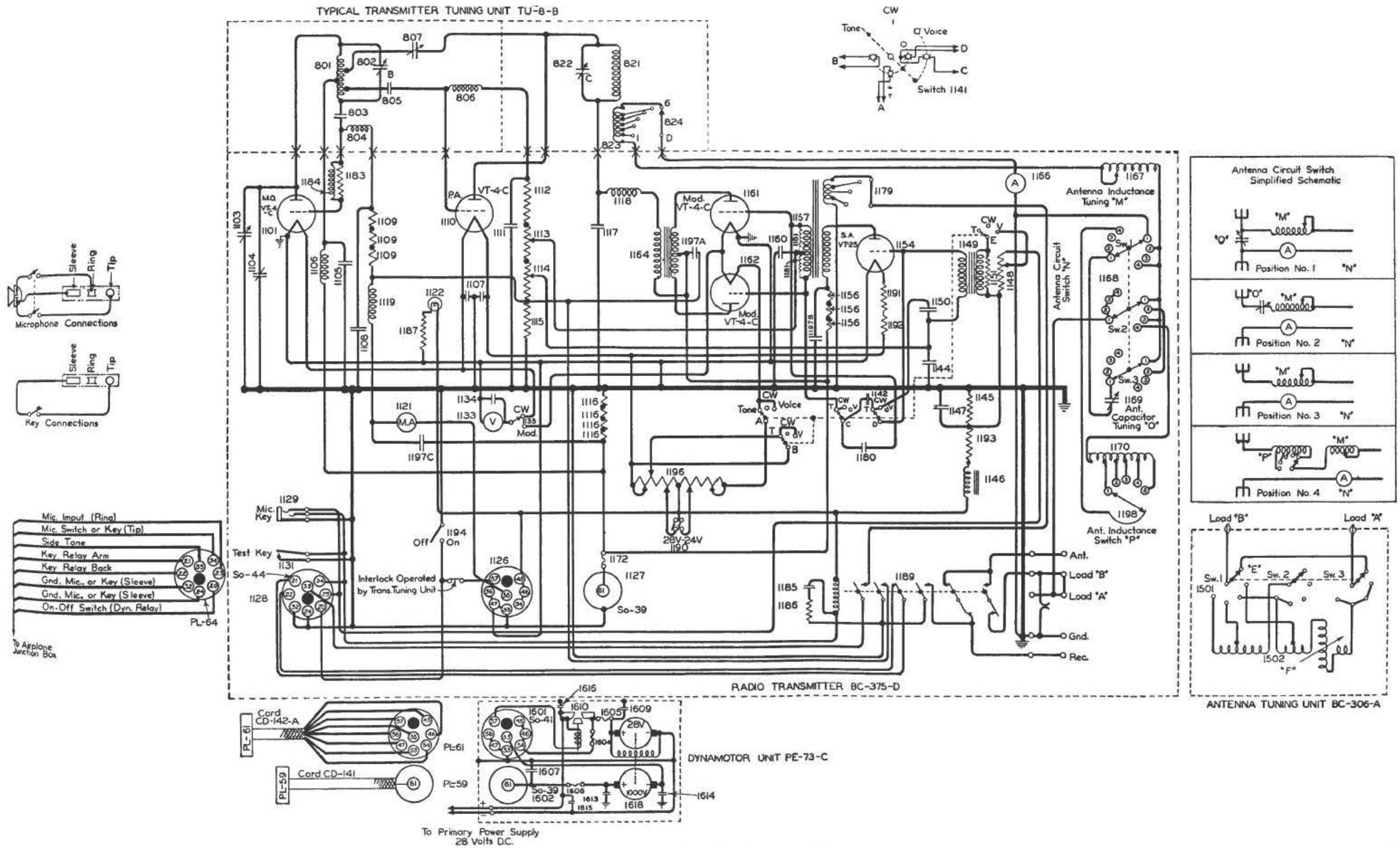
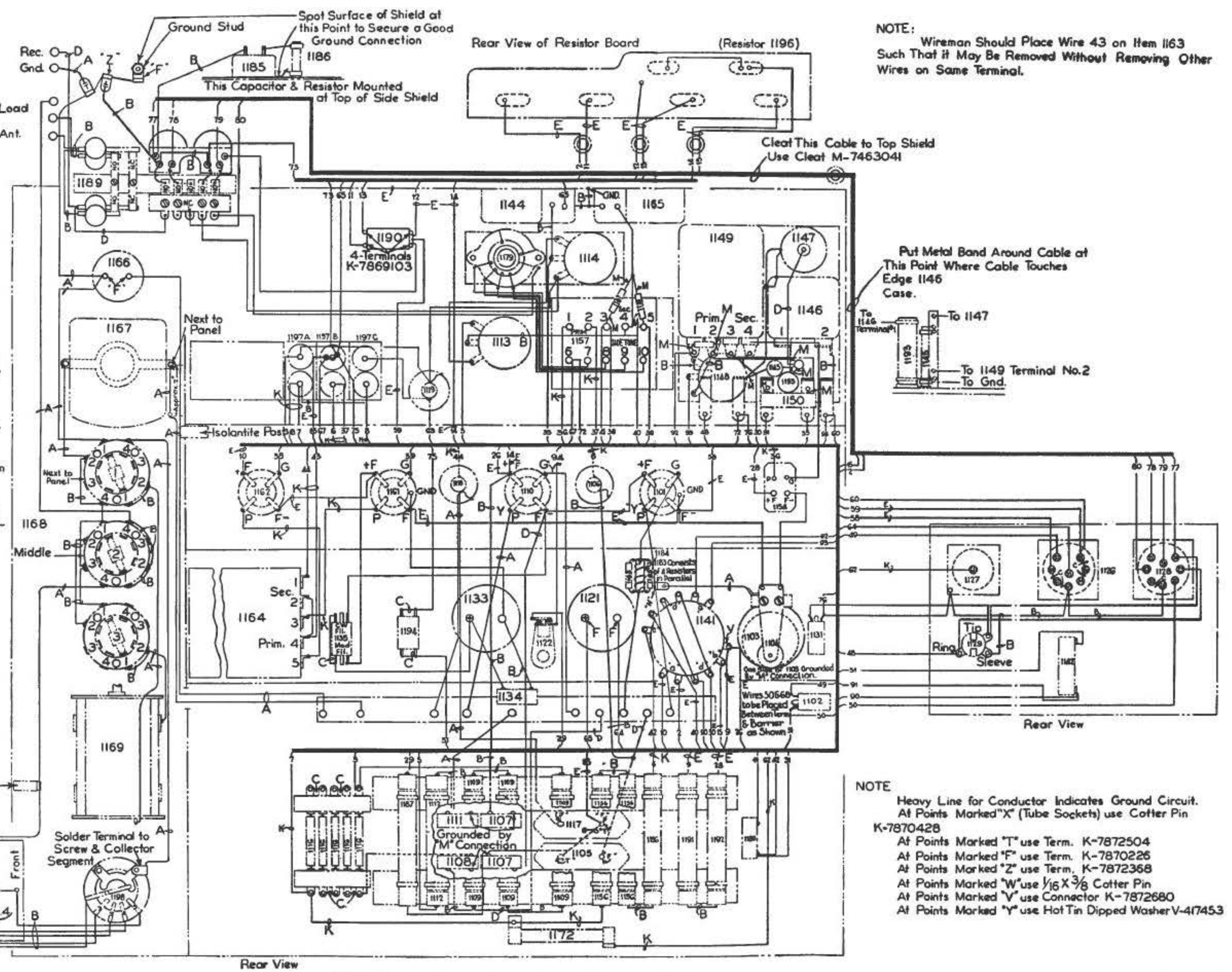


Figure 83. Radio Transmitter BC-375-D, Schematic Diagram

Fault	Test Procedures
Radio transmitter sparks over at high altitudes	Read instructions on high altitude operation. If the radio transmitter does not meet the altitude operation stated in the above section, the radio transmitter must be thoroughly checked over. Tuning units must be blown clean and capacitors wiped plate by plate with a pipe cleaner. The master-oscillator and power-amplifier tubes should be changed. The air gap on the back of the output terminal board must be set for 0.171 inch. Wipe the key relay posts and output terminal board with a clean dry lintless cloth. Inspect antenna compartment for clearances of the wiring. All wires should be spaced clear from ground. Compare the faulty transmitter antenna compartment with a normal unit.
No modulation on VOICE	Check Tone-CW-Voice selector switch for position. Substitute another Tube VT-25, (1 Figure 51). Check that CW carrier is properly adjusted. Check voice increase of 20 to 35 main total plate current over CW value of 220 ma. If total plate current cannot be adjusted for this increase, change modulator tubes, (4 Figure 51). Check continuity of circuits with all power off. Remove high voltage Plug PL-59 from radio transmitter and place high resistance voltmeter of Test Set across terminals 3 and 4, of transformer 1149, Figure 71. Speak into microphone with filaments lighted. AC voltage on a loud signal should be approximately 1 to 2 volts. This is a check of input circuits. If no voltage is read, check continuity of circuits as given in resistance chart.
No modulation on Tone	If the CW and Voice operation is normal, one can assume that the tubes are satisfactory and the trouble lies in the fact that the speech-amplifier tube fails to oscillate. If this is the case, no side-tone will be heard on pin No. 33 of socket 1128 (SO-44), Figure 72 either on the CW or Tone positions. Check the S-A BIAS control, Figure 70. This will usually be between 6 and 7.5 on the dial. If still no tone modulation exists, remove dynamotor cables and check continuity of circuits, especially switch 1141, Figure 73.
Distortion on VOICE	Check Input Level control, Figure 70. The setting of this control depends on the microphone and the voice level of the operator. It will usually be found that a setting of 7 to 8 on the dial allows the total plate current to swing to 350 milliamperes on peaks of voice level, using the standard Signal Corps microphones.
	If the Voice Modulator bias has been properly adjusted and distortion is still present, set the Input Level so that peaks of modulation are limited as shown by the total plate current swinging upward to a maximum of 300 milliamperes. If either modulator tube (4 Figure 51) VT-4-C or the speech amplifier Tube VT-25 (1 Figure 51) are defective, distortion will exist. Recheck CW first, then Voice adjustments to see if properly adjusted.



NOTE:
Wireman Should Place Wire 43 on Item 1163 Such That it May Be Removed Without Removing Other Wires on Same Terminal.

NOTE:
Fasten Wires Securely to Terminals Mechanically Before Soldering. Use Rosin Core Solder B20D3C. Apply One Coat of No. 1234 Glyptal Over all Soldered Joints.

The Heavy Lines Highways are Merely Guide Lines to Assist in Tracing Connections on the Diagram and do not Necessarily Indicate Cables.

Conductors Should be Cabled in the Most Convenient Manner Wherever Cabling is Advantageous.

NOTE

Heavy Line for Conductor Indicates Ground Circuit.
At Points Marked "X" (Tube Sockets) use Cotter Pin K-7870428
At Points Marked "T" use Term. K-7872504
At Points Marked "F" use Term. K-7870226
At Points Marked "Z" use Term. K-7872368
At Points Marked "W" use 1/16 X 3/8 Cotter Pin
At Points Marked "V" use Connector K-7872680
At Points Marked "Y" use Hot Tin Dipped Washer V-417453

Figure 84. Radio Transmitter BC-375-D, Connection Diagram

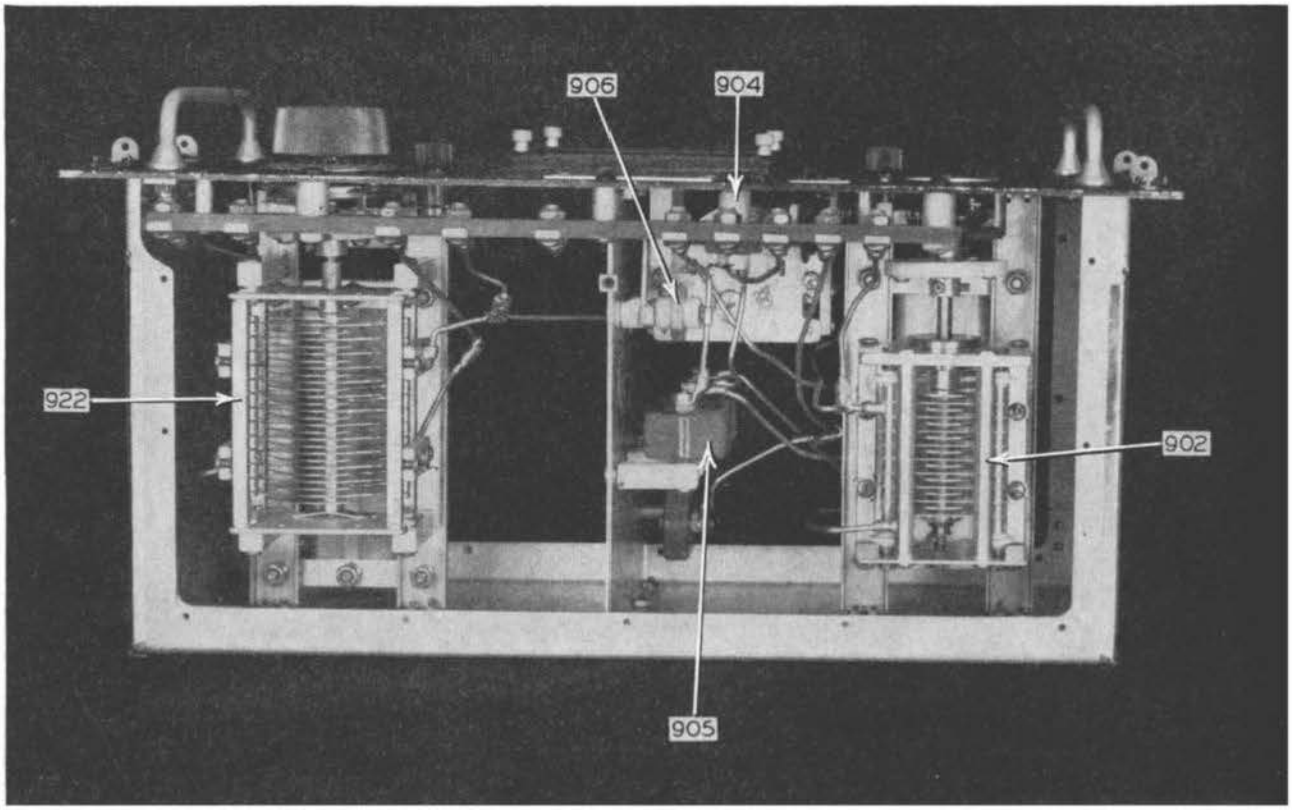


Figure 85. Transmitter Tuning Unit TU-9-B, Top View, Cover Removed

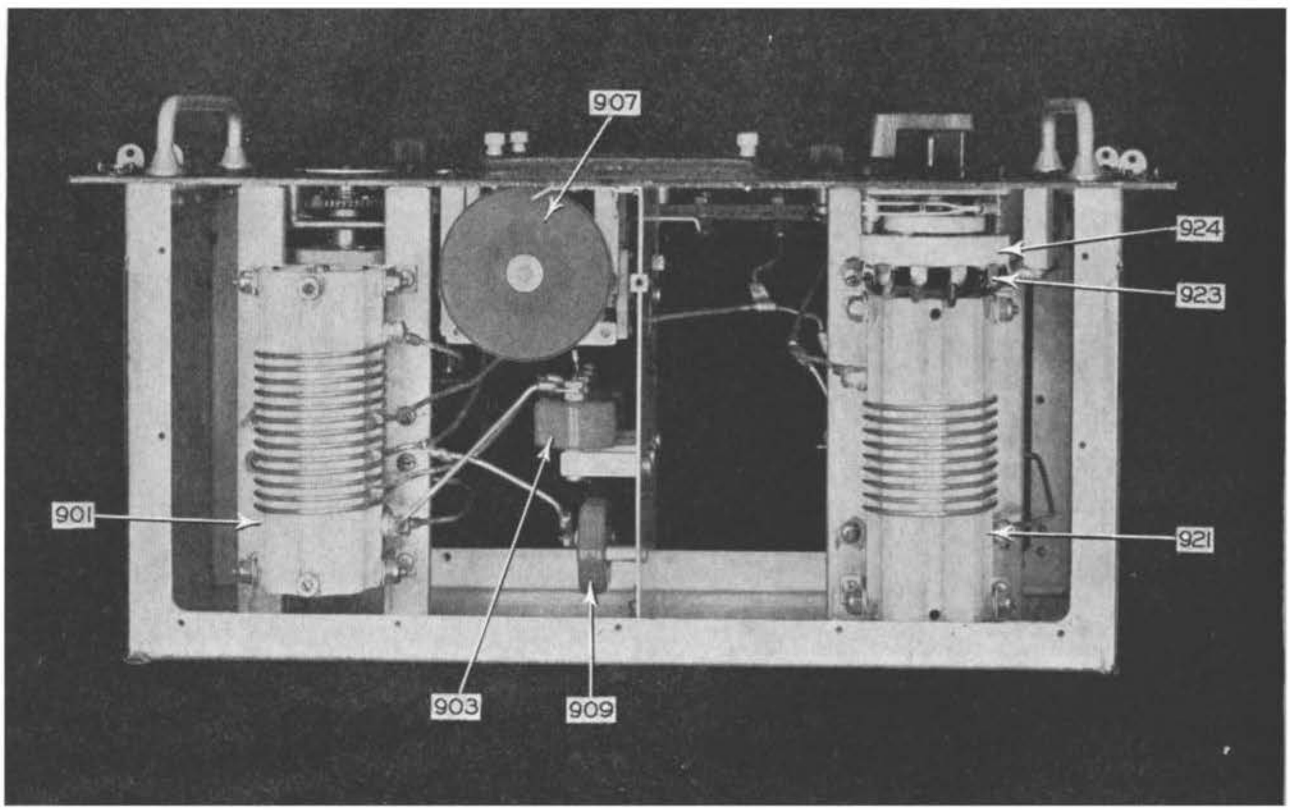


Figure 86. Transmitter Tuning Unit TU-9-B, Bottom View, Cover Removed

DIO FREQUENCY POWER OUTPUT

Transmitter Tuning Unit	F kc.	Ca (1)	A	B	C	D	E (2)	F (2)	M	N	O	P	Total IP MA	Watts Out. (3)	Ant. Current
TU-5-B	1500	200	1	1335	43	3			12.5	4		2	205	45.0	3.0
TU-5-B	3000	200	4	2098	80	2			21.5	3			220	65.0	3.6
TU-6-B	3000	150	1	976	41	3			21.8	3			220	60.0	3.46
TU-6-B	4500	150	2	2162	86	2			12.5	3			220	55.0	3.32
TU-7-B	4500	100		419	22	2			14.5	3		2	220	60.0	3.46
TU-7-B	6200	100		2180	95	3			5.4	3		2	220	75.0	3.87
TU-8-B	6200	100		698	20	2			7.8	3		5	220	70.0	3.74
TU-8-B	7700	100		2163	84	2			4.5	3		5	220	75.0	3.87
TU-9-B	7700	100		580	23	3			4.8	3		5	220	70.0	3.74
TU-9-B	10000	100		2169	82	2			1.0	3		5	220	75.0	3.87
TU-10-B	10000	100		468	18	2			4.8	2	100	5	220	65.0	3.60
TU-10-B	12500	100		2095	76	2			1.0	2	100	5	220	75.0	3.87
TU-22-B	350	400	1	770	24	1	3	54	0	3			220	45.0	3.00
TU-22-B	650	400	3	1776	67	4	1	16	0	3			220	40.0	2.83

(1) Apparent capacitance (Ca in micromicrofarads.)

(2) Where readings are not listed in columns "E" and "F" Antenna Tuning Unit BC-306-A is not used. The antenna circuit tuning given is considered the most efficient method of loading for the particular frequency used.

(3) Nominal 5-ohm phantom resistor.

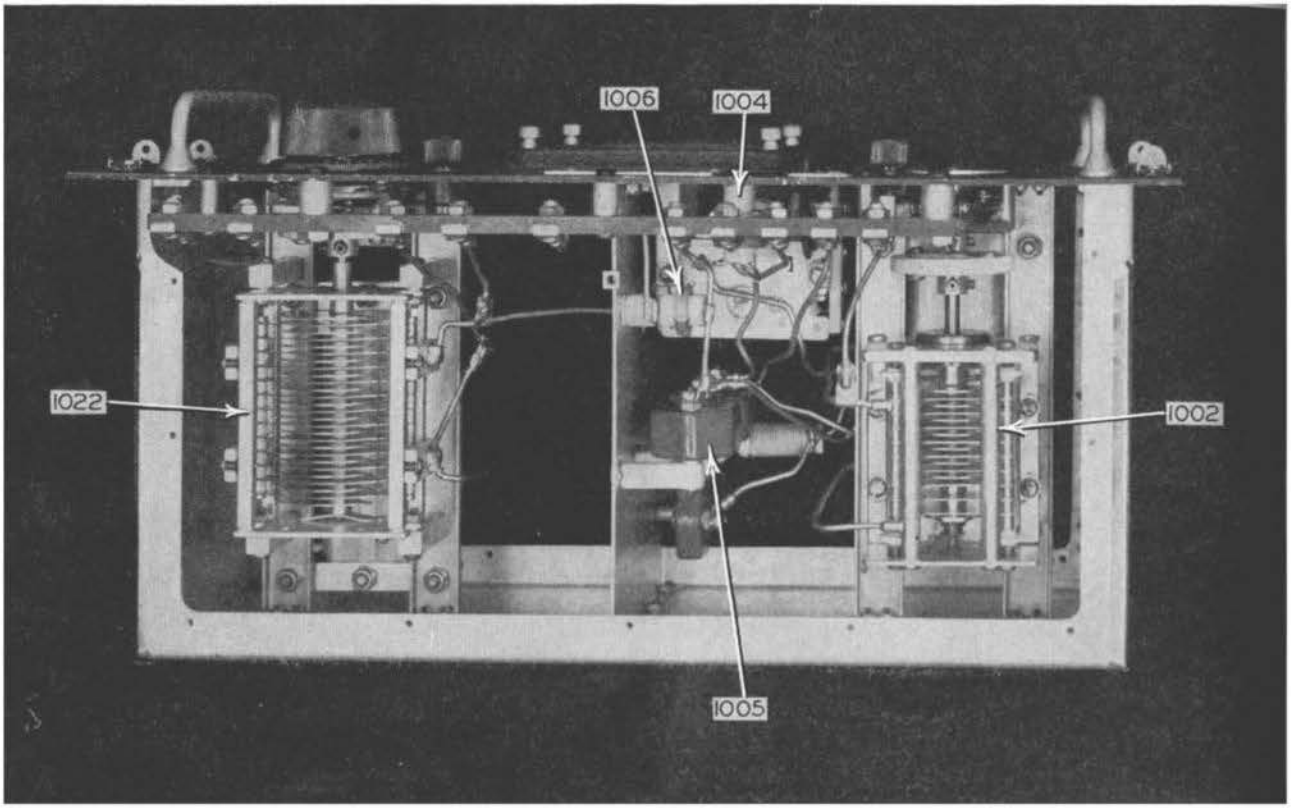


Figure 87. Transmitter Tuning Unit TU-10-B, Top View, Cover Removed

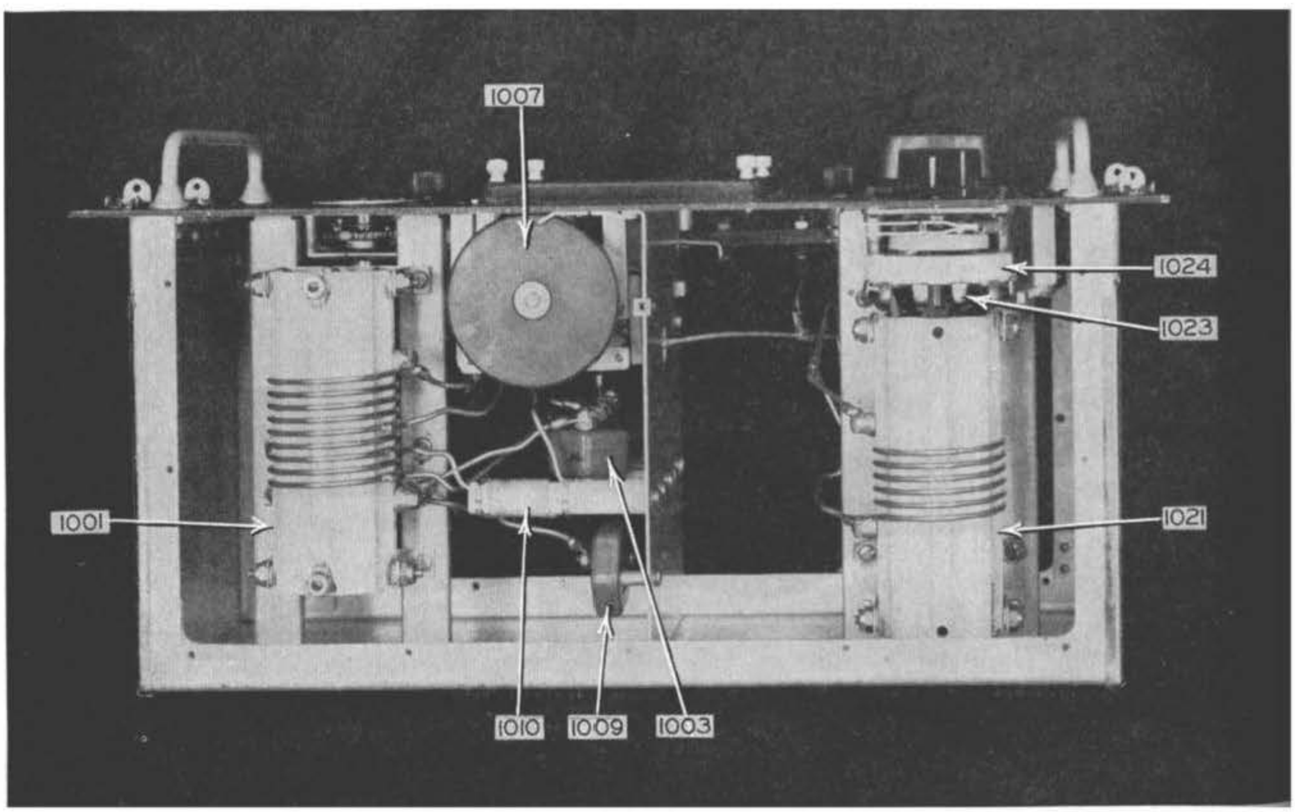


Figure 88. Transmitter Tuning Unit TU-10-B, Bottom View, Cover Removed

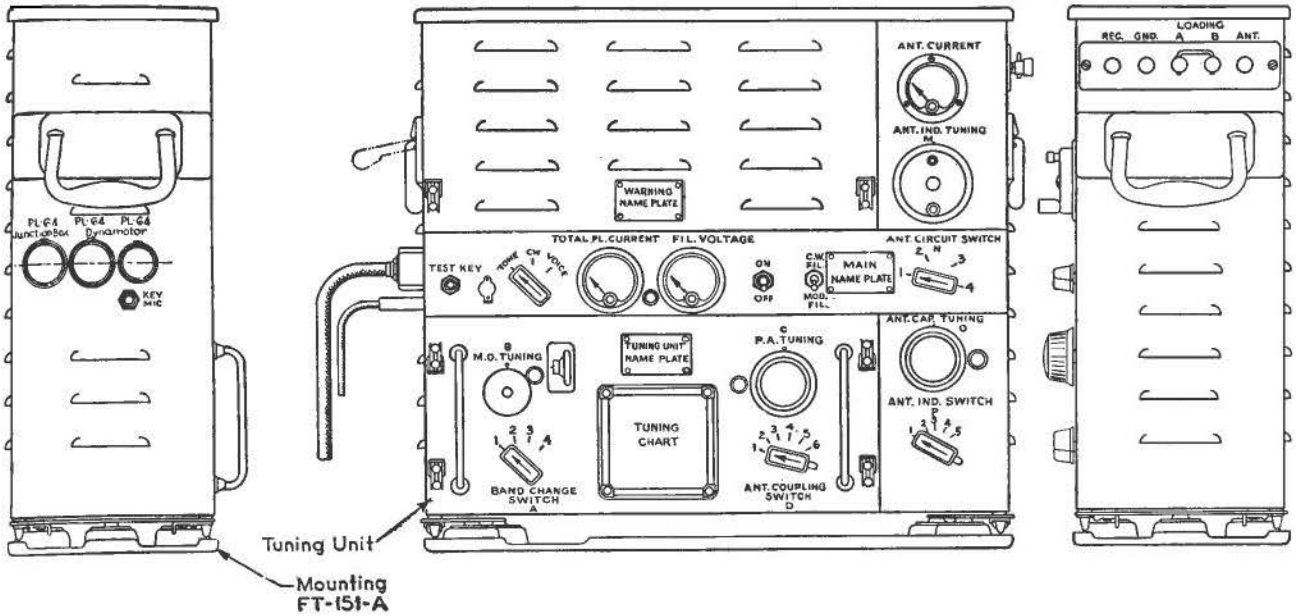


Figure 89. Radio Transmitter BC-375-D, Outline Sketch

Resistance Charts: To expedite the location of faults, the following point-to-point checks are suggested. Circuits which may be tested with a simple continuity meter (i.e., a voltmeter in series with a flashlight cell) are listed as having zero resistance. Average resistance values are tabulated and are to be tested with the Weston Voltohmmeter, Model 564, Type 38 of Test Set I-56-A. Individual radio transmitters will vary somewhat from the average values given, the maximum tolerance being approximately ten per cent.

RADIO TRANSMITTER BC-375-D

Refer to Schematic Diagram, Figure 83. All Voltages, Tuning Unit and Back Shield Removed

Master-oscillator and Power-amplifier Circuits

	OHMS
Point 61 of Socket SO-39 (1127) to Socket Shell, ground..................	1 meg.
Point 61 of Socket SO-39 (1127 to point 2 of Tuning Unit Plugboard.......	10
Point 61 of Socket SO-39 (1127) to point 2 of Transformer 1164............	4
Point 2 of Transformer 1164 to point 8 of Tuning Unit Plugboard..........	115
Point 3 of Tuning Unit Plugboard to Grid Terminal of M-O Socket........	0
Point 4 of Tuning Unit Plugboard to Terminal 55 of Socket SO-41 (1126)...	7500
Point 6 of Tuning Unit Plugboard to Terminal 55 of Socket SO-41 (1126)...	10,000

Modulator Circuits

Point 61 of Socket SO-39 (1127) to Plate of Socket 1161..................	70
Point 61 of Socket SO-39 (1127) to Plate of Socket 1162..................	70

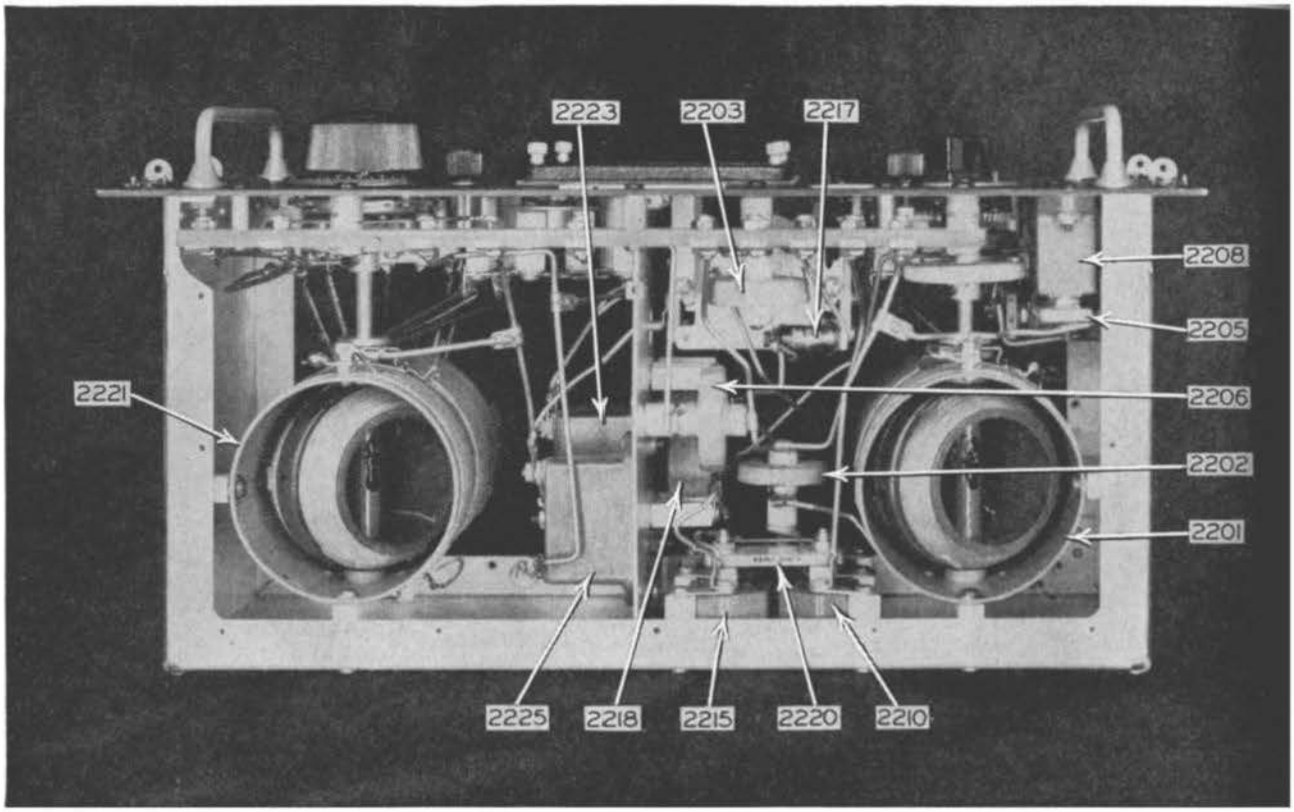


Figure 90. Transmitter Tuning Unit TU-26-B, Top View, Cover Removed

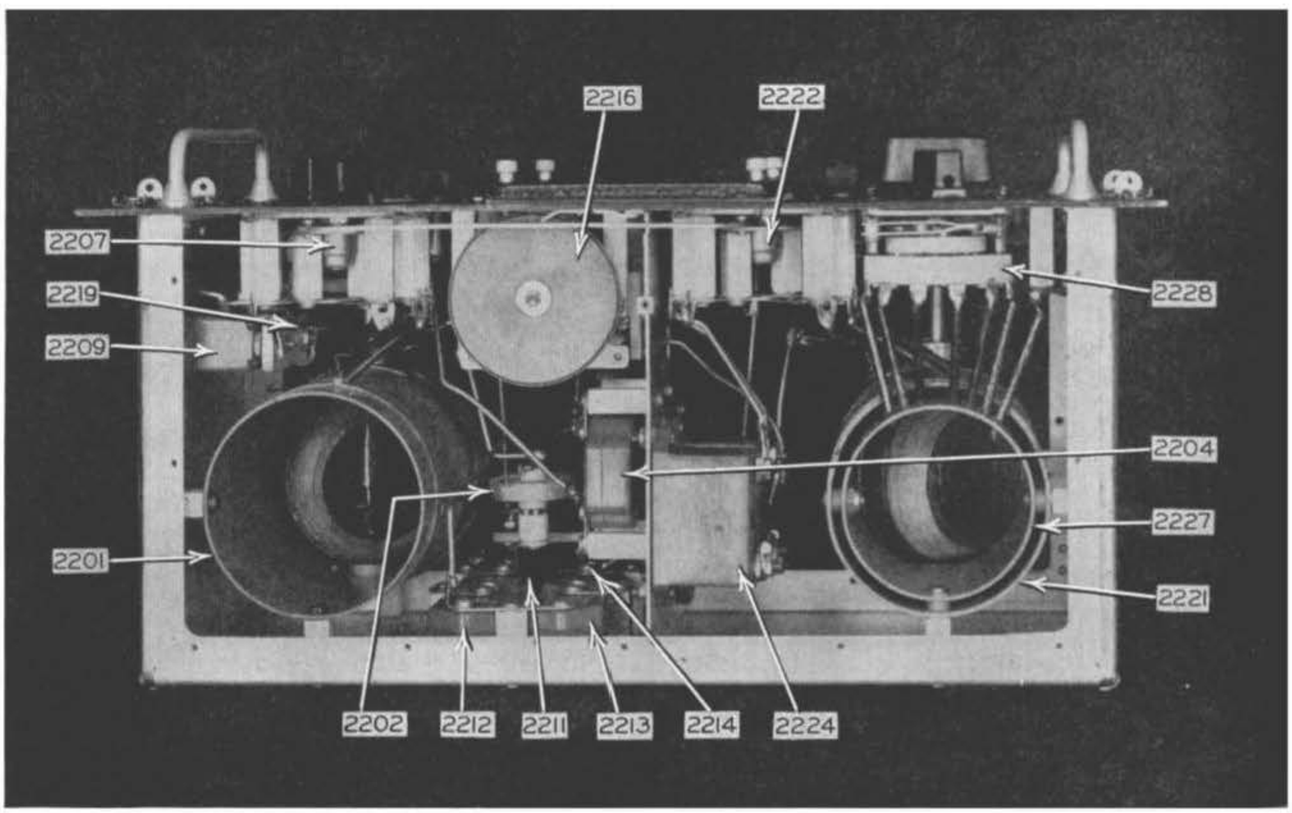


Figure 91. Transmitter Tuning Unit TU-26-B, Bottom View, Cover Removed

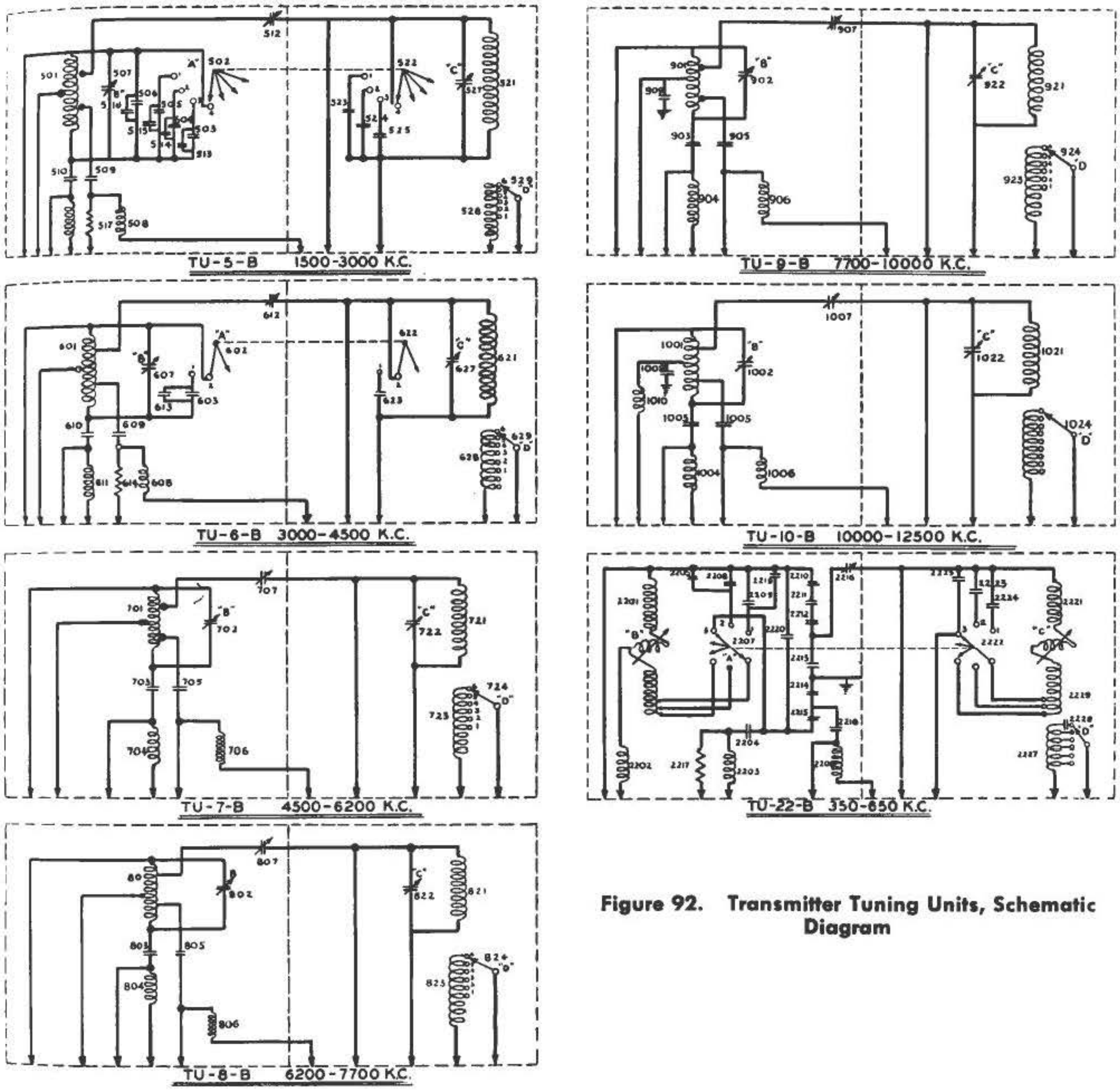


Figure 92. Transmitter Tuning Units, Schematic Diagram

	OHMS
Terminal 4 of Transformer 1157 to Grid of Socket 1161..................	500
Terminal 4 of Transformer 1157 to Grid of Socket 1162..................	500
Terminal 4 of Transformer 1157 to Terminal 55 of Socket SO-41 (1126).....	3000 to 7000

Speech-amplifier and Side Tone Circuits

Side-tone Switch on Tap 4, orange and green wire on 1179 to ground.......	150
Point 61 of Socket SO-39 (1127) to Terminal 2 of Transformer (1157).......	33,000
Terminal 2 of Transformer 1157 to Plate of Socket 1154.................	700
Grid of Socket 1154 to Terminal 3 of Transformer 1149..................	6,000

	OHMS
Terminal 3 of Transformer 1149 to Terminal 55 of Socket SO-41 (1126).....	3,100
Terminal 2 of Transformer 1149 to ground..............................	35
Terminal 1 of Transformer 1149 to Terminal 23 of Socket SO-44 (1128)	
Voice Position..	0 to 200
CW or Tone Position...	220

Dynamotor Unit PE-73-C

− L.V. Input Terminal to Negative Brush..............................	0
− L.V. Input Terminal to ground......................................	0
+ L.V. Brush to ground (brush removed)...............................	25
+ L.V. Terminal to Terminal 57 of Socket SO-41 (1601)..................	50
+ L.V. Brush to Terminal 54 of Socket SO-41 (1601) Fuses in.............	2
+ H.V. Brush to −H.V. Brush..	87.5

The transmitter tuning unit circuits are shown in Figure 92. All circuits, not broken by a capacitor, are of low enough resistance to be checked by a continuity meter. The resistors are approximately 15 ohms and the radio-frequency chokes will have resistances between 1 and 40 ohms, depending upon the tuning unit tested.

Various other circuits may be easily checked by reference to the values of resistances and tolerances given in Supplementary Data and List of Replaceable Parts.

Neutralization of Power Amplifier—Neutralization of the power amplifier is ordinarily unnecessary, since this is done when the units are tested at the manufacturer's plant. However, if the setting is disturbed for any reason, the following procedure may be used to restore the adjustment.

The radio transmitter should first be set up and tuned to see that all power supplies are correct and the radio transmitter is functioning properly. Then remove the power supply cords and the back shield of the radio transmitter. From Connection Diagram Figure 84, locate wire 43 (red) on filter capacitor 1197A. Remove this wire with a soldering iron and tape clear of terminal on capacitor 1197A. This removes the power-amplifier DC plate voltage and leaves the r-f circuits intact. Connect the vertical plates of a cathode-ray oscillograph to terminals "LOAD A" and "GND," on the radio transmitter. Place the "ANT. IND. TUNING, M," (9 Figure 50) at dial zero and the "ANT. CIRCUIT SWITCH N," (10 Figure 50) on position "3." Tune the PA to resonance as shown by a maximum amplitude of r-f carrier on the oscillograph. Proceed by turning the neutralizing control, located behind the tuning chart, for a minimum amplitude on the oscillograph, at the same time maintaining the PA in tune. When the best minimum is reached with the PA in tune, the tuning unit is neutralized. In the lower frequency tuning units, the oscillograph pickup will be practically zero at neutralization, while on the higher frequencies, considerable amplitude will be noticed from stray ground currents. A check on the neutralization may be made by noticing the low reaction on the total plate meter, at neutralization, as the PA is tuned through resonance. The operator must remove all power plugs while the radio transmitter back cover is removed and lead (43) is resoldered in position upon completion of foregoing instruction.

SUPPLEMENTARY DATA AND LIST OF REPLACEABLE PARTS

NOTE: A number in parenthesis after a reference number indicates that the reference covers more than one item and the quantity.

RADIO TRANSMITTER BC-375-D

Reference No.	Renewal Part Designation	Name of Part	Description	Function	Drawing No. (G. E. Co.)
1101	TSK-1	Socket	For Tube VT-4-C	M-O tube	Cat. 7461594 G1
1102	CSW-1	Switch	G. E. Cat. GA19A14, modified	Interlock	ML-7876926 G1
1103		Capacitor		Tube thermal compensator	ML-7462641 G1
1104		Capacitor	Part of 1103	Calibration reset	ML-7462641 G1
1105	C-9	Capacitor	Cornell-Dubilier type 15L, modified, 0.006 mfd. ± 10%, 2500 volts	M-O plate by-pass	P-7761442 P12
1106	RFC-14	Coil		M-O plate R-F choke	ML-7461859 G1
1107 (2)	C-10	Capacitor	Cornell-Dubilier type 9L, modified, 0.02 mfd. ± 10%, 1000 volts	P-A filament by-pass	P-7761443 P22
1108	C-11	Capacitor	Cornell-Dubilier type 9L, modified, 0.0001 mfd. ± 10%, 1000 volts	M-O grid by-pass	P-7761443 P23
1109 (3)	R-2	Resistor	I.R.C. type DJ-1 (A) coating, modified, 2500 ohms ± 5%, 12 watts	M-O grid	P-7761526 P7
1110	TSK-1	Socket	For Tube VT-4-C	P-A tube	Cat. 7461594 G1
1111	C-11	Capacitor	Cornell-Dubilier type 9L, modified, 0.0001 mfd. ± 10%, 1000 volts	P-A grid by-pass	P-7761443 P23
1112	R3	Resistor	I.R.C. type DJ-1 (A) coating, modified, 4000 ohms, ± 5%, 12 watts	P-A grid (Fixed)	P-7761481 P10
1113	VR-1	Resistor	Yaxley Mfg. Co., 3000 ohms, +5%, −0%, no taper	Modulator bias (variable)	K-7870710
1114	VR-1	Resistor	Yaxley Mfg. Co., 3000 ohms, +5%, −0%, no taper	S-A bias (variable)	K-7870710
1115	R-4	Resistor	I.R.C. type BT-1 waxed, modified, 200,000 ohms ± 10%, 1 watt, red body, black end, yellow dot	Keying	P-7761481 P27
1116 (4)	R-5	Resistor	I.R.C. type BT-1 waxed, modified, 250,000 ohms, ± 10%, 1 watt, red body, green end, yellow dot	H-V bridge	P-7761481 P3

RADIO TRANSMITTER BC-375-D—Continued

Reference No.	Renewal Part Designation	Name of Part	Description	Function	Drawing No. (G. E. Co.)
1117	C-12	Capacitor	Cornell-Dubilier type 15L, modified, 0.001 mfd. ± 5%, 4500 volts	P-A plate by-pass	P-7761442 P13
1118	RFC-4	Coil		P-A plate choke	ML-7461859 G1
1119	RFC-15	Coil		H-V supply R-F choke	ML-7462675 G1
1121	M-1	Ammeter IS-22	G. E. type DW-41, 500 milliamperes DC, white blocking on scales from 210 to 220 M.A.	Plate current	ML-7875379 G2
1122		Lamp LM-27	Mazda No. 44, 6.3 volts, 0.25 amp.	Pilot	
1126		Socket SO-41	Plug receptacle	For plug PL-61	ML-7761424 G1
1127		Socket SO-39	Plug receptacle	For plug PL-59	ML-7761427 G1
1128		Socket SO-44	Plug receptacle	For plug PL-64	ML-7761424 G2
1129	J-1	Jack JK-33-A		Microphone and Key	ML-7461866 G1
1131	CSW-1	Switch	G. E. Cat. GA19A14, modified	Test Key	ML-7876926 G1
1133	M-2	Voltmeter IS-122	AC-DC, white blocking on scale at 10 volts	Filament	ML-7875379 G3
1134	C-14	Capacitor	Cornell-Dubilier type 9L, modified, 0.01 mfd. ± 10%, 1000 volts.	Filament voltmeter by-pass	P-7761443 P24
1135	CSW-3	Switch	Arrow-Hart & Hegeman Elec. Co. No. 21189 modified single circuit two way, 1 amp. at 250 V, 3 amp. at 125 V.	Filament voltmeter	ML-7876928 G1
1141	CSW-5	Switch		Selector "Tone CW-Voice"	ML-7463230 G1
1142	C-15	Capacitor	Cornell-Dubilier type 9L, modified, 0.001 mfd. ± 10% 2500 volts.	Tone feedback	P-7761443 P20
1144	C-16	Capacitor	Cornell-Dubilier Type HC-1010A, modified, 1 mfd. ± 10%, 300 volts DC	S-A grid by-pass	K-7870639 P1
1145	R-8	Resistor	I.R.C. type AB-1 (A) coating modified, 50 ohms, ± 10%, 4 watts	Microphone	P-7761481 P11
1146	AFC-1	Reactor		Microphone filter	P-7762353 G1

Reference No.	Renewal Part Designation	Name of Part	Description	Function	Drawing No. (G. E. Co.)
1147	C-17	Capacitor	Cornell-Dubilier type "A" Model MA-12658-PE, modified, 25 mfd. ± 40%, − 10%, 25 volts DC	Microphone filter	K-7870437 P1
1148	VR-2	Resistor	Yaxley Mfg. Co., 200 ohms ± 10%, no taper	Input Level (Variable)	K-7870693 P1
1149	TR-1	Transformer		Microphone	P-7762352 G1
1150	C-18	Capacitor	Cornell-Dubilier type 9L modified, 0.001 mfd. ± 5%, 2500 v.	S-A grid	P-7761443 P8
1151	R-9	Resistor	I.R.C. type AA-1 (A) coating modified, 200 ohms, ± 5%, 2 watts	Input load	P-7761526 P10
1154	TSK-2	Socket	Hammarlund Mfg. Co. type S-4, modified	S-A Tube VT-25	K-7870442 P1
1156 (3)	R-11	Resistor	I.R.C. type DJ-1 (A) coating, modified, 11,000 ohms, ± 5%, 12 watts	S-A plate	P-7761526 P8
1157	TR-2	Transformer		Interstage	P-7761434 G1
1160	C-16	Capacitor	Cornell-Dubilier type HC-1010A, modified, 1 mfd. ± 10%, 300 volts DC	Modulator grid by-pass	K-7870639 P1
1161	TSK-1	Socket	For Tube VT-4-C	Modulator tubes	Cat. 7461594 G1
1162	TSK-1	Socket	For Tube VT-4-C		Cat. 7461594 G1
1164	TR-3	Transformer		Modulation	P-7761432 G1
1166	M-3	Ammeter IS-89	G. E. type DW-44, 8 amperes R.F. with thermocouple	Antenna current	ML-7875379 G1
1167		Coil		Antenna induct.	ML-7761938 G1
1168	CSW-7	Switch		Antenna circuit	ML-7463231 G1
1169		Capacitor	Hammarlund Mfg. Co., 22 mmf. to 118 mmf.	Antenna tuning (variable)	M-7463006 P1
1170		Coil	Antenn	a Load Inductance	ML-7761429 G1
1172	FU-12	Fuse FU-12-A	0.5 amp. 1000 volts	Plate	Cat. 7871111 P1
1179	CSW-6	Switch	Yaxley Mfg. Co. type B-12473, modified single section, one circuit, four point, non-shorting	Sidetone	K-7870711 P1
1180	C-19	Capacitor	Cornell-Dubilier type 9L, modified, 0.01 mfd. ± 5%, 2500 volts	Modulator grid (Tone)	P-7761443 P26

Reference No.	Renewal Part Designation	Name of Part	Description	Function	Drawing No. (G. E. Co.)
1181 (2)	R-12	Resistor	I.R.C. type BT-1 waxed, modified, 30,000 ohms, ± 5%, 1 watt, orange body, black end, orange dot	Modulator grid	P-7761526 P12
1183	R-13	Resistor		M-O grid parasitic	ML-7871909 G1
1184		Coil	Ganged with 1183	M-O grid parasitic choke	ML-7871909 G1
1185	C-16	Capacitor	Cornell-Dubilier type HC-1010A, modified, 1 mfd. ± 10%, 300 volts DC	Key filter	K-7870639 P1
1186	R-14	Resistor	I.R.C. type AA-1 (A) coating, modified, 5 ohms, ± 5%, 2 w.	Key filter	P-7761526 P16
1187	R-16	Resistor	I.R.C. type DJ-1 (A) coating, modified, 100 ohms, ± 5%, 12 watts.	Pilot lamp	P-7762203 P20
1189	REL-4	Relay		Antenna switching	ML-7660600 G2
1190	CSW-2	Switch	Arrow-Hart & Hegeman Elec. Co. Cat. 80600 double pole, single throw, 6 amp. at 250 v., 12 amp. at 125 v.	Filament	ML-7876927 G1
1191	R-17	Resistor	I.R.C. type DJ-1 (A) coating, modified, 5 ohms, ± 5%, 12 w.	S-A filament	P-7762203 P21
1192	R-17	Resistor	I.R.C. type DJ-1 (A) coating, modified, 5 ohms, ± 5%, 12 w.	S-A filament	P-7762203 P21
1193	R-18	Resistor	I.R.C. type DG-1 (A) coating, modified, 150 ohms, ± 5%, 8 watts	Microphone	P-7762203 P22
1194	CSW-2	Switch	Arrow-Hart & Hegeman Elec. Co. Cat. 80600, double-pole, single-throw, 6 amp. at 250 v., 12 amp. at 125 v.	Off-On	ML-7876927 G1
1196	R-15	Resistor	G.E. Co., 2.70 ohms, 36 watts; 3.70 ohms, 26 watts dissipation; blue stick resistor mounted on tapped connection board	Filament	ML-7761699 G2
1197A	C-34	Capacitor	G. E. Co. type 25F34 modified, 1-1-1 mfd., 3000 v. DC	Modulator Plate by-pass	K-7877630
1197B	C-34	Capacitor	Included in 1197A	S-A plate by-pass	K-7877630
1197C	C-34	Capacitor	Included in 1197A	Filter	K-7877630
1198	CSW-8	Switch	Included in 1197A	Antenna tap	ML-7762960 G2

TRANSMITTER TUNING UNIT TU-5-B (1500-3000 KC)

Reference No.	Renewal Part Designation	Name of Part	Description	Function	Drawing No. (G. E. Co.)
501		Inductance		M-O tank	ML-7761605 G1
502	CSW-9	Switch	(Ganged with 522)	M-O band change	ML-7659203 G2
503	C-1	Capacitor	Cornell-Dubilier type 15 H modified, 0.0001 mfd. ± 2%, 3000 volts	M-O tank	P-7761662 P3
504	C-1	Capacitor	Cornell-Dubilier type 15H, modified, 0.0001 mfd. ± 2%, 3000 volts	M-O tank	P-7761662 P3
505	C-1	Capacitor	Cornell-Dubilier type 15H, mod., 0.0001 mfd. ± 2%, 3000 v.	M-O tank	P-7761662 P3
506	C-2	Capacitor	Cornell-Dubilier type 15H, modified, 0.00003 mfd. ± 5%, 2000 volts	M-O tank	P-7761662 P1
507		Capacitor	Hammarlund Mfg. Co. max. 135 mmf. ± 2%, min. 20 mmf. ± 1 mmf.	M-O tank (variable)	P-7761569 P2
508	RFC-1	Coil	(With resistor 517)	P-A grid choke	ML-7462657 G1
509	C-3	Capacitor	Cornell-Dubilier type 9HL, modified, 0.0004 mfd. ± 10%, 5000 volts	P-A grid blocking	P-7761663 P1
510	C-3	Capacitor	Cornell-Dubilier type 9HL, modified, 0.0004 mfd. 10%, 5000 volts	M-O grid blocking	P-7761663 P1
511	RFC-2	Coil		M-O grid choke	ML-7462706 G1
512		Capacitor	Hammarlund Mfg. Co., max. 26 mmf. ± 4%; min. 8 mmf. ± 1.5 mmf.	Neutralizing	T-7660443 P8
513		Compensator			ML-7462769 G1
514		Compensator	(Ganged to 513)		ML-7462769 G1
515		Compensator	(Ganged to 513)		ML-7462769 G1
516		Compensator	(Ganged to 513)		ML-7462769 G1
517	RFC-1	Resistor	G. E. Co. type QLK, 15 ohms, 4.5 watts	P-A grid parasitic	QLK-2155993 15 ohms
521		Inductance		P-A tank	ML-7761615 G1
522	CSW-9	Switch	(Ganged 502)	P-A band change	P-7659203 G2
523	C-4	Capacitor	Cornell-Dubilier type 15L, modified, 0.00009 mfd. ± 5%, 3000 volts	P-A tank	P-7761442 P15

NOTE FOR SOLDERING:
Wire to be Fastened Mechanically to Terminals before Soldering. Use Rosin Core Solder B20 DC3.
There shall be No Sharp Points Left After Unit is Wired Either from Lumps of Solder or Irregularly Cut Wire Ends.

Symbol	Name of Unit
501	M.O. Tank Inductance
502	M.O. Band Change Switch
503	M.O. Fixed Tank Capacitor
504	" " " "
505	" " " "
506	" " " "
507	M.O. Variable Tank Capacitor
508	P.A. Grid Choke
509	" " Blocking Capacitor
510	M.O. " " "
511	" " Choke
512	Neutralizing Capacitor
513	M.O. Tank Compensating Cap
514	" " " "
515	" " " "
516	" " " "
517	M.O. Grid Parasitic Resistor
521	P.A. Tank Inductance
522	P.A. Band Change Switch
523	P.A. Fixed Tank Capacitor
524	" " " "
525	" " " "
527	P.A. Variable Tank Capacitor
528	Ant. Coupling Coil
529	" " Switch

Connector	Description
M	Unit Piece of Apparatus
Not Marked	.102" Dia Copper Wire Tinned

NOTE:
At Points Marked "X" Use Term V-1444451
" " " "Z" " " K-7872717
" " " "Y" " " V-2454945
" " " "W" " " K-7872368
" " " "T" " " K-7872305
" " " "S" Solder Complete Joint Together

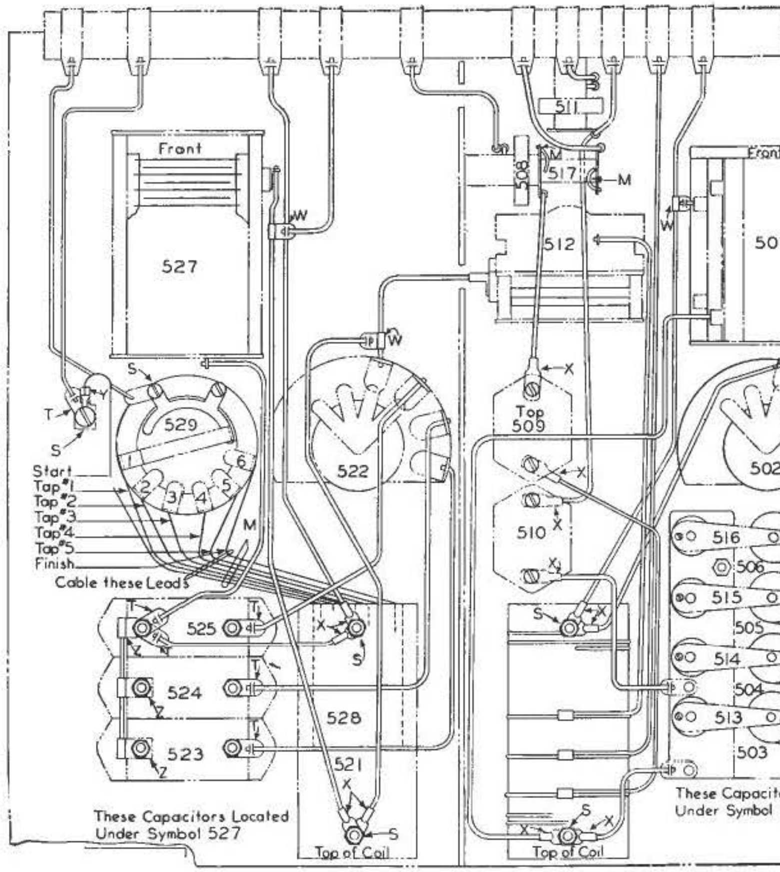
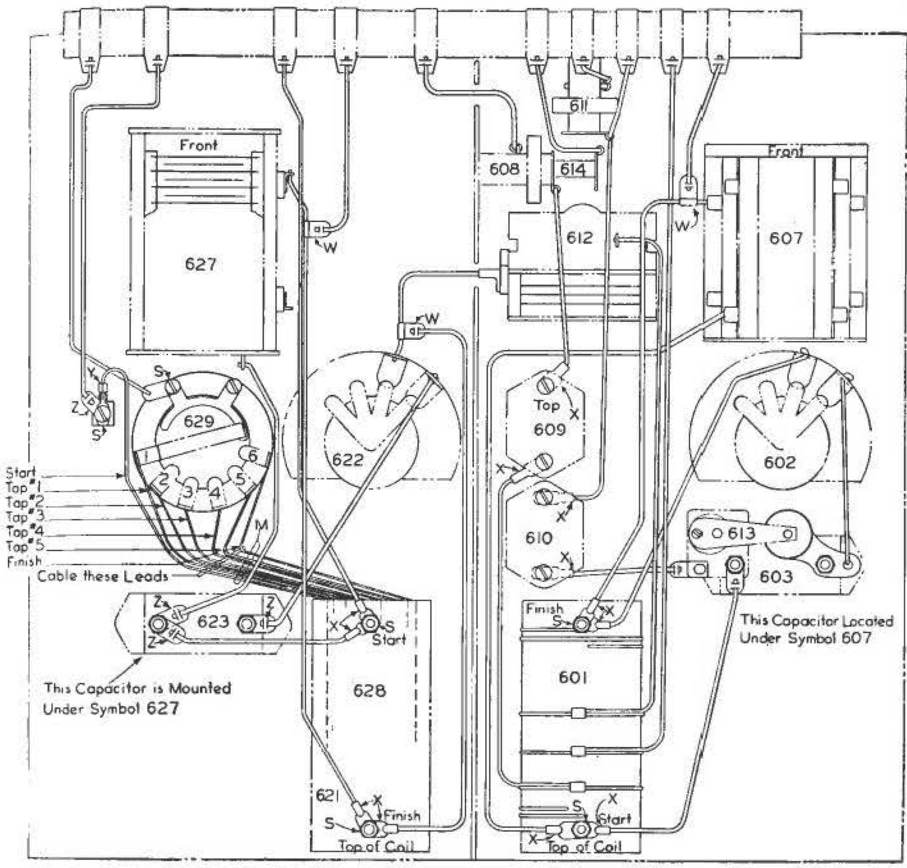


Figure 93. Transmitter Tuning Unit TU-5-B, Connection Diagram

TRANSMITTER TUNING UNIT TU-5-B—(1500-3000 KC) Continued

Reference No.	Renewal Part Designation	Name of Part	Description	Function	Drawing No. (G. E. Co.)
524	C-4	Capacitor	Cornell-Dubilier type 15L, modified, 0.00009 mfd. ± 5%, 3000 volts	P-A tank	P-7761442 P15
525	C-4	Capacitor	Cornell-Dubilier type 15L, modified, 0.00009 mfd. ± 5%, 3000 volts	P-A tank	P-7761442 P15
527		Capacitor	Hammarlund Mfg. Co., max. 156 mmf. ± 3%; min. 20 mmf. ± 1.5 mmf.	P-A tank (Variable)	T-7660443 P6
528		Coil		Antenna coupling	ML-7462710 G1
529	CSW-10	Switch		Antenna coupling	ML-7762960 G1



NOTE
There Shall be No Sharp Points Left After Unit is Wired Either from Lumps of Solder or Irregularly Cut Wire Ends.
Wire to be Fastened Mechanically to Terminals before Soldering.
Use Rosin Core Solder B20 D3C

Symbol	Name of Unit
601	M.O. Tank Inductance
602	M.O. Band Change Switch
603	M.O. Fixed Tank Capacitor
607	M.O. Variable Tank Capacitor
608	P.A. Grid Choke
609	P.A. Grid Blocking Capacitor
610	M.O. Grid Blocking Capacitor
611	M.O. Grid Choke
612	Neutralizing Capacitor
613	M.O. Compensating Capacitor
614	P.A. Grid Parasitic Resistor
621	P.A. Tank Inductance
622	P.A. Band Change Switch
623	P.A. Fixed Tank Capacitor
627	P.A. Variable Tank Capacitor
628	Antenna Coupling Coil
629	Antenna Coupling Switch

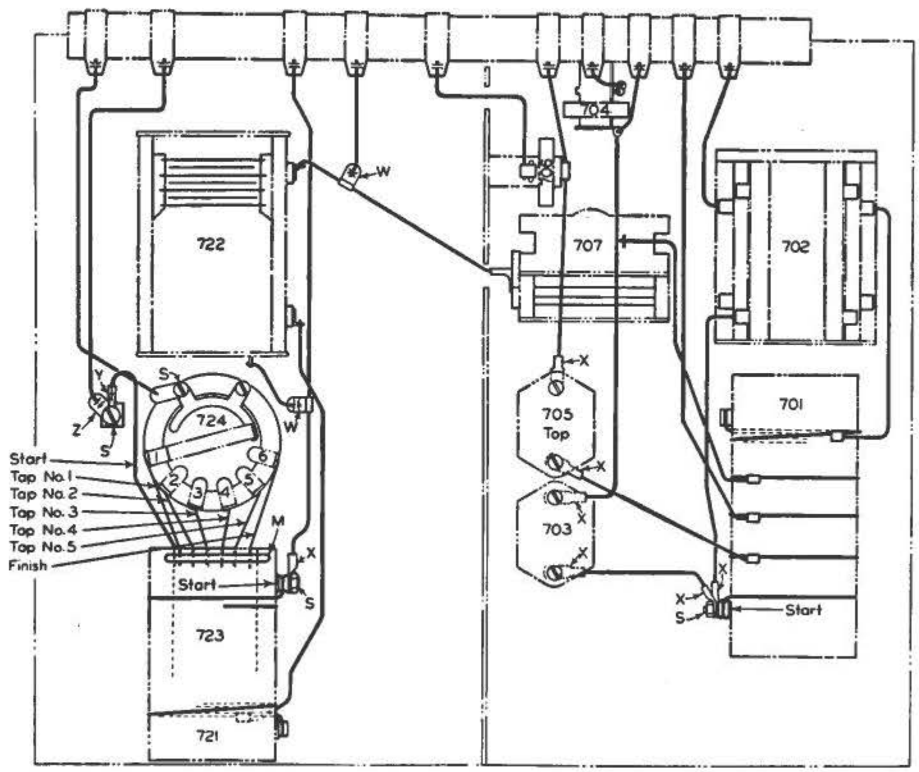
Connection	Size of Connector
M	Unit Piece of Apparatus
Not Marked	.102"Dia. Copper Wire Tinned

NOTE:
At Points Marked "X" Use Term V-1444451
" " " "Z" " " K-7872305
" " " "Y" " " V-2454945
" " " "W" " " K-7872368
" " " "S" Solder Complete Joint Together

Figure 94. Transmitter Tuning Unit TU-6-B, Connection Diagram

TRANSMITTER TUNING UNIT TU-6-B (3000-4500 KC)

Reference No.	Renewal Part Designation	Name of Part	Description	Function	Drawing No. (G. E. Co.)
601		Inductance		M-O tank	ML-7761606 G1
602	CSW-11	Switch	(Ganged with 622)	M-O band change	ML-7659555 G1
603	C-7	Capacitor	Cornell-Dubilier type 15H. modified, 0.00005 mfd. ± 5%, 3000 volts	M-O tank	P-7761662 P2
607		Capacitor	Hammarlund Mfg. Co., max. 77 mmf. ± 2%; min. 15 mmf. ± 1 mmf.	M-O tank (Variable)	P-7761569 P3
608	RFC-3	Coil	(With resistor 614)	P-A grid choke	ML-7462659 G2
609	C-3	Capacitor	Cornell-Dubilier type 9HL, modified, 0.0004 mfd. ± 10%, 5000 volts	P-A grid blocking	P-7761663 P1
610	C-3	Capacitor	Cornell-Dubilier type 9HL, modified, 0.0004 mfd. ± 10%, 5000 volts	M-O grid blocking	P-7761663 P1
611	RFC-4	Coil		M-O grid choke	ML-7462659 G1



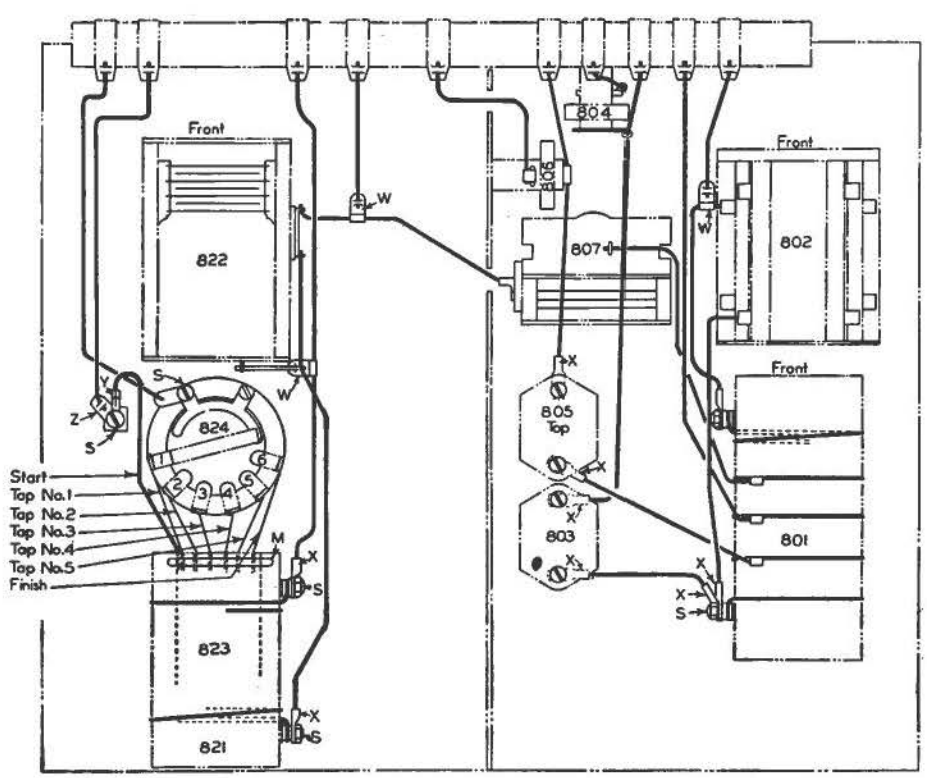
NOTE.
At Points Marked "X" Use Term. V-144445I
" " " "Z" " " K-7872305
" " " "Y" " " V-2454945
" " " "W" " " K-7872368
" " " "S" Solder Complete Joint Together

NOTE.
There Shall be no Sharp Points Left After Unit is Wired Either from Lumps of Solder or Irregularly Cut Wire Ends.
Wire to be Fastened Mechanically to Terminals before Soldering Use Rosin Core Solder B20038.

Symbol Unit No. 7	Name of Unit
701	M.O. Tank Inductance
702	M.O. Tank Capacitor
703	M.O. Grid Blocking Capacitor
704	M.O. Grid Choke
705	P.A. Grid Blocking Capacitor
706	P.A. Grid Choke
707	Neutralizing Capacitor
721	P.A. Tank Inductance
722	P.A. Tank Capacitor
723	Ant. Coupling Coil
724	Ant. Coupling Switch

Connector	Size of Connector
M	Specified in Mechanical Drawing
Not Marked	Copper Wire Tinned .102 Dia.

Figure 95. Transmitter Tuning Unit TU-7-B, Connection Diagram



NOTE.
At Points Marked "X" Use Term. V-144445I
" " " "Z" " " K-7872305
" " " "Y" " " V-2454945
" " " "W" " " K-7872368
" " " "S" Solder Complete Joint Together

NOTE
There Shall be no Sharp Points Left After Unit is Wired Either from Lumps of Solder or Irregularly Cut Wire Ends.
Wire to be Fastened Mechanically to Terminals Before Soldering use Rosin Core Solder B-20038

Symbol Unit No. 8	Name of Unit
801	M.O. Tank Inductance
802	M.O. Tank Capacitor
803	M.O. Grid Blocking Capacitor
804	M.O. Grid Choke
805	P.A. Grid Blocking Capacitor
806	P.A. Grid Choke
807	Neutralizing Capacitor
821	P.A. Tank Inductance
822	P.A. Tank Capacitor
823	Ant. Coupling Coil
824	Ant. Coupling Switch

Connection	Size of Connector
M	Specified on Mechanical Drawing
Not Marked	Copper Wire Tinned .102 Dia.

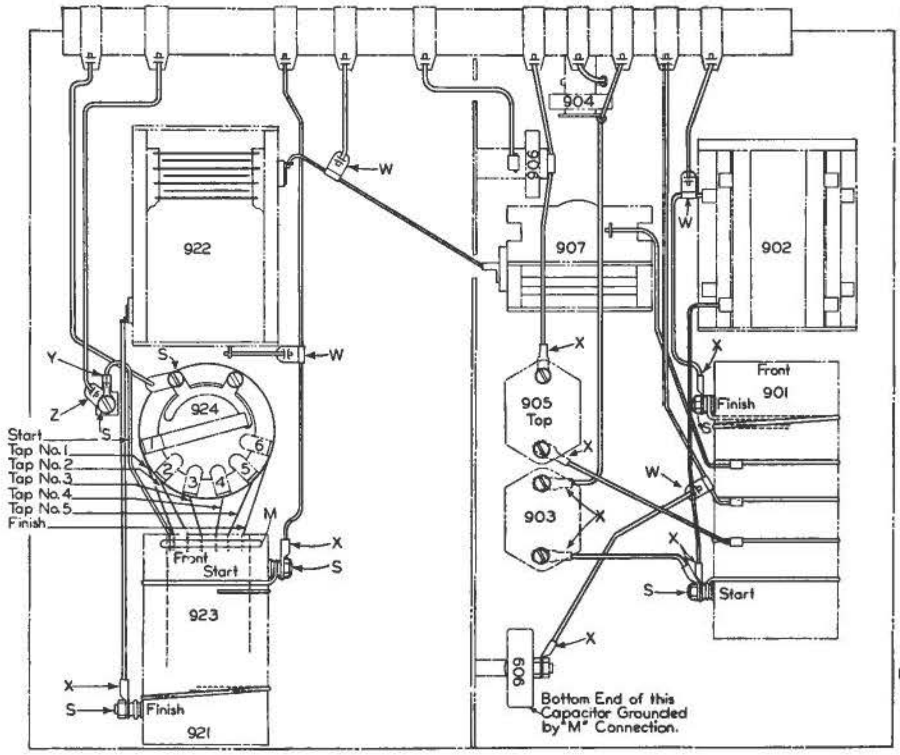
Figure 96. Transmitter Tuning Unit TU-8-B, Connection Diagram

TRANSMITTER TUNING UNIT TU-6-B (3000-4500 KC)—Continued

Reference No.	Renewal Part Designation	Name of Part	Description	Function	Drawing No. (G. E. Co.)
612		Capacitor	Hammarlund Mfg. Co. max. 26 mmf. ± 4%; min. 8 mmf. ± 1.5 mmf.	Neutralizing	T-7660443 P8
613		Compensator		M-O tuning	ML-7462707 G1
614	RFC-3	Resistor	G.E. Co. type QLK, 15 ohms, 4.5 watts	P-A grid parasitic	QLK-2155993 15 ohms
621		Inductance		P-A tank	ML-7761616 G1
622	CSW-11	Switch	(Ganged with 602)	P-A band change	ML-7659555 G1
623	C-6	Capacitor	Cornell-Dubilier type 15L, modified, 0.00005 mfd. ± 5%, 3000 volts	P-A fixed tank	P-7761442 P11
627		Capacitor	Hammarlund Mfg. Co. max. 116 mmf. ± 3%; min. 19 mmf. ± 1.5 mmf.	P-A tank (Variable)	T-7660443 P1
628		Coil		Antenna coupling	ML-7461825 G1
629	CSW-10	Switch		Antenna coupling	ML-7762960 G1

TRANSMITTER TUNING UNIT TU-7-B (4500-6200 KC)

Reference No.	Renewal Part Designation	Name of Part	Description	Function	Drawing No. (G. E. Co.)
701		Inductance		M-O tank	ML-7761607 G1
702		Capacitor	Hammarlund Mfg. Co. max. 111 mmf. ± 2%; min. 23 mmf. ± 1 mmf.	M-O tank (Variable)	P-7761569 P4
703	C-3	Capacitor	Cornell-Dubilier type 9HL, modified, 0.0004 mfd. ± 10%, 5000 volts	M-O grid blocking	P-7761663 P1
704	RFC-5	Coil		M-O grid choke	ML-7462659 G3
705	C-3	Capacitor	Cornell-Dubilier type 9HL, modified, 0.004 mfd. ± 10%, 5000 volts	P-A grid blocking	P-7761663 P1
706	RFC-6	Coil		P-A grid choke	ML-7462639 G1
707		Capacitor	Hammarlund Mfg. Co. max. 26 mmf. ± 4%; min. 8 mmf. ± 1.5 mmf.	Neutralizing	T-7660443 P8
721		Inductance		P-A tank	ML-7761617 G1
722		Capacitor	Hammarlund Mfg. Co. max. 116 mmf. ± 2.5% min. 19 mmf. ± 1.5 mmf.	P-A tank (Variable)	T-7660443 P2
723		Coil		Antenna coupling	ML-7462759 G1
724	CSW-10	Switch		Antenna coupling	ML-7762960 G1



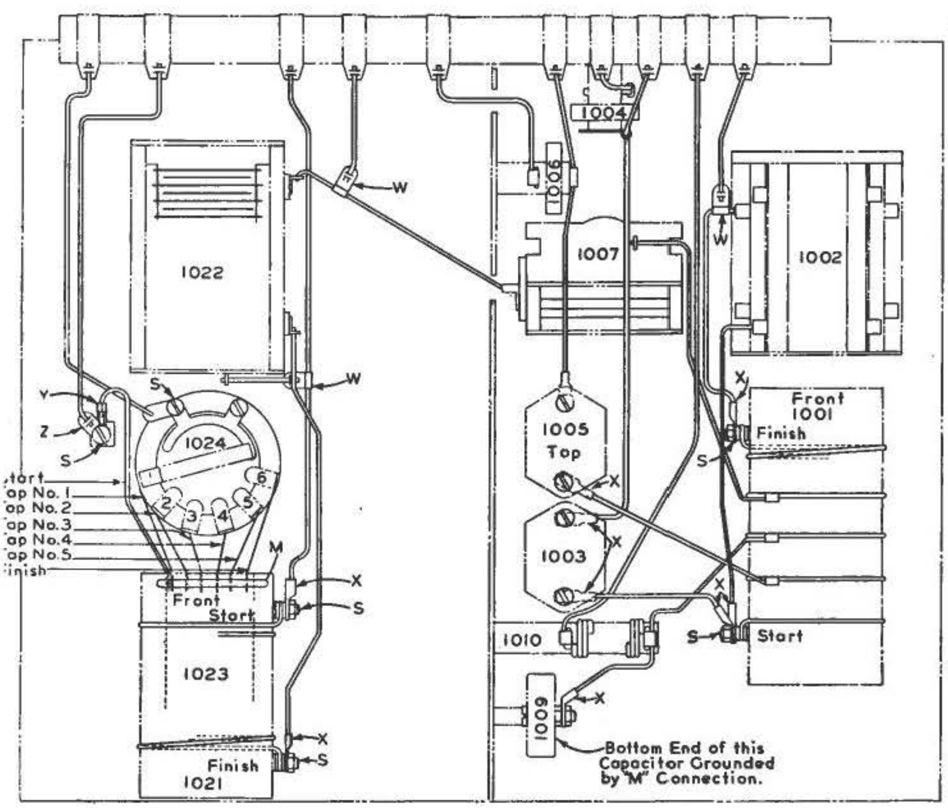
NOTE:
At Points Marked "X" Use Term. V-144445I
" " " "Z" " " K-7872305
" " " "Y" " " (V-2454945)
" " " "W" " " K-7872368
" " " "S" Solder Complete Joint Together

Symbol Unit No 9	Name of Unit	
901	M.O. Tank Inductance	
902	M.O. Tank Capacitor	
903	M.O. Grid Blocking Capacitor	
904	M.O. Grid Choke	
905	P.A. Grid Blocking Capacitor	
906	P.A. Grid Choke	
907	Neutralizing Capacitor	
909	M.O. By Pass Capacitor	
921	P.A. Tank Inductance	
922	P.A. Tank Capacitor	
923	Ant. Coupling Coil	
924	Ant. Coupling Switch	

Connection	Size of Connector	
M	Specified on Mechanical Drawing	
Not Marked	Copper Wire Tinned .102 Dia.	

NOTE:
There Shall be No Sharp Points Left After Unit is Wired Either from Lumps of Solder or Irregularly Cut Wire Ends.
Wire to be Fastened Mechanically to Terminals before Soldering. Use Rosin Core Solder B-20D38

Figure 97. Transmitter Tuning Unit TU-9-B, Connection Diagram



NOTE:
At Points Marked "X" Use Term. V-144445I
" " " "Z" " " K-7872305
" " " "Y" " " (V-2454945)
" " " "W" " " K-7872368
" " " "S" Solder Complete Joint Togeth

Symbol Unit No10	Name of Unit
1001	M.O. Tank Inductance
1002	M.O. Tank Capacitor
1003	M.O. Grid Blocking Capacitor
1004	M.O. Grid Choke
1005	P.A. Grid Blocking Capacitor
1006	P.A. Grid Choke
1007	Neutralizing Capacitor
1009	M.O. By Pass Condenser
1010	M.O. Choke
1021	P.A. Tank Inductance
1022	P.A. Tank Capacitor
1023	Ant. Coupling Coil
1024	Ant. Coupling Switch

Connection	Size of Connector
M	Specified on Mechanical Drawing
Not Marked	Copper Wire Tinned .102 Dia.

NOTE:
There Shall Be No Sharp Points After Unit is Wired Either from Lumps of Solder or Irregularly Cut Wire Ends.
Wire to be Fastened Mechanically to Terminals before Soldering. Use Rosin Core Solder B20D38

Figure 98. Transmitter Tuning Unit TU-10-B, Connection Diagram

TRANSMITTER TUNING UNIT TU-8-B (6200-7700 KC)

Reference No.	Renewal Part Designation	Name of Part	Description	Function	Drawing No. (G. E. Co.)
801		Inductance		M-O tank	ML-7761608 G1
802		Capacitor	Hammarlund Mfg. Co. max. 66 mmf. ± 2%; min. 14 mmf. ± 1 mmf.	M-O tank (Variable)	P-7761569 P5
803	C-3	Capacitor	Cornell-Dubilier type 9HL, modified, 0.0004 mfd. ± 10%, 5000 volts	M-O grid blocking	P-7761663 P1
804	RFC-7	Coil		M-O grid choke	ML-7462638 G1
805	C-3	Capacitor	Cornell-Dubilier type 9HL, modified, 0.004 mfd. ± 10%, 5000 volts	P-A grid blocking	P-7761663 P1
806	RFC-8	Coil		P-A grid choke	ML-7462658 G1
807		Capacitor	Hammarlund Mfg. Co. max. 26 mmf. ± 4%; min. 8 mmf. ± 1.5 mmf.	Neutralizing	T-7660443 P8
821		Inductance		P-A tank	ML-7761618 G1
822		Capacitor	Hammarlund Mfg. Co. max. 81 mmf. ± 3%; min. 15 mmf. ± 1.5 mmf.	P-A tank (Variable)	T-7660443 P7
823		Coil		Antenna coupling	ML-7462672 G1
824	CSW-10	Switch		Antenna coupling	ML-7762960 G1

TRANSMITTER TUNING UNIT TU-9-B (7700-10,000 KC)

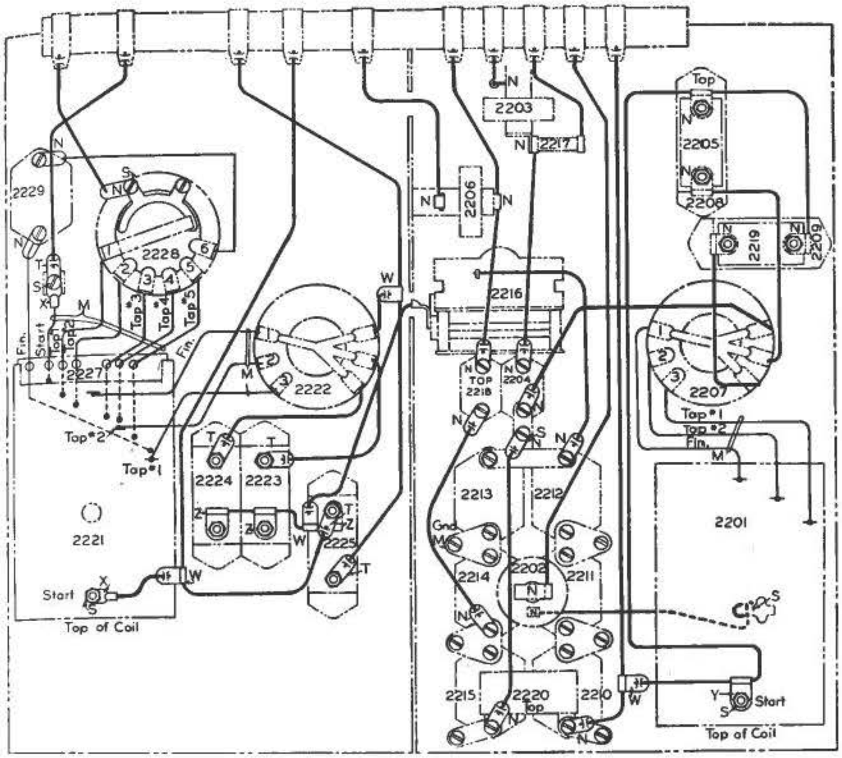
Reference No.	Renewal Part Designation	Name of Part	Description	Function	Drawing No. (G. E. Co.)
901		Inductance		M-O tank	ML-7761609 G1
902		Capacitor	Hammarlund Mfg. Co. max. 77 mmf. ± 2%; min. 15 mmf. ± 1 mmf.	M-O tank (Variable)	P-7761569 P6
903	C-3	Capacitor	Cornell-Dubilier type 9HL, modified, 0.0004 mfd. ± 10%, 5000 volts	M-O grid blocking	P-7761663 P1
904	RFC-9	Coil		M-O grid choke	ML-7462662 G1
905	C-3	Capacitor	Cornell-Dubilier type 9HL, modified, 0.0004 mfd. ± 10%, 5000 volts	P-A grid blocking	P-7761663 P1
906	RFC-10	Coil		P-A grid choke	ML-7463044 G1
907		Capacitor	Hammarlund Mfg. Co. max. 26 mmf. 4%; min. 8 mmf. ± 1.5 mmf.	Neutralizing	T-7660443 P8

TRANSMITTER TUNING UNIT TU-9-B (7,700-10,000 KC)—Continued

Reference No.	Renewal Part Designation	Name of Part	Description	Function	Drawing No. (G. E. Co.)
909	C-8	Capacitor	Cornell-Dubilier type 9L, modified, 0.0004 mfd. ± 5%, 5000 volts	M-O by-pass	P-7761443 P2
921		Inductance		P-A tank	ML-7761619 G1
922		Capacitor	Hammarlund Mfg. Co. max. 116 mmf. ± 2.5%; min. 19 mmf. ± 1.5 mmf.	P-A tank (Variable)	T-7660443 P3
923		Coil		Antenna coupling	ML-7462770 G1
924	CSW-10	Switch		Antenna coupling	ML-7762960 G1

TRANSMITTER TUNING UNIT TU-10-B (10,000-12,500 KC)

1001		Inductance		M-O tank	ML-7761610 G1
1002		Capacitor	Hammarlund Mfg. Co. max. 62 mmf. ± 2%; min. 14 mmf. ± 1 mmf.	M-O tank (Variable)	P-7761569 P7
1003	C-3	Capacitor	Cornell-Dubilier type 9HL, modified, 0.0004 mfd. ± 10%, 5000 volts	M-O grid blocking	P-7761663 P1
1004	RFC-11	Coil		M-O grid choke	ML-7462661 G1
1005	C-3	Capacitor	Cornell-Dubilier type 9HL, modified, 0.0004 mfd. ± 10%, 5000 volts	P-A grid blocking	P-7761663 P1
1006	RFC-12	Coil		P-A grid choke	ML-7463045 G1
1007		Capacitor	Hammarlund Mfg. Co. max. 26 mmf. ± 4%; min. 8 mmf. ± 1.5 mmf.	Neutralizing	T-7660443 P8
1009	C-8	Capacitor	Cornell-Dubilier type 9L, modified, 0.0004 mfd. ± 5%, 5000 volts	M-O by-pass	P-7761443 P2
1010	RFC-13	Coil		M-O choke	ML-7462679 G1
1021		Inductance		P-A tank	ML-7761620 G1
1022		Capacitor	Hammarlund Mfg. Co. max. 116 mmf. ± 2.5%; min. 19 mmf. ± 1.5 mmf.	P-A tank (Variable)	T-7660443 P4
1023		Coil		Antenna coupling	ML-7462755 G1
1024	CSW-10	Switch		Antenna coupling	ML-7762960 G1



Note for Soldering:-
Wire to be Fastened Mechanically to Terminals Before Soldering. Use Rosin Core Solder B20D3C.

There Shall be no Sharp Points Left After Unit is Wired Either From Lumps of Solder or Irregularly Cut Wire Ends.

Symbol	Name of Part	
2201	M.O. Tank Inductance	
2202	M.O. Plate Choke	
2203	M.O. Grid Choke	
2204	M.O. Grid Blocking Capacitor	
2205	M.O. Tank Compensating Cap.	
2206	P.A. Grid Choke	
2207	M.O. Band Change Switch	
2208	M.O. Fixed Tank Capacitor	
2209	M.O. Fixed Tank Capacitor	
2210	M.O. Chain Capacitor	
2211	M.O. Chain Capacitor	
2212	M.O. Chain Capacitor	
2213	M.O. Chain Capacitor	
2214	M.O. Chain Capacitor	
2215	M.O. Chain Capacitor	
2216	Neutralizing Capacitor	
2217	M.O. Grid Parasitic Resistor	
2218	P.A. Grid Blocking Capacitor	
2219	M.O. Tank Compensating Cap.	
2220	M.O. Tank Compensating Cap.	
2221	P.A. Tank Inductance	
2222	P.A. Band Change Switch	
2223	P.A. Fixed Tank Capacitor	
2224	P.A. Fixed Tank Capacitor	
2225	P.A. Fixed Tank Capacitor	
2227	Ant. Coupling Coil	
2228	Ant. Coupling Switch	
2229	Ant. Coupling Capacitor	

Connector	Description
M	Unit Piece of Apparatus
Not Marked	.102" Dia. Copper Wire Tinned

Note:- At Points Marked "S" Solder Complete Joint Together.
At Points Marked "T" Use Term. K-7872305.
At Points Marked "W" Use Term. K-7872368.
At Points Marked "X" Use Term. V-1444451.
At Points Marked "Z" Use Term. K-7870226.
At Points Marked "N" Terminals Called for on Mechanical Drawing.
At Points Marked "Y" Use Term. V-1451309.

Figure 99. Transmitter Tuning Unit TU-22-B, Connection Diagram

TRANSMITTER TUNING UNIT TU-22-B (350-650 KC)

Reference No.	Renewal Part Designation	Name of Part	Description	Function	Drawing No. (G. E. Co.)
2201		Variometer		M-O tank	ML-7761803 G3
2202	RFC-16	Coil		M-O plate choke	ML-7463139 G1
2203	RFC-17	Coil	(With resistor 2217)	M-O grid choke	ML-7463144 G2
2204	C-21	Capacitor	Cornell-Dubilier type 9HL, modified, 0.002 mfd. ± 10%, 5000 v.	M-O grid	P-7761663 P2
2205		Compensator			K-7872696
2206	RFC-18	Coil		P-A grid choke	ML-7463142 G1
2207	CSW-13	Switch	(Ganged with 2222)	M-O band change	ML-7659203 G3
2208	C-22	Capacitor	Cornell-Dubilier type 15H, modified, 0.0001 mfd. ± 2%, 3000 volts	M-O tank	K-7872594 P3
2209	C-23	Capacitor	Cornell-Dubilier type 15H, modified, 0.0002 mfd. ± 5%, 3000 volts	M-O tank	K-7872594 P4
2210	C-24	Capacitor	Cornell-Dubilier type 9HL, modified, 0.003 mfd. ± 5%, 5000 volts	M-O chain	P-7761663 P3

TRANSMITTER TUNING UNIT TU-22-B (350-650 KC)—Continued

Reference No.	Renewal Part Designation	Name of Part	Description	Function	Drawing No. (G. E. Co.)
2211	C-24	Capacitor	Cornell-Dubilier type 9HL, modified, 0.003 mfd. ± 5%, 5000 volts	M-O chain	P-7761663 P3
2212	C-25	Capacitor	Cornell-Dubilier type 9HL, modified, 0.0035 mfd. ± 5%, 5000 volts	M-O chain	P-7761663 P15
2213	C-26	Capacitor	Cornell-Dubilier type 9HL, modified, 0.0024 mfd. ± 5%, 5000 volts	M-O chain	P-7761663 P16
2214	C-26	Capacitor	Cornell-Dubilier type 9HL, modified, 0.0024 mfd. ± 5%, 5000 volts	M-O chain	P-7761663 P16
2215	C-25	Capacitor	Cornell-Dubilier type 9HL, modified, 0.0035 mfd. ± 5%, 5000 v.	M-O chain	P-7761663 P15
2216		Capacitor	Hammarlund Mfg. Co. max. 26 mmf. ± 4%; min. 8 mmf. ± 1.5 mmf.	Neutralizing	T-7660443 P8
2217	RFC-17	Resistor	G.E. type QLK, 15 ohms. 4.5 watts	M-O grid parasitic	QLK-2155993 15 ohms
2218	C-21	Capacitor	Cornell-Dubilier type 9HL, modified, 0.002 mfd. ± 10%, 5000 v.	P-A grid	P-7761663 P2
2219		Compensator			K-7872696
2220		Compensator			K-7875316
2221		Variometer		P-A tank	ML-7761804 G2
2222	CSW-13	Switch	(Ganged with 2207)	P-A band change	ML-7659203 G3
2223	C-27	Capacitor	Cornell-Dubilier type 15L, modified, 0.0001 mfd. ± 5%, 3000 volts	P-A tank	P-7761442 P9
2224	C-28	Capacitor	Cornell-Dubilier type 15L, modified, 0.0002 mfd. ± 5%, 3000 volts	P-A tank	P-7761442 P8
2225	C-29	Capacitor	Cornell-Dubilier type 15L, modified, 0.0008 mfd. ± 5%, 3000 volts	P-A tank	P-7761442 P17
2227		Coil		Antenna coupling	ML-7463895 G1
2228	CSW-10	Switch		Antenna coupling	ML-7762960 G1
2229	C-30	Capacitor	Cornell-Dubilier type 9L, modified, 0.002 mfd. ± 2%, 5000 volts	Antenna coupling	P-7761443 P27

ANTENNA TUNING UNIT BC-306-A

Reference No.	Renewal Part Designation	Name of Part	Description	Function	Drawing No. (G. E. Co.)
1501	CSW-12	Switch		Antenna variometer	ML-7463975 G1
1502		Variometer		Antenna tuning	ML-7761714 G1

DYNAMOTOR UNIT PE-73-C

1601		Socket SO-41	Plug Receptacle	For Plug PL-61	ML-7761424 G1 Signal Corps Dwg. No. SC-D-457
1602		Socket SO-39	Plug Receptacle	For Plug PL-59	ML-7761427 G1 Signal Corps Dwg. SC-D-457
1604	FU-13	Fuse FU-13	G. E. Fuse No. GE-1027 modified, 30 amp., 250 volts	Transmitter L-V supply	K-7870616 P1
1605	FU-22	Fuse FU-22	Bussmann Mfg. Co. No. 1021, modified, 60 amp., 250 volts	Dynamotor L.V.	K-7870604 P1
1607	C-20	Capacitor	Cornell-Dubilier type 9L, modified, 0.005 mfd. ± 5%, 5000 volts	H-V filter	P-7761443 P6
1608	FU-18	Fuse FU-18-A	G. E. Fuse 78x159, modified, 1 amp., 1000 volts	Dynamotor H.V.	K-7870617 P1
1609	C-14	Capacitor	Cornell-Dubilier type 9L, modified, 0.01 mfd. ± 10%, 1000 volts	L-V filter	P-7761443 P24
1610	REL-3	Relay	G. E. Cat. CR-2600-384A3, nominal coil voltage 24 volts, D.C.	Starting	M-7464026 P3
1613	C-31	Capacitor	Cornell-Dubilier type 9L, modified, 0.015 mfd. ± 10%, 5000 volts	Filter	P-7762618 P6
1614	C-31	Capacitor	Cornell-Dubilier type 9L, modified, 0.015 mfd. ± 10%, 5000 volts	Filter	P-7762618 P6
1615	C-32	Capacitor	Cornell-Dubilier type 3YL, modified, 0.01 mfd. ± 10%, 600 volts	Filter	P-7761774 P8
1616	C-33	Capacitor	Cornell-Dubilier type 3LL, modified, 0.01 mfd. ± 10%, 600 volts	Filter	P-7761774 P7
1618		Dynamotor	G. E. Model List 5D48B9 28/1000 volts, 5000 rpm.		K-7876653

MOUNTINGS

Renewal Part Designation	Name of Part	Function	Drawing No. (G. E. Co.)
FT-107	Mounting FT-107	Part of Dynamotor Unit PE-73-C	ML-7461031 G1 Signal Corps Dwg. SC-D-447
FT-115	Mounting FT-115-B	Disposable for use with Radio Transmitter BC-375-D	Dwg. SC-C-2286
FT-142	Mounting FT-142	Part of Antenna Tuning Unit BC-306-A	ML-7462801 G1 Signal Corps Dwg. SC-D-2389
FT-151A	Mounting FT-151-A	Part of Radio Transmitter	ML-7761671 G1 Signal Corps Dwg. SC-D-2290

TABLE OF INTERCHANGEABLE PARTS

The following items of the same type are electrically and mechanically interchangeable:

Description	Reference Numbers
Capacitor, Cornell-Dubilier type 9HL, 5000 volts rated 0.0004 mfd.	509, 510, 609, 610, 703, 705, 803, 805, 903, 905, 1003, 1005
Capacitor, Cornell-Dubilier type 15H, 3000 volts rated 0.0001 mfd.	503, 504, 505
Capacitor, Cornell-Dubilier type 9HL, 5000 volts rated 0.002 mfd.	2204, 2218
Capacitor, Cornell-Dubilier type 9HL, 5000 volts rated 0.003 mfd.	2210, 2211
Capacitor, Cornell-Dubilier type 9HL, 5000 volts rated 0.0035 mfd.	2212, 2215
Capacitor, Cornell-Dubilier type 9HL, 5000 volts rated 0.0024 mfd.	2213, 2214
Capacitor, Cornell-Dubilier type PL, 3000 volts rated 0.00009 mfd.	523, 524, 525
Capacitor, Cornell-Dubilier type 9L, 1000 volts rated 0.0001 mfd.	1108, 1111
Capacitor, Cornell-Dubilier type 9L, 5000 volts rated 0.0004 mfd.	909, 1009
Capacitor, Cornell-Dubilier type HC, 300 volts rated 1.0 mfd.	1144, 1160, 1185
Capacitor, Cornell-Dubilier type 9L, 1000 volts rated 0.01 mfd.	1134, 1609
Capacitor, Hammarlund Mfg. Co., 8 to 26 mmf	512, 612, 707, 807, 907, 1007, 2216
Choke, R.F., G.E. ML-7461859 G1	1106, 1118

Description	Reference Numbers
Compensator, G.E. K-7872696	2205, 2219
Resistor, wire wound, rated.5 ohms, 12 watts	1191, 1192
Resistor, wire wound, rated 15 ohms, 4.5 watts	517, 614, 2217
Resistor, Yazley, variable, rated 3000 ohms	1113, 1114
Socket SO-39 for Plug PL-59	1127, 1602
Socket SO-41 for Plug PL-61	1126, 1601
Socket for Tube VT-4-C	1101, 1110, 1161, 1162
Switch, filament, G. E. ML-7876926 G1	1102, 1131
Switch, filament, G. E. ML-7876927 G1	1190, 1194
Switch, antenna, G. E. ML-7762960 G1	529, 629, 724, 824, 924, 1024, 2228

RENEWAL PARTS

Spare Part Desig- nation	Electrical Rating	Manufacturer	Dimensions in Inches				Wt. in Lb.	Description
			Lgth.	Wth.	Hgt.	Dia.		
AFC-1	0.5 h., 0.1 amp.	General Electric	2.25	2.50	2.59		0.68	Microphone filter reactor
ARM-2		General Electric	9.375			3.25	7.25	Armature for dynamotor unit PE-73-C
BG-1		New Departure			0.5	1.25	0.06	Dynamotor bearing
BP-3		General Electric			2.18	2.06	0.18	Binding post on antenna tuning unit
BP-4		General Electric			0.81	0.50	0.03	Binding post on antenna tuning unit
BP-5		General Electric	6.84	2.25	1.87			Antenna binding post on transmitter
BR-5	H-V for Dynamotor	General Electric	0.62	0.25	0.25		0.01	Dynamotor brush
BR-6	L-V for Dynamotor	General Electric	0.81	0.75	0.43		0.08	Dynamotor brush
C-1	0.0001 mfd. 3000 v.	Cornell-Dubilier	2.81	0.93	1.93		0.27	Mica capacitor
C-2	0.00003 mfd. 2000 v.	Cornell-Dubilier	2.81	0.93	1.93		0.22	Mica capacitor
C-3	0.0004 mfd. 5000 v.	Cornell-Dubilier	1.75	1.32	1.78		0.12	Mica capacitor
C-4	0.00009 mfd. 5000 v.	Cornell-Dubilier	2.81	0.93	1.93		0.27	Mica capacitor
C-6	0.00005 mfd. 3000 v.	Cornell-Dubilier	2.81	0.93	1.93		0.22	Mica capacitor
C-7	0.00005 mfd. 3000 v.	Cornell-Dubilier	2.81	0.93	1.93		0.22	Mica capacitor

RENEWAL PARTS—Continued

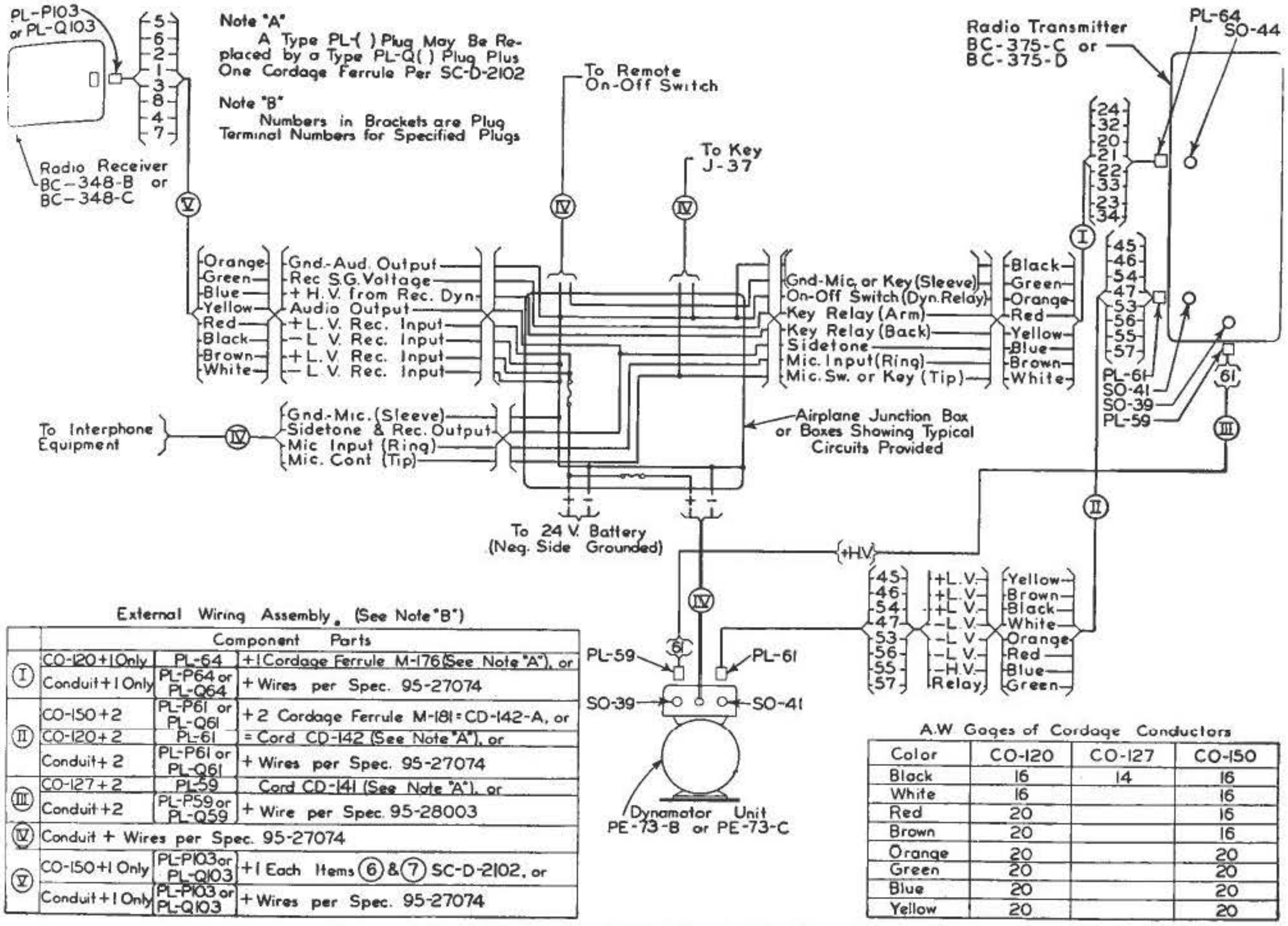
Spare Part Designation	Electrical Rating	Manufacturer	Dimensions in Inches				Wt. in Lb.	Description
			Lgth.	Wth.	Hgt.	Dia.		
C-8	0.0004 mfd. 5000 v.	Cornell-Dubilier	1.75	1.32	0.46		0.06	Mica capacitor
C-9	0.006 mfd. 2500 v.	Cornell-Dubilier	2.81	0.93	1.93		0.24	Mica capacitor
C-10	0.02 mfd. 1000 v.	Cornell-Dubilier	1.75	1.32	0.46		0.09	Mica capacitor
C-11	0.0001 mfd. 1000 v.	Cornell-Dubilier	1.75	1.32	0.46		0.06	Mica capacitor
C-12	0.001 mfd. 4500 v.	Cornell-Dubilier	2.81	0.93	1.93		0.25	Mica capacitor
C-14	0.01 mfd. 1000 v.	Cornell-Dubilier	1.75	1.32	0.46		0.07	Mica capacitor
C-15	0.001 mfd. 2500 v.	Cornell-Dubilier	1.75	1.32	0.46		0.07	Mica capacitor
C-16	1 mfd. 300 v.	Cornell-Dubilier	2.75	2.07	1.00		0.21	Paper capacitor
C-17	25 mfd. 25 v.	Cornell-Dubilier	2.12	1.43	2.75		0.14	Electrolytic capacitor
C-18	0.001 mfd. 2500 v.	Cornell-Dubilier	1.75	1.32	0.46		0.07	Mica capacitor
C-19	0.01 mfd. 2500 v.	Cornell-Dubilier	1.75	1.32	0.46		0.07	Mica capacitor
C-20	0.005 mfd. 5000 v.	Cornell-Dubilier	1.75	1.32	0.46		0.07	Mica capacitor
C-21	0.002 mfd. 5000 v.	Cornell-Dubilier	1.75	1.31	0.78		0.12	Mica capacitor
C-22	0.001 mfd. 3000 v.	Cornell-Dubilier	2.81	0.93	2.12		0.25	Mica capacitor
C-23	0.0002 mfd. 3000 v.	Cornell-Dubilier	2.81	0.93	2.12		0.25	Mica capacitor
C-24	0.003 mfd. 5000 v.	Cornell-Dubilier	1.75	1.31	0.78		0.12	Mica capacitor
C-25	0.0035 mfd. 5000 v.	Cornell-Dubilier	1.75	1.31	0.78		0.12	Mica capacitor
C-26	0.0024 mfd. 5000 v.	Cornell-Dubilier	1.75	1.31	0.78		0.12	Mica capacitor
C-27	0.0001 mfd. 3000 v.	Cornell-Dubilier	2.81	0.93	1.93		0.25	Mica capacitor
C-28	0.002 mfd. 3000 v.	Cornell-Dubilier	2.81	0.93	1.93		0.25	Mica capacitor
C-29	0.0008 mfd. 3000 v.	Cornell-Dubilier	2.81	0.93	1.93		0.24	Mica capacitor
C-30	0.002 mfd. 5000 v.	Cornell-Dubilier	1.75	1.31	0.46		0.06	Mica capacitor
C-31	0.015 mfd. 5000 v.	Cornell-Dubilier	1.75	1.31	0.78		0.12	Mica capacitor
C-32	0.01 mfd. 600 v.	Cornell-Dubilier	2.62	0.62	0.31		0.02	Mica capacitor
C-33	0.01 mfd. 600 v.	Cornell-Dubilier	1.93	0.62	0.31		0.03	Mica capacitor
C-34	1-1-1 mfd. 3000 v.	General Electric	4.75	2.5	3.0			Pyranol askarel filled capacitor
CSW-1		General Electric	1.18	0.53	1.56		0.03	Interlock switch and test key
CSW-2		Arrow-Hart Hegeman	1.75	0.75	1.59		0.06	On-Off switch

RENEWAL PARTS—Continued

Stock Part Designation	Electrical Rating	Manufacturer	Dimensions in Inches				Wt. in Lb.	Description
			Lgth.	Wth.	Hgt.	Dia.		
CSW-3		Arrow-Hart Hegeman	1.56	0.625	1.32		0.032	Voltmeter switch
CSW-5		General Electric	2.63	2.63	2.109		0.150	Selector switch
CSW-6		Yaxley Co.	1.5	2.38	2.0		0.106	Side-tone switch
CSW-7		General Electric	2.38	2.75	2.75		0.565	Antenna circuit
CSW-8		General Electric	2.375	2.375	2.50		0.343	Antenna tap switch
CSW-9		General Electric	10.0	2.56	2.43		0.55	Tandem control switch
CSW-10		General Electric	2.375	2.375	2.50		0.343	Antenna coupling switch
CSW-11		General Electric	10.0	2.56	2.38		0.498	Tandem control switch
CSW-12		General Electric	5.18			2.75	0.594	Antenna variometer switch
CSW-13		General Electric	10.0	2.56	3.0		0.656	Tandem control switch
FT-107		General Electric	10.62	7.5	0.82		1.45	Mounting FT-107
FT-115		General Electric	2.12	2.31	1.21		0.195	Mounting FT-115-B
FT-142		General Electric	9.5	8.0	0.40		0.69	Mounting FT-142
FT-151A		General Electric	22.0	8.0	1.35		3.797	Mounting FT-151-A
FU-12	0.5 amp. 1000 v.	General Electric	3.0			0.50	0.018	Fuse FU-12-A
FU-13	30 amp. 250 v.	General Electric	2.0			0.56	0.055	Fuse FU-13
FU-18	1 amp. 1000 v.	General Electric	3.0			0.50	0.0187	Fuse FU-18-A
FU-22	60 amp. 250 v.	Bussman Mfg. Co.	3.0			0.81	0.117	Fuse FU-22
INS-1		General Electric	0.25			2.0	0.045	Ceramic ring
INS-2		General Electric	1.81	0.375	0.375		0.020	Ceramic post
INS-3		General Electric	1.25	0.375	1.25		0.049	Ceramic insulator
INS-4		General Electric	1.75	0.375	0.875		0.048	Ceramic insulator
INS-6		General Electric	2.43	0.375	0.875		0.07	Ceramic insulator
INS-7		General Electric	1.25	0.375	0.375		0.014	Ceramic insulator
INS-8		General Electric	0.875	0.375	0.375		0.01	Ceramic insulator
INS-9		General Electric	1.0	0.375	0.375		0.012	Ceramic post

RENEWAL PARTS—Continued

Spare Part Desig-nation	Electrical Rating	Manufacturer	Dimensions in Inches				Wt. in Lb.	Description
			Lgth.	Wth.	Hgt.	Dia.		
INS-10		General Electric	1.25	0.375	0.375		0.013	Ceramic post
INS-11		General Electric	1.25	0.375	0.375		0.013	Ceramic post
INS-12		General Electric	3.25	3.0	0.375		0.021	Ceramic end plate
INS-13		General Electric	0.875	0.375	0.375		0.01	Ceramic post
INS-14		General Electric	1.0	0.375	0.375		0.012	Ceramic post
INS-15		General Electric	1.375			2.12	0.125	Ceramic insulator
INS-16		General Electric	0.281			0.62	0.007	Ceramic insulator
J-1		General Electric	1.245	0.937	0.75		0.030	Jack JK-33-A
M-1	500 ma DC.	General Electric	2.03			2.56	0.274	Ammeter IS-22 (Plate milliammeter)
M-2	15 volts AC-DC.	General Electric	2.03			2.56	0.278	Voltmeter IS-1229
M-3	8 amp. R.F.	General Electric	2.03			2.56	0.400	Ammeter IS-8
M-141	30 amp., 250 v.	General Electric	2.25	0.25	0.010		0.001	Fuse Link M-141 for Fuse FU-13
M-168	60 amp., 250 v.	Bussman Mfg. Co.	3.43	0.375	0.060		0.008	Fuse Link M-168 for Fuse FU-22
R-2	2500 ohm, 12 watt	IRC	3.0			0.750	0.059	Fixed Resistor
R-3	4000 ohm, 12 watt	IRC	3.0			0.750	0.059	Fixed Resistor
R-4	200,000 ohm, 1 watt	IRC	1.25			0.25	0.006	Fixed resistor
R-5	250,000 ohm, 1 watt	IRC	1.25			0.25	0.006	Fixed resistor
R-8	50 ohm, 4 watt	IRC	1.75			0.43	0.020	Fixed resistor
R-9	200 ohm, 2 watt	IRC	0.875			0.43	0.013	Fixed resistor
R-11	11,000 ohm 12 watt	IRC	3.0			0.75	0.059	Fixed resistor
R-12	30,000 ohm, 1 watt	IRC	1.25			0.25	0.006	Fixed resistor
R-13	100 ohm, 1 watt	General Electric	5.687	1.37	1.37		0.094	Parasitic resistor and choke
R-14	5 ohm, 2 watt	IRC	0.875			0.43	0.014	Fixed resistor
R-15	2.70 ohm, 36 watt 3.70 ohm, 26 watts	General Electric	10.75	2.75	1.93		1.84	Fixed resistor with terminal board
R-16	100 ohm, 12 watt	IRC	3.0			0.75		Fixed resistor
R-17	5 ohm, 12 watt	IRC	3.0			0.75		Fixed resistor
R-18	150 ohm, 8 watt	IRC	2.0			0.75		Fixed resistor



External Wiring Assembly. (See Note "B")

	Component Parts		
(I)	CO-120+1 Only	PL-64	+1 Cordage Ferrule M-176 (See Note "A"), or
	Conduit+1 Only	PL-P64 or PL-Q64	+ Wires per Spec. 95-27074
(II)	CO-150+2	PL-P61 or PL-Q61	+ 2 Cordage Ferrule M-181 = CD-142-A, or
	CO-120+2	PL-61	= Cord CD-142 (See Note "A"), or
	Conduit+2	PL-P61 or PL-Q61	+ Wires per Spec. 95-27074
(III)	CO-127+2	PL-59	Cord CD-141 (See Note "A"), or
	Conduit+2	PL-P59 or PL-Q59	+ Wire per Spec. 95-28003
(IV)	Conduit + Wires per Spec. 95-27074		
(V)	CO-150+1 Only	PL-P103 or PL-Q103	+1 Each Items (6) & (7) SC-D-2102, or
	Conduit+1 Only	PL-P103 or PL-Q103	+ Wires per Spec. 95-27074

A.W Gages of Cordage Conductors

Color	CO-120	CO-127	CO-150
Black	16	14	16
White	16		16
Red	20		16
Brown	20		16
Orange	20		20
Green	20		20
Blue	20		20
Yellow	20		20

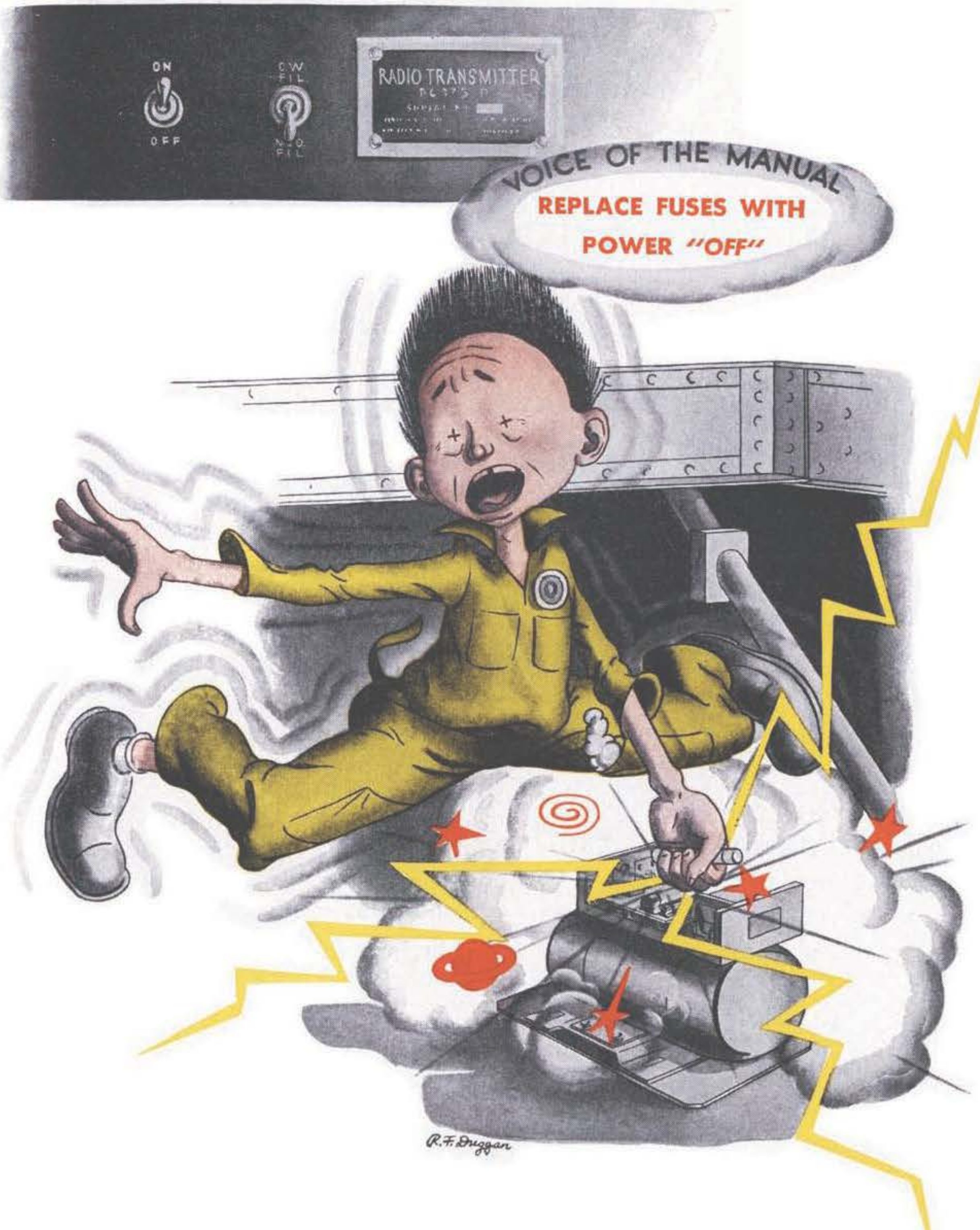
Figure 100. Radio Set SCR-287-A, Cording Diagram

RENEWAL PARTS—Continued

Spare Part Designation	Electrical Rating	Manufacturer	Dimensions in Inches				Wt. in Lb.	Description
			Lgth.	Wth.	Hgt.	Dia.		
REL-3		General Electric	4.0	2.56	2.75		2.00	Starting relay for dynamotor
REL-4		General Electric	5.62	2.75	2.56		1.36	Antenna switch relay
RFC-1		General Electric			2.84	1.50	0.08	Radio freq. choke and fixed resistor
RFC-2		General Electric			1.45	1.50	0.06	Radio freq. choke
RRC-3		General Electric			1.45	1.18	0.06	Radio freq. choke and fixed resistor
RFC-4		General Electric			1.45	1.187	0.06	Radio freq. choke
RFC-5		General Electric			1.45	1.19	0.06	Radio freq. choke
RFC-6		General Electric			1.45	1.18	0.04	Radio freq. choke

RENEWAL PARTS—Continued

Spare Part Designation	Electrical Rating	Manufacturer	Dimensions in Inches				Wt. in Lb.	Description
			Lgth.	Wth.	Hgt.	Dia.		
RFC-7		General Electric			1.45	1.06	0.04	Radio freq. choke
RFC-8		General Electric			1.45	1.06	0.06	Radio freq. choke
RFC-9		General Electric			1.45	0.93	0.03	Radio freq. choke
RFC-10		General Electric			1.45	0.93	0.03	Radio freq. choke
RFC-11		General Electric			1.45	0.93	0.03	Radio freq. choke
RFC-12		General Electric			1.45	0.93	0.03	Radio freq. choke
RFC-13		General Electric			2.81	0.62	0.05	Radio freq. choke
RFC-14		General Electric			1.93	1.18	0.05	Radio freq. choke
RFC-15		General Electric			1.45	1.06	0.05	Radio freq. choke
RFC-16		General Electric			1.50	1.45	0.06	Radio freq. choke
RFC-17		General Electric			1.48	1.68	0.12	Radio freq. choke and fixed resistor
RFC-18		General Electric			1.84	1.68	0.09	Radio freq. choke
TR-1		General Electric	4.0	2.62	2.95		2.5	Microphone Transf.
TR-2		General Electric	4.09	2.75	3.37		2.31	Interstage transf.
TR-3		General Electric	3.75	3.25	4.75		4.81	Modulation transf.
TSK-1		General Electric			1.25	4.0	0.22	Socket for Tube VT-4-C
TSK-2		Hammarlund Mfg. Co.	2.25	1.62	0.68		0.06	Socket for Tube VT-25
VR-1	3000 ohm.	Yaxley Mfg. Co.	1.37	1.62	2.0		0.10	Variable resistor
VR-2	200 ohm.	Yaxley Mfg. Co.	1.625	1.62	2.0		0.10	Variable resistor


ON
OFF
CW FIL
NO FIL
RADIO TRANSMITTER
VOICE OF THE MANUAL
REPLACE FUSES WITH
POWER "OFF"
R.F. Duggan

LIAISON RECEIVER BC-348-H

This radio receiver is an 8 tube, 6 band superheterodyne type receiver covering the frequency ranges of 200 KC. to 500 KC. and 1.5 to 18.0 megacycles. All controls are located directly on the face of the receiver and no provision is made for remote operation. It is capable of reception of tone, voice, or C-W reception on either manual or automatic volume control.

MODULATED SIGNAL RECEPTION

1. Throw the "AVC-OFF-MVC" switch (3), Figure 101, to "MVC" and set other switches and controls as follows:

   "C-W OSC" switch (1) in "OFF" position.

   "CRYSTAL" switch (2) in "OUT" position.

   Antenna alignment set to maximum background level.

2. Set the band switch (6) or signal strength at approximately 500 KC., to the desired frequency band and adjust the tuning control (7) to the desired frequency. It is of great importance that this tuning be accomplished with the receiver switch in the MVC position.

   NOTE: The "AVC" position should not be employed while tuning in a signal. Tuning should always be done in the "MVC" position and with the volume control (4) advanced only as far as required for a comfortable output level.

3. Increase the volume control (4) until the desired signal is heard or the background noise attains a fair level.
4. Adjust the tuning control (7) until maximum output from the desired signal is obtained. This insures correct alignment or proper tuning of the receiver.
5. If automatic volume control is desired, turn switch (3) to the "AVC" position and readjust the volume control (4) for the desired output level.

C-W RECEPTION

1. The procedure is the same as outlined above with the exception that the C-W oscillator switch (1) is "ON" and tuning accomplished with the beat frequency control (5) set near the zero beat position (arrow on knob pointing up).
2. After tuning in the desired signal the beat frequency control (5) may be varied and the frequency of the beat note adjusted as desired.
3. Automatic volume control may be employed for C-W reception by switching (3) to the "AVC" position and readjusting the volume control.
4. When extreme selectivity is desired to minimize interference, the crystal filter (2) is switched "IN." A slight readjustment of the tuning, beat frequency and volume controls may be required to secure the desired beat note frequency and volume level.

   NOTE: The crystal band pass filter is intended primarily for use in C-W reception. However, the added selectivity may at times prove helpful in receiving modulated signals through heavy interference.

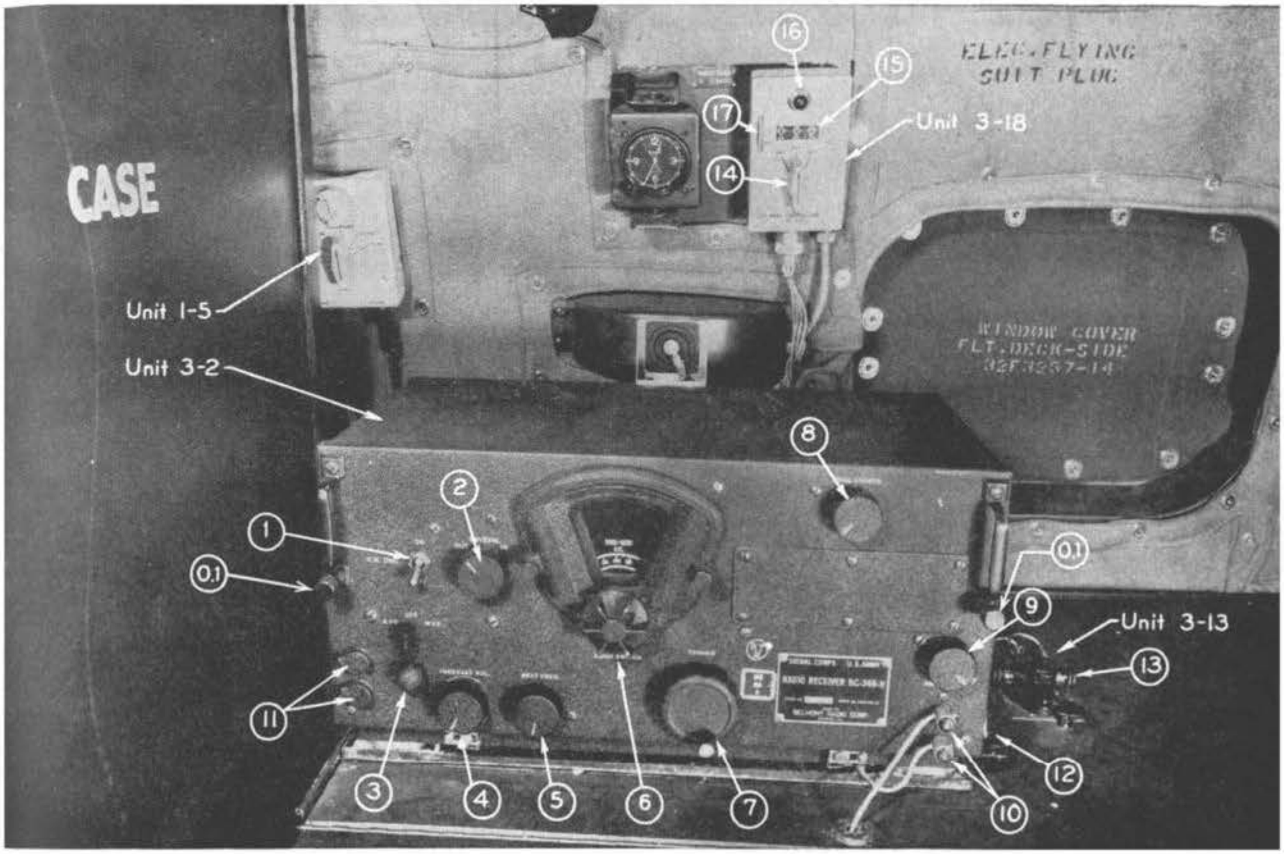


Figure 101. Liaison Receiver

Unit 3-2—LIAISON RECEIVER BC 348H
(0.1)—Thumb screws
(1)—CW oscillator control switch
(2)—Crystal switch
(3)—Power-AVC-MVC switch
(4)—Volume control
(5)—CW Oscillator beat frequency control
(6)—Band change switch and dial
(7)—Tuning control
(8)—Dial light rheostat
(9)—Antenna alignment control
(10)—Antenna and Ground connections
(11)—Telephone jacks
(12)—Monitor switch

Unit 3-13
(13)—Transmission key J-37

Unit 3-18—Antenna Reel Control Box BC 461
(14)—Reel control switch
(15)—Reel footage indicator
(16)—Reel indicating light
(17)—Indicator re-set

CHARACTERISTICS OF TUBES, LAMPS, VOLTAGE REGULATOR AND FUSE

Tube Characteristics

Tube	Heater		Screen Volts	Plate Volts	Grid Volts	Plate Ma	Screen		Plate Resistance Ohms	Mutual Conductance Micromhos
	Volts	Amps.					Ma	Mu		
VT-86	6.3	0.3	100	250	−3	7.0	1.7	1,160	800,000	1,450
VT-91	6.3	0.3	100	250	−3	2.0	0.5	1,500	1,500,000	1,225
VT-70	6.3	0.3	100	250	−3	6.5	1.5	900	850,000	1,100
		Tri.	...	100	−3	3.5	...	8	16,000	500
VT-93	6.3	0.3	125	250	−3	10.0	2.3	800	600,000	1,325
VT-65	6.3	0.3	...	250	−8	8.0	...	20	10,000	2,000
VT-152	6.3	0.4	250	250	−18	32.0	5.5	150	68,000	2,200

Dial Lamps

Type	Volts	Amps.
LM-27	6.3	0.25

Fuse

Type	Amps.
FU-35	5

Voltage Regulator

Type 991—Starting Supply Voltage 87 volts min.
Operating Voltage 60 volts
Operating Current 0.5 to 2 milliamperes

DYNAMOTOR DM-28-H

The dynamotor and associated R-F circuits are assembled in one unit. The R-F filters are of the unbalanced type for use with a primary supply in which the negative side is grounded. This dynamotor supplies all of the high voltage direct current required for the operation of the receiver and in addition a maximum of 20 milliamperes for use in operating accessory equipment.

MAINTENANCE OF LIAISON RECEIVER

NOTE: No attempt at either mechanical or electrical servicing of this receiver should be made except at signal corps repair shops and signal corps radio section (or signal sections) at air depots unless suitable shop and testing facilities are available and authority to repair has been granted by the corps area signal officer. A standard signal generator, a phantom antenna, a test set I-56-A, and other like equipment should be used for alignment purposes and the instructions in this book carefully followed.

INSPECTION

1. **Daily**—Turn on receiver. Check dial lamps. Check for operation on all bands with C-W oscillator "ON." This test can best be made by observing noise level with volume control at maximum.
2. **20 Hour**—Repeat above with additional check of antenna, ground and cable connections for effects of vibration.
3. **40 Hour**—Repeat above with additional check of all vacuum tubes, regulator tube and dial lamps. Inspect receiver for loose grid clips, tube shield, etc. Inspect all tubes with Model 685 Type 2 Tube Checker of Test Set I-56-A.
4. **6 Months**—Repeat above with additional cleaning and lubrication of dynamotor as described on page 117.
5. Repeat above with inspection and replacement of dynamotor brushes if necessary. Lubricate dial and tuning condenser drive mechanism. Check dynamotor and tube socket voltages as described in Figure 112.

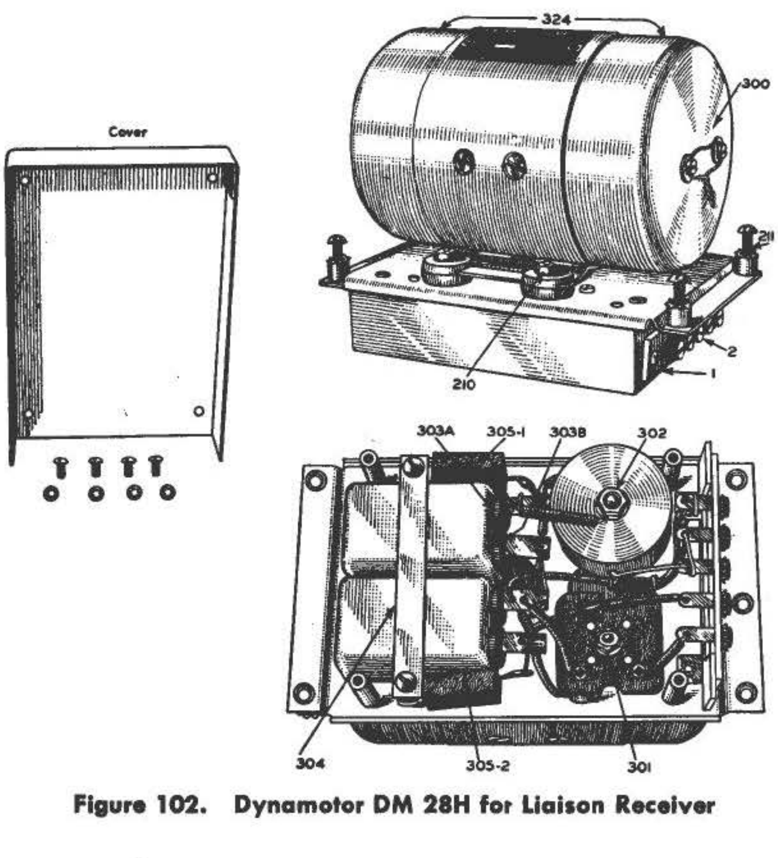


Figure 102. Dynamotor DM 28H for Liaison Receiver

CARE AND SERVICING OF DYNAMOTOR DM-28-H

The dynamotor and filter assembly is removable from the receiver chassis without disturbing other parts, provided the procedure outlined below is followed:

1. Loosen the two thumb screws (0.1), Figure 101, on the receiver panel and draw the chassis from the cabinet.
2. Lay the chassis with top upwards on a smooth, flat surface with the rear toward the operator.
3. Loosen the five connector screws (2), Figure 102, on the dynamotor terminal strip (1), Figure 102, and withdraw the spade terminals from beneath them.
4. Loosen the four captive screws (211), Figure 102, which hold the dynamotor unit to the chassis.
5. Remove the dynamotor and filter assembly from the receiver by grasping the dynamotor and lifting vertically.

The filter portion of the dynamotor unit is accessible by removing the cover at the bottom. See Figures 102 and 103.

This dynamotor requires lubricating after 1,000 hours or approximately 6 months of ordinary service and should be lubricated **only** with Air Corps Grade 375 grease. The directions for lubrication are stamped on the inside of the end-bell dust covers (324), Figure 102. Access to the bearings of the dynamotor is obtained by first removing the dust covers after cutting the safety wires and removing the retaining screws (300), Figure 102, then unscrewing the bearing end plates. Do not PACK the lubricant in these bearings.

When necessary to replace the ball bearings or turn down the commutators, first remove the brushes (308, 309, 310, 311), Figure 103, from their cartridges. Remove the nuts from the tie rods (319) which hold the bearing end-bells (315 and 316) and pull the end-bells away from the field coil assembly (317, 318). The armature (306) can now be taken out. Examine the brushes to see that they have worn properly and are free from hard spots. Should such spots be apparent (they generally cause grooves in the commutator surface) the brush should be replaced and the commutator smoothed down. The ball bearing retainers and the shaft are machined for very snug fits, but a slight tapping will loosen them. To remove the bearing retainers from the end-bells, use two small screwdrivers as wedges between the outer ball race and the end-bell. If the grease slinger becomes bent during removal, it should be straightened and replaced on the shaft before replacing the bearing.

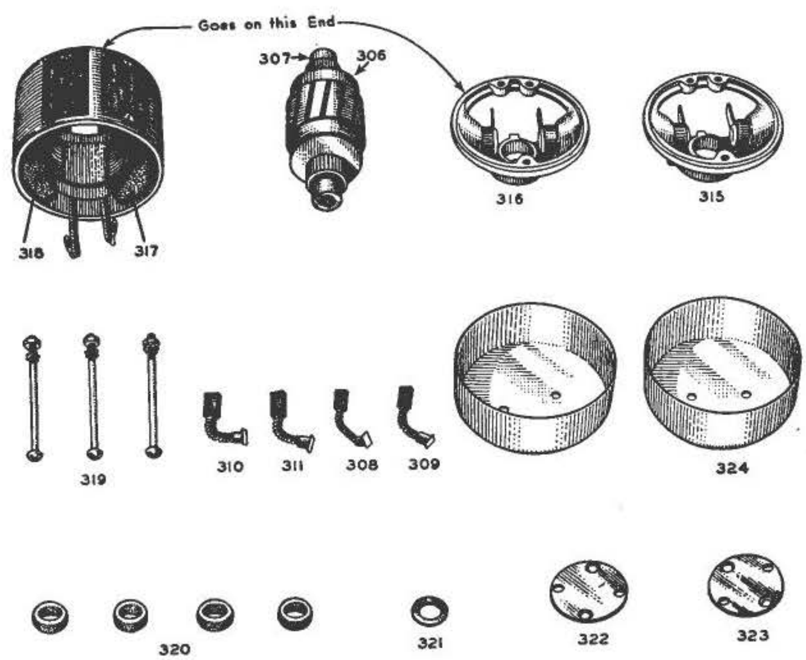


Figure 103. Assemblies of DM 28H Dynamotor

To smooth down the commutator rotate it in a lathe holding a fine grade of sandpaper, not coarser than size 00, lightly against the commutator surface. **Never use emery cloth.** All residue of dust, sand and dirt, should be wiped away to leave a clean, smooth, polished commutator surface. A commutator having a smooth or polished surface should never be sanded or turned down simply because it is discolored. If the commutator is turned down in a lathe, the mica segment separators must be undercut.

Reassembly of the dynamotor is substantially the reverse of the disassembly procedure, except that the use of the screwdrivers as wedges is not necessary. In replacing the brushes check to see that the "plus" and "minus" markings on the brushes correspond with those on the brush holder supports, and that the **marked side of the brush is towards the top of the dynamotor.** The commutator must be given a final inspection for free running, cleanliness and absence of grease or oil. The end-bells should be wiped clean and dry before replacing them on the dynamotor.

The nominal rating of Dynamotor DM-28-H is: Input, 1.23 amperes at 27.9 volts; Output, 70 milliamperes at 220 volts; Regulation 12 per cent. Average performance data on Dynamotor DM-28-H is as follows: (dynamotor and filter disconnected from receiver and negative high voltage connection made to case of unit).

Input		**Output**	
Volts	**Amperes**	**Volts**	**Milliamperes**
24	0.7	215	0.
24	1.1	210	30.
24	1.3	202	60.
28	0.8	258	0.
28	1.1	246	40.
28	1.5	236	75.

REMOVAL OF FRONT PANEL

For adjustment of dial or mask, or for servicing of certain parts, it may become necessary to remove the panel. The chassis, with panel attached, should be taken completely out of the cabinet and placed for inspection with the panel facing upwards. Unsolder the lead to the antenna binding post and the lead from the chassis to the dial lights. Remove the dial light housing cover, the two thumb screw rods, the handles, and all knobs and retaining nuts of all controls except the "DIAL LIGHTS" control. The retaining nuts of the "TEL" jacks should also be removed. The panel may be lifted off after the removal of the end plate holding screws, the chassis holding screws, and the dial casting holding screws.

In replacing the "BEAT FREQ" control knob, turn the flexible shaft until the set screw in the coupling at the internal end points away from the panel. Now mount the knob so that the arrow points vertically towards the top of the receiver. This knob has two set screws. In replacing the other knobs on the shafts, it will be noted that flats on the shafts provide for proper location. All set screws must be tightened securely, and the set screw on the band switch knob in particular should be given a second tightening after the shaft has been rotated a few times.

DIAL AND MASK ASSEMBLY

Attached to the front panel and to the main frame or chassis casting is an aluminum casting which is the frame for the switch drive shaft, dial mask and detent (star wheel), and also for the tuning dial, tuning shaft, reduction gears and stop. All of these parts are assembled, and can be moved, as a unit, which simplifies any service operations which might be required.

The switch drive shaft passes through a hole in an adjustable plate located in the dial lamp housing and through a clearance hole in the panel. The hole in the adjustable plate is purposely given a larger clearance than bearing requirements would dictate, since its use is to support the shaft against forces which might spring it or damage the internal bearing. The shaft extends through a long bushing pressed in the dial housing. At the inside end of the shaft, the detent (star wheel) and the driving portion of the coupling member are pinned in place by means of taper pins. The dial assembly runs on the outside surface of the long bushing referred to above. Just inside the panel the shaft has attached to it, by taper pin, the hub of the mask.

On the back of the dial frame casting is a stop arm which engages a pin in the detent so as to limit its rotation to 6 positions which are spaced 60 degrees apart. There is attached the assembly of pivot pins, arms with rollers, and spring which positions the detent. This assembly is locked with two dowel pins after the correct location is made.

On the front (panel) end of the bushing through which the switch shaft passes, there is a narrow shoulder which supports the lower end of the dial index plate. This index plate is attached to the casting at its upper end with means for removing any slack and keeping it straight and taut. The inner end of the mask hub and the outer end of the dial hub turn, and are held, against opposite sides of the index plates.

The dial is attached to a flange on a hub which runs on the outside surface of the bushing, through which the switch drive shaft passes. This hub also carries a large gear which is driven by a pinion, combined with a split idler gear. This split idler gear and pinion has adjustment in the clearance holes for the mounting screws to enable the backlash in the mesh of the pinion with the large dial gear to be reduced to the smallest practicable amount when assembling.

The tuning shaft has, in addition to the pinion referred to above, a stop, and a worm which meshes with a split worm gear on a cross shaft at the back of the frame. Both this cross shaft and the tuning shaft run in bearings which are integral in the casting. Both shafts have spring thrust washers to remove end play. The cross shaft carries a pinion which is meshed with a split gear on the tuning capacitor shaft at assembly. The degree of mesh of this pinion and gear is adjustable by moving the tuning capacitor towards or away from the panel after it is placed in position and before the holding screws are finally tightened.

The overall gear ratio between the tuning shaft and the capacitor shaft is 200 to 1. Since the design of the tuning capacitor permits but a small amount of rotation at either end of its travel beyond the 180 degrees required to give its complete range in electrical capacity, means are provided to stop the tuning shaft at either end of a total of approximately 100 revolutions. This is accomplished by a cam on the outer edge of the tuning dial which operates an arm pivoted on a pin of the frame casting. One end of this arm has a roller (part of item 368 Figure 104) which runs on the outer edge of the tuning dial. The roller is held in contact with the dial by a spring (379 Figure 104). The dial periphery is out away in such a manner that when the point corresponding to either end of the tuning capacitor travel is reached, the roller, and therefore the end of the arm, can move toward the center of the dial, being forced in that direction by the spring. Thus the opposite end of the stop arm is moved so that the hook at the end of the arm engages the rotating stop on the tuning shaft, and the shaft is thereby prevented from further turning. When the direction of rotation of the tuning shaft is reversed, the roller and arm are pushed outward against the spring by the cam edge of the dial and the stop disengages.

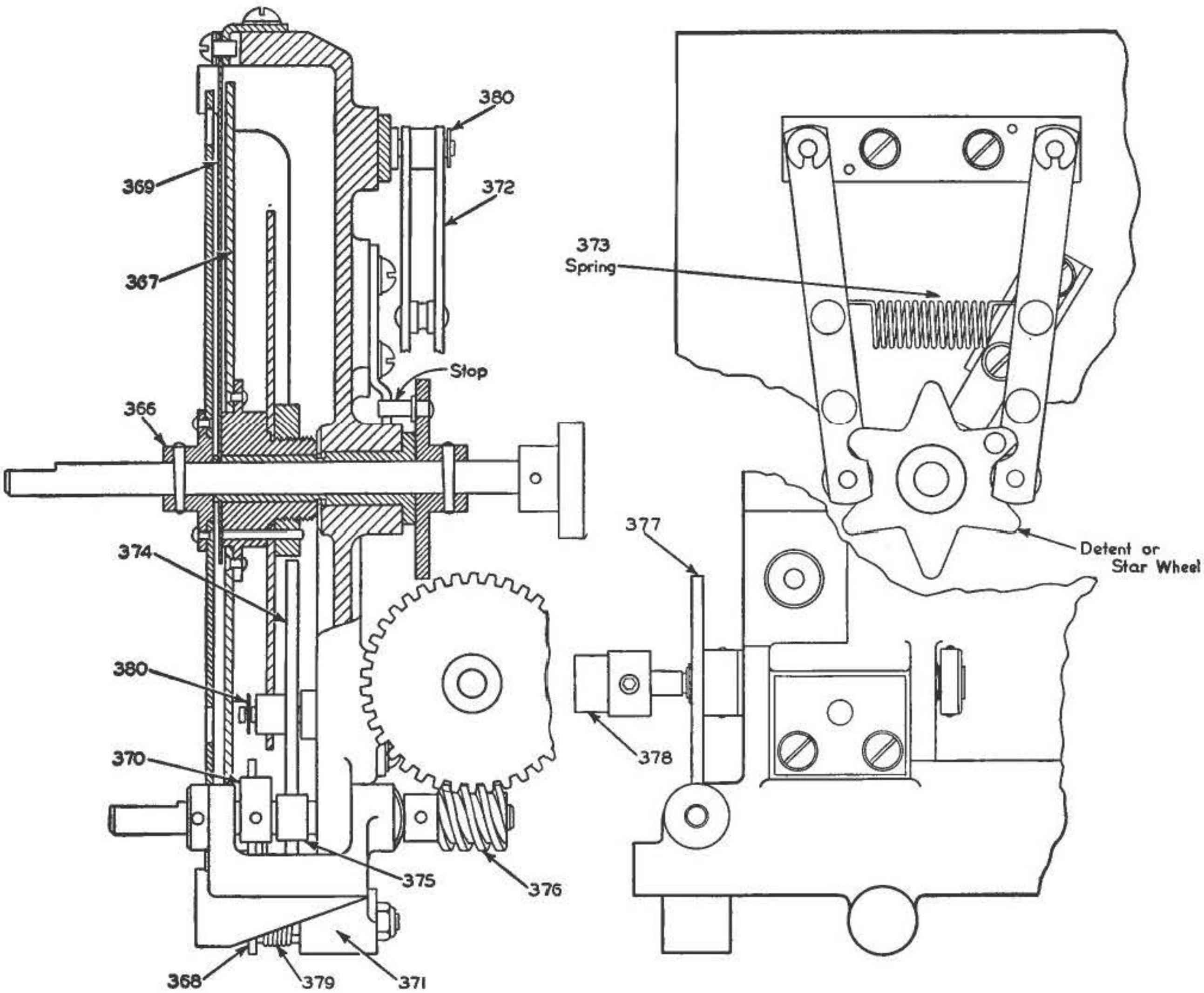


Figure 104. Radio Receiver BC-348-H Dial and Mask Assembly

Since a definite relation must be set and maintained between the dial position and the angular position of the rotor of the tuning capacitor, adjustment is provided at the pinion on the cross shaft at the rear of the frame. (This is the shaft which also carries the worm gear.) This pinion is held in place by two set screws which bear in a groove on the shaft. By loosening these two set screws, either the dial or the tuning capacitor can be rotated while the other part remains fixed. The correct relation between these is that the tuning capacitor rotor plates are fully meshed with the stator plates (maximum capacity) when the dial is set with the isolated index mark at the low frequency end of the 13.5 to 18.0 m.c. band in line with the index.

REMOVAL AND REPLACEMENT OF DIAL MECHANISM

In the event that the dial mechanism is to be removed from the chassis for any servicing operations, it is necessary first to remove the front panel in accordance with instructions given previously. The frame of the mechanism is attached to the chassis by the bracket holding the fuse, and by two slotted hexagon head screws through the flange on the under side of the chassis. Note that one of these screws is beneath the removable shield which covers the terminal of the first I.F. transformer. When these screws are removed, the complete unit can be removed. The center disc of the flexible coupling is loose and will drop out of engagement.

To remove the index and dial, the taper pin holding the mask hub to the switch drive shaft must be removed. It is necessary to support the shaft when driving out this pin, so that excess stress will not be placed on the center bushing. After the removal of the mask and the index, the dial and its gear are free to slide off the bushing. In replacing these parts, the thrust washer behind the dial hub must be turned in the position to give maximum thrust, which is convex side outward.

If the dial is removed and replaced, it is possible that in meshing the dial gear with the idler gear the stop relationship may not be correct, in which case it may be necessary to change gear mesh, a tooth at a time, to correct this condition. The stop relationship must be such that the roller arm hook and the tuning shaft stop arm engage fully at the end of the last revolution, but on the previous revolution the arm must not start to move until after the rotating arm has passed under the roller arm hook. This adjustment can only be made by trial and inspection, but it can be secured in one or two trials. Substitution of a different stop arm may also require readjustment, but in this case the adjustment should be made by lengthening or shortening the roller end of the arm. This is done by loosening the two nuts on the arm, after which the arm can be adjusted by the slotted holes provided.

When the dial mechanism is replaced, the flexible coupling must be properly positioned so that the position of the mask corresponds to the switch position, since it is possible otherwise to get the band switches to an inoperative position. The correct relative positions are obtained when the mask is set to band 200-500 KC and the set screw locking the flat switch shaft to the large bevel gear hub is vertical.

If any of the gear trains including split gears have been unmeshed in disassembly, the split gears must be reset to put tension on the loose section when they are again meshed. Normally, a displacement of one tooth between the two sections is sufficient. Trial will show whether this will remove the backlash.

When the dial mechanism is reassembled to the chassis, the relation between the dial and the tuning capacitor must be carefully adjusted in order to maintain the calibration and prevent over-running the capacitor. (Refer to paragraph on Dial and Mask Assembly.) This is done by loosening the two set screws in the pinion on the cross shaft on the back of the dial assembly. Before putting the mechanism in place, this pinion can be moved along the shaft toward the worm gear so as to clear the capacitor split gear. This facilitates assembly since the gears can be meshed after the dial mechanism is bolted in place, making it easier

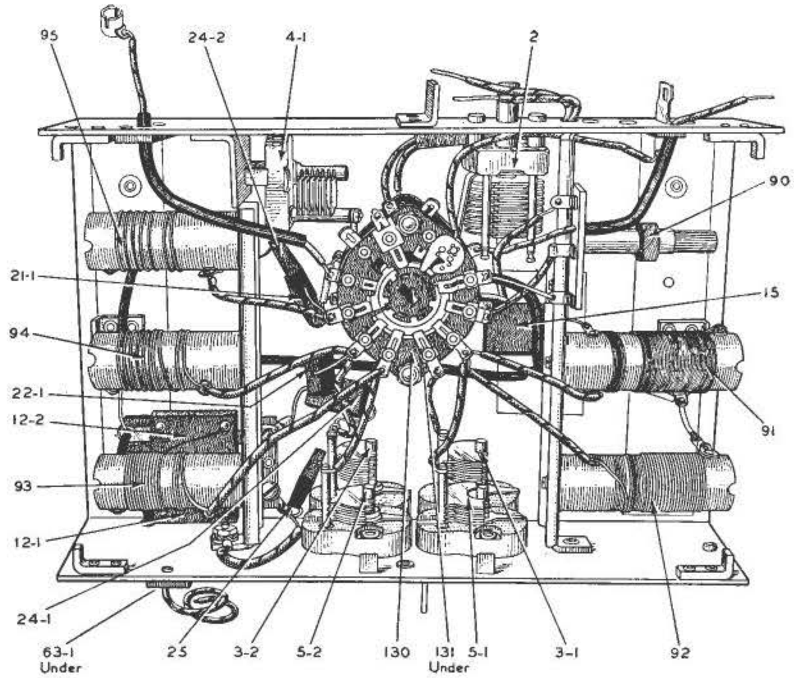


Figure 105. Liaison Receiver Antenna Unit

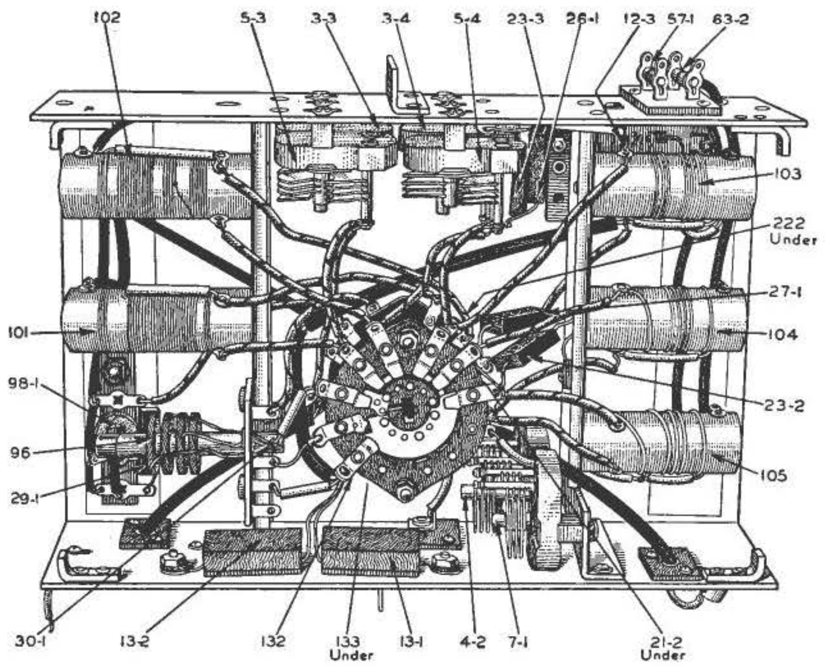


Figure 106. Liaison Receiver R. F. Unit

to get the tension on the split gear in the capacitor assembly.

REMOVAL OF ANTENNA, R-F. DETECTOR AND OSCILLATOR UNITS

In many cases servicing of these units will require only the removal of the top or bottom cover of a particular unit; however, any unit may be removed and replaced independently as follows:

1. Unsolder the lead to the main tuning capacitor at the capacitor by first removing the shield. Unsolder all other leads at the unit.
2. Disconnect the band switch drive shaft and withdraw same from the antenna unit end.
3. In case of antenna unit, disconnect the antenna alignment control shaft.
4. Remove the screws holding unit to the tie strips at the bottom.
5. Remove screws holding the unit to the chassis.
6. Lift the unit from the receiver, taking care that it comes out freely.

When replacing a unit, reverse the above procedure; however, do not tighten the chassis holding screws tightly until the drive shaft has been replaced and band change switch knob has been rotated a number of times. This will insure the self-alignment of the unit and the proper action of the detent or star wheel.

TROUBLE LOCATION AND REMEDY

General—The normal sensitivity (number of microvolts input to produce 10 milliwatts output into a 4,000 ohm resistance load) of the receiver is better than 9 microvolts when measured under the following conditions:

"AVC-OFF-MVC" switch at "MVC"; 28 volts input; c-w oscillator "ON"; crystal filter "OUT"; output load 4,000 ohms non-inductive resistance; pure c-w input from signal generator applied between antenna-ground terminals through a 1000-mmf dummy antenna; volume control set to produce 0.3 milliwatt noise output.

This sensitivity will, of course, be subject to tube aging, etc. Therefore, it is recommended that no attempt be made to retrim or realign the equipment unless the sensitivity is found to be worse than 17 microvolts with new average tubes. This receiving equipment has been carefully adjusted and aligned by the manufacturer before shipment and should maintain these adjustments over reasonably long periods of time. Major adjustments and repairs should be made only in an authorized repair shop equipped with the necessary servicing tools and equipment. All others must refrain from changing any of the adjustment of the radio frequency circuits. The difficulties usually experienced are the result of external deteriorating influences, such as worn-out vacuum tubes, improper operating voltage, blown fuse, external noises, etc. However, in order to permit the servicing of this equipment, the testing procedure shown should be followed in determining the sources of trouble. This has been divided into the following major divisions, with respect to the nature of the troubles being experienced:

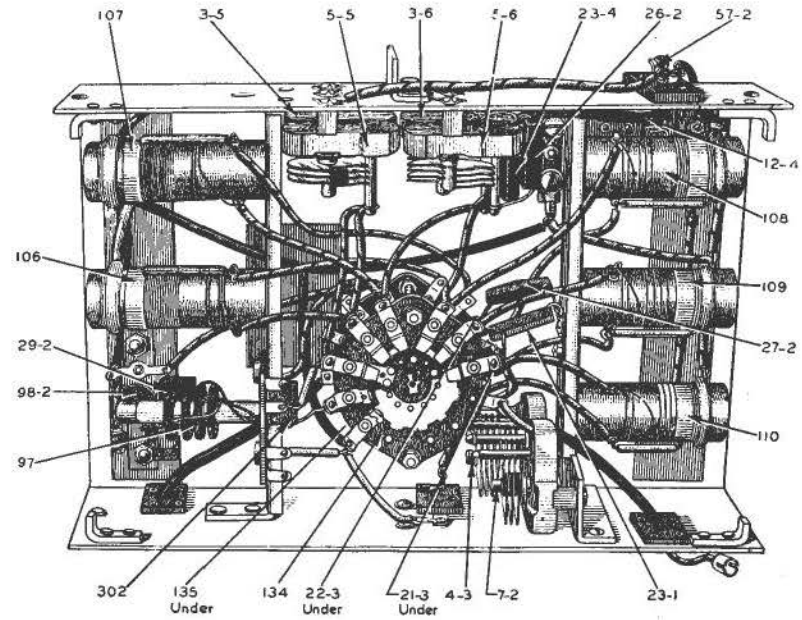


Figure 107. Liaison Receiver Detector Unit

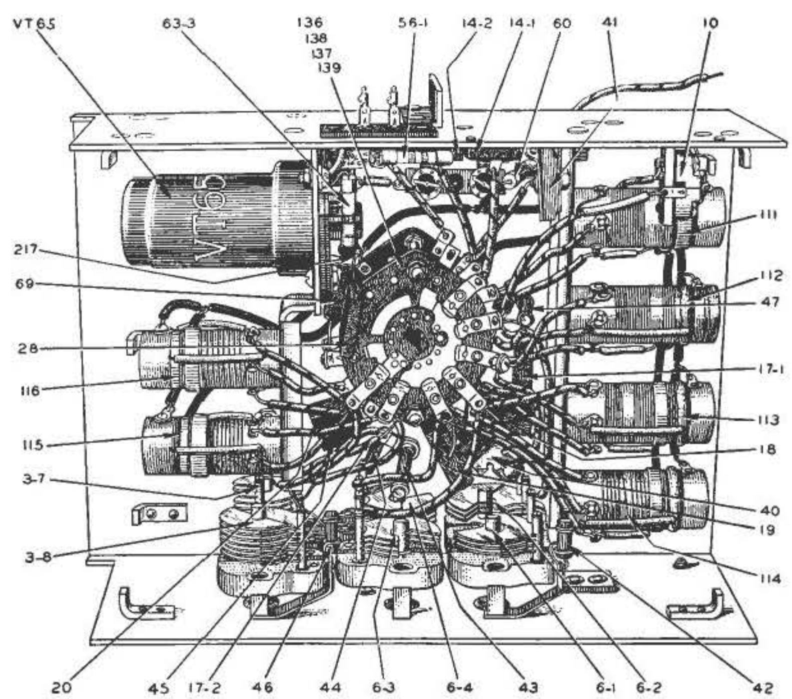


Figure 108. Liaison Receiver Oscillator Unit

Weak or No signals on all bands—Modulated reception.

Weak or No signals on any one band—Modulated reception.

Weak or No signals on all bands—C-W reception (Modulated reception normal).

Figure 113 graphically outlines the procedure for trouble location.

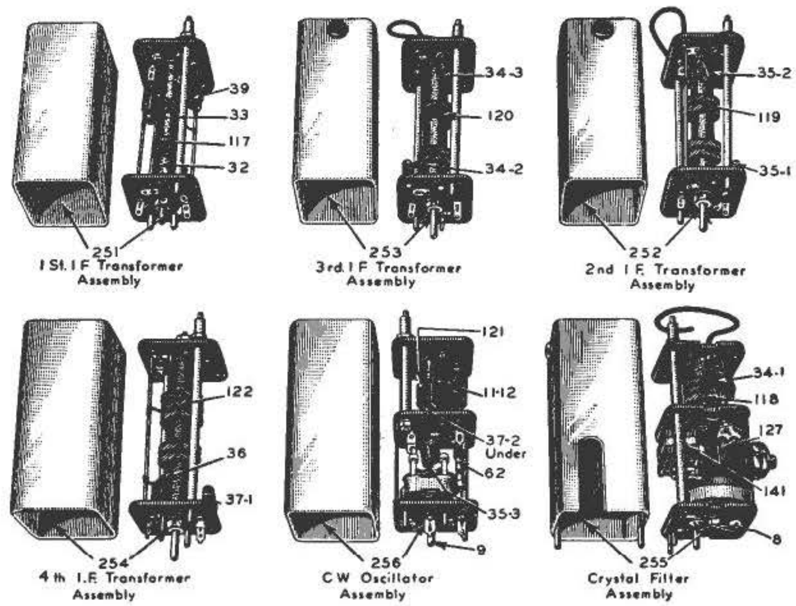


Figure 109. Liaison Receiver Coil Assemblies

Equipment Required—Few instruments other than those found in a standard set analyzer (Test Set I-56-A or equivalent) are required in locating the most probable troubles in this receiver. The individual instruments are as follows:

1. A modulated test oscillator (standard signal generator) with a frequency range from 150 to 18,000 KC with provision for calibration accuracy better than 0.1% at aligning frequencies.
2. *Voltmeter — 1,000 ohms per volt, ranges 0-10; 0-100; 0-250 volts.
3. *Continuity tester.
4. *Output meter rectifier type, 0-15 volt, 4,000 ohms.
5. Microammeter, 0-200.
6. Audio frequency oscillator.
7. Pair of telephone receivers.
8. An Adapter, FT-211 consisting of an 8 prong octal plug, and an 8-prong octal socket connected together by a short length of 8-conductor cable, to permit use of the Test Set I-56-A Analyzer on the r-f tubes on the tube shelf.

Weak or No Signals on All Bands, Modulated Reception

Check of Dynamotor Voltages—When all signals on all bands are weak or no signals are heard even when known to be present, the procedure follows that shown in the chart. The voltages checked at the dynamotor terminal board should closely approximate the values shown in Figure 112. Conditions for measurement are as follows: Input 28 volts; Crystal "Out"; "MVC"; Volume Max.; C-W Osc. "Off"; Load 4,000 ohms resistance. If these voltage readings do not approximate the values shown, the fuse should be checked as well as the dynamotor and filter circuits, wiring and components.

Tube Check—If the voltages at the dynamotor terminal board approximate the values given, proceed to check all tubes for emission and characteristics or replace all tubes with those of known average characteristics.

* Part of Test Set I-56-A.

Check of Socket Voltages—If tubes check satisfactorily, or if, after replacing with tubes known to be good, the sensitivity is still low, proceed to check all tube socket voltages. The average socket voltages are given in Figure 112.

Check Circuit Wiring and Components—If the tube socket voltages do not approximate the values shown in Figure 112, the associated circuits and components should be checked for grounds, shorts, and similar defects.

Test of Audio-Frequency Amplifier—Having checked all socket voltages and found the values to be correct, proceed to the test of the audio frequency amplifier. This can be checked by capacitively-coupling a 400-cycle voltage of approximately 2 volts R.M.S. from the detector diode socket prong to ground using a capacitor of .50 mfd. As an alternative, a modulated 9.5 KC signal of 2 volts may be coupled to this point and ground. Proper functioning of the audio amplifier will be indicated by an output well over 10 milliwatts for the 2 V. audio input or approximately 1 milliwatt output for 915 KC input. Circuits, wiring and components should be checked if this order of response is not obtained.

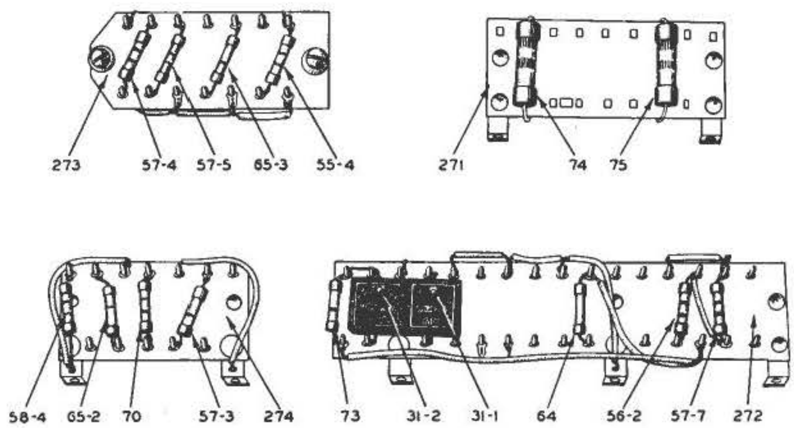


Figure 110. Liaison Receiver BC-348-H—Resistor Board Assemblies View A

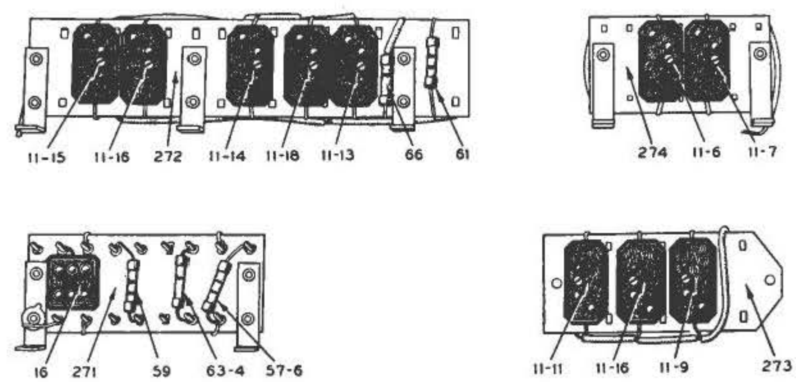


Figure 111. Liaison Receiver BC-348-H—Resistor Board Assemblies View B

Test of Intermediate-Frequency Amplifier—Following a satisfactory test of the audio amplifier, check the intermediate frequency amplifier by capacitively coupling the modulated test oscillator to the grid cap of the first detector tube and ground, through a 0.1 mfd. capacitor, the frequency of the test oscillator being adjusted to 915 KC. A rough check of the proper functioning of the IF amplifier is indicated by a comfortable headphone output level with low input from the test oscillator. (Approximately 30 microvolts input for 10 milliwatts output.)

IF Amplifier Circuit Check—If the IF amplifier does not respond as above or lacks sensitivity, a progressive check, stage by stage, should be made. The test oscillator, 915 KC modulated input, is connected through a 0.1 mfd. capacitor to the second detector diode socket prong and to ground. A signal response indicates proper functioning. Coupling the test oscillator to the grid of the third IF should indicate a decided gain in sensitivity.

Proceeding similarly towards the first detector, each stage should show a decided gain, and a faulty stage can be checked for grounds, shorts, or defective components.

Alignment of IF Amplifier—When all stages have been tested, the IF amplifier alignment is checked by capacitively coupling a low level input signal of 915 KC to the first detector grid and adjusting the IF tuning cores of both primary and secondary windings of the first, second, third, and fourth IF transformers and the tuned circuit of the crystal filter assembly for maximum output. The fourth IF transformer is slightly over-coupled with a resultant flat top.

Check and Alignment of CW Oscillator—The CW oscillator is checked and adjusted by coupling the 915 KC input (modulation off) to the grid of the first detector tube and then

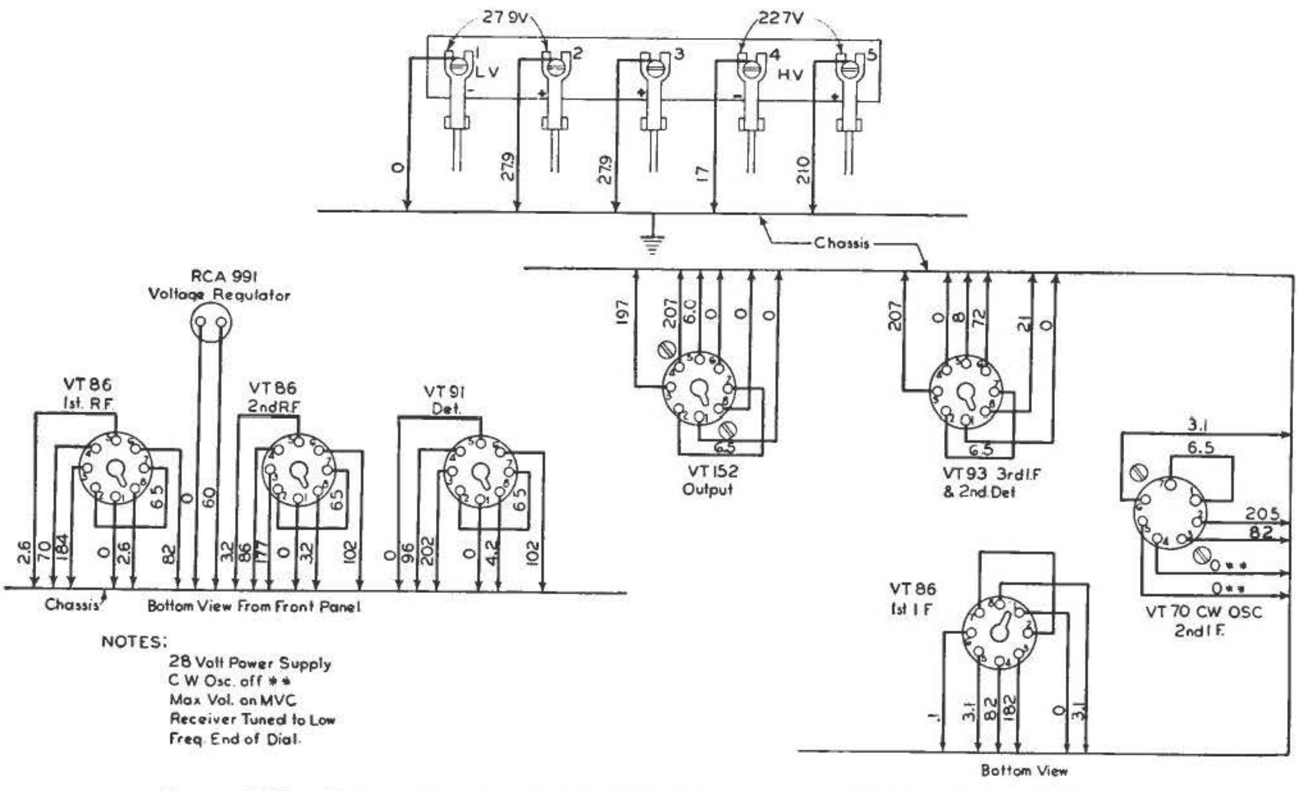


Figure 112. Liaison Receiver DC-348-H—Dynamotor and Tube Socket Voltages

switching the CW oscillator "ON." With the beat frequency control set at mid-position the oscillator inductance tuning core 121 of osc. assembly 256 Figure 119, is adjusted for zero beat. If no CW beat can be heard, the CW oscillator circuit should be checked for grounds, shorts, or defective components. With the CW oscillator "ON" the screen voltage at the first and second IF sockets drops to approximately 45 volts (measured to ground).

Test and Adjustment of Crystal Band Pass Filter—Normally the crystal band pass filter is adjusted at the factory for a band width of 1500 to 2,000 cycles at 10X down from resonance. This filter can be tested by applying an unmodulated signal of approximately 915 KC connected through a 0.1 mfd. capacitor to the grid of the first detector tube and ground. The CW oscillator should be off during this test. To adjust the band width of the crystal filter, a signal generator or microvolter having an expanded tuning scale in the vicinity of 915 KC and having also an attenuator with a multiplier of 10 times (20 db) is required. The following procedure is recommended: Connect a microammeter with a range of approximately 200 microamperes in series with a cathode return of the "AVC" volume control (79-B white lead). Throw the crystal switch to the "IN" position, and with the unmodulated 915 KC input from the test oscillator find the resonance peak of the crystal by slightly retuning the test oscillator until maximum deflection is indicated on the microammeter. The phasing control (8) Figure 109 is adjusted until the resonance curve as indicated on the microammeter is symmetrical and free from dips or peaks except for the main resonance peak of the crystal. The band width with an input voltage ratio of 10X is adjusted

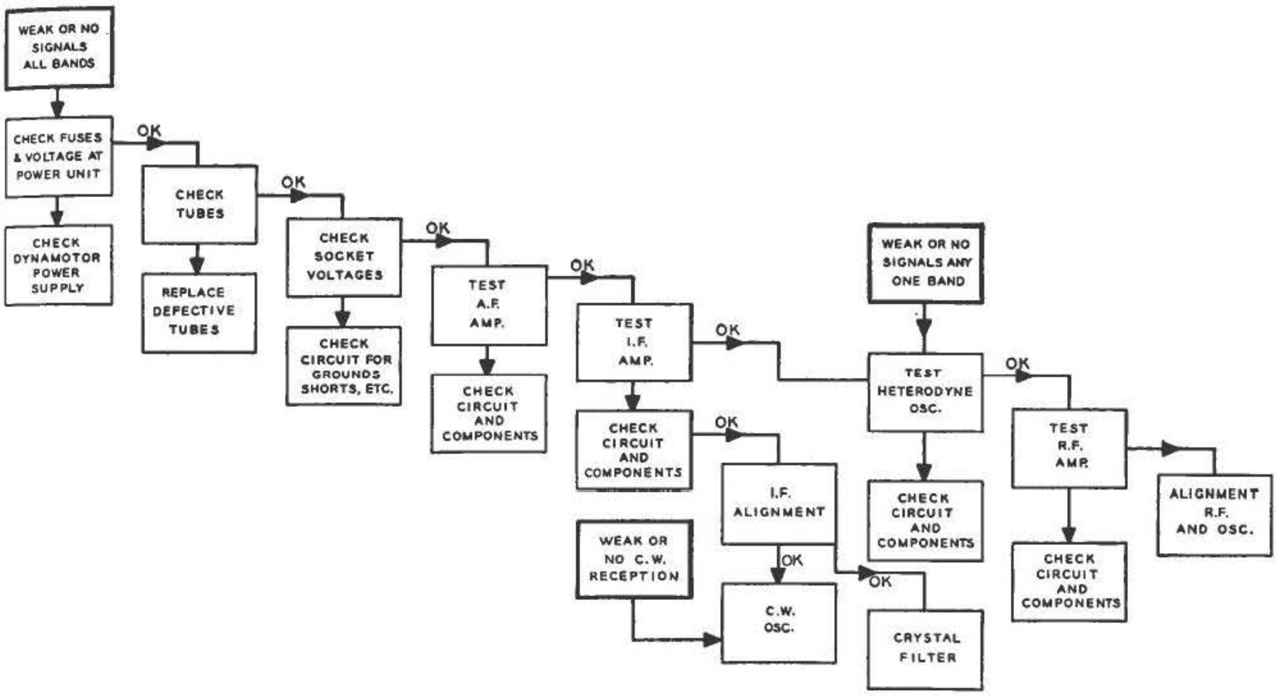


Figure 113. Liaison Receiver—Trouble Location and Correction Chart

to approximately 2 KC by slight realignment of the secondary (top) tuning core of the 1st IF Transformer (251) Figures 109 and 119. After concluding the above described tests, remove the microammeter and restore the circuit to normal.

Check of Heterodyne Oscillator—Having checked the functioning of the IF and audio amplifiers, if signals are not heard on any band, the heterodyne oscillator should be checked for oscillation. This can be done by observing the cathode voltages at the socket of the first detector Tube VT-91 (See Figure 119) when grounding the stator of the oscillator section I-D (See Figure 119) of the tuning capacitor. If no change in voltage is noted with this test, the oscillator circuit should be checked for grounds, shorts, or defective components.

Test of the RF Amplifier—Having completed the test and alignment of the audio amplifier, IF amplifier and heterodyne oscillator, the RF amplifier is tested as follows:

With the band switch set on the band lacking sensitivity, a modulated signal from the test oscillator is capacitively coupled through a 100 mmf. dummy antenna to the antenna

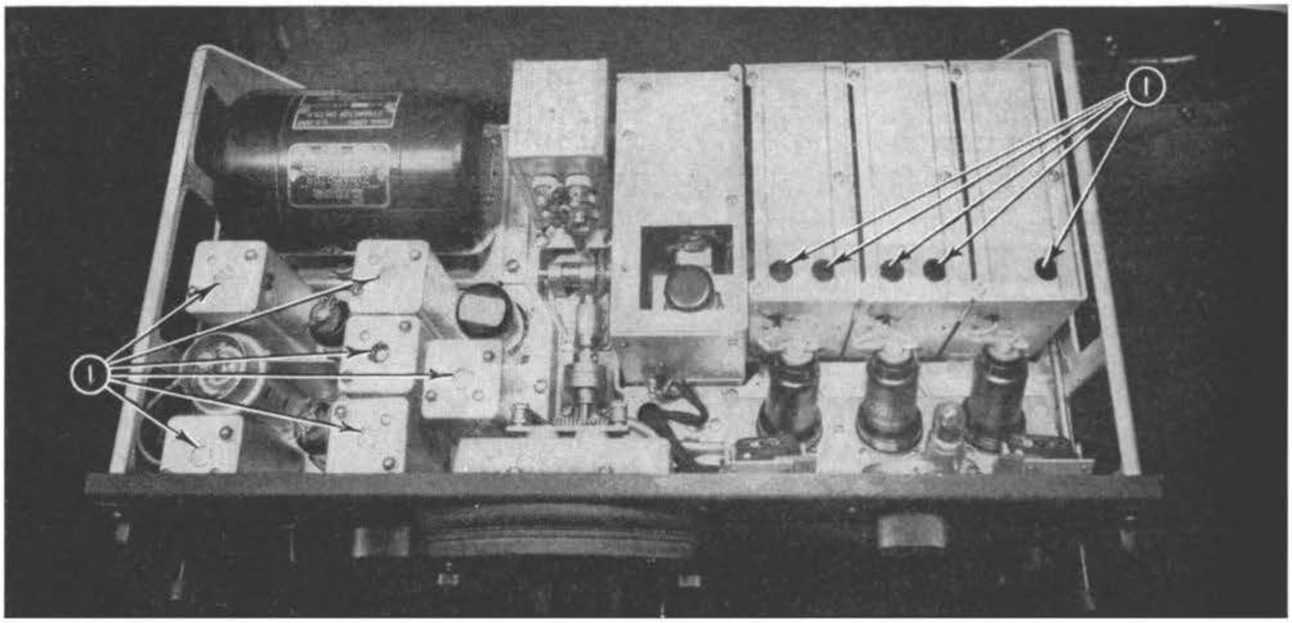


Figure 114. Liaison Receiver—Top View—Case Removed

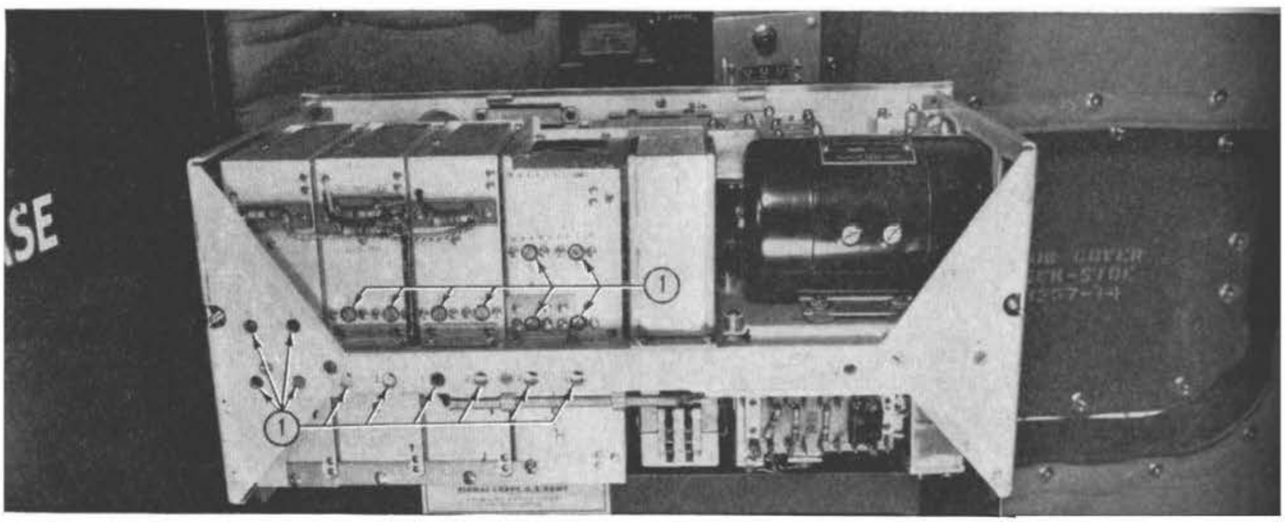


Figure 115. Liaison Receiver—Rear View—Case Removed

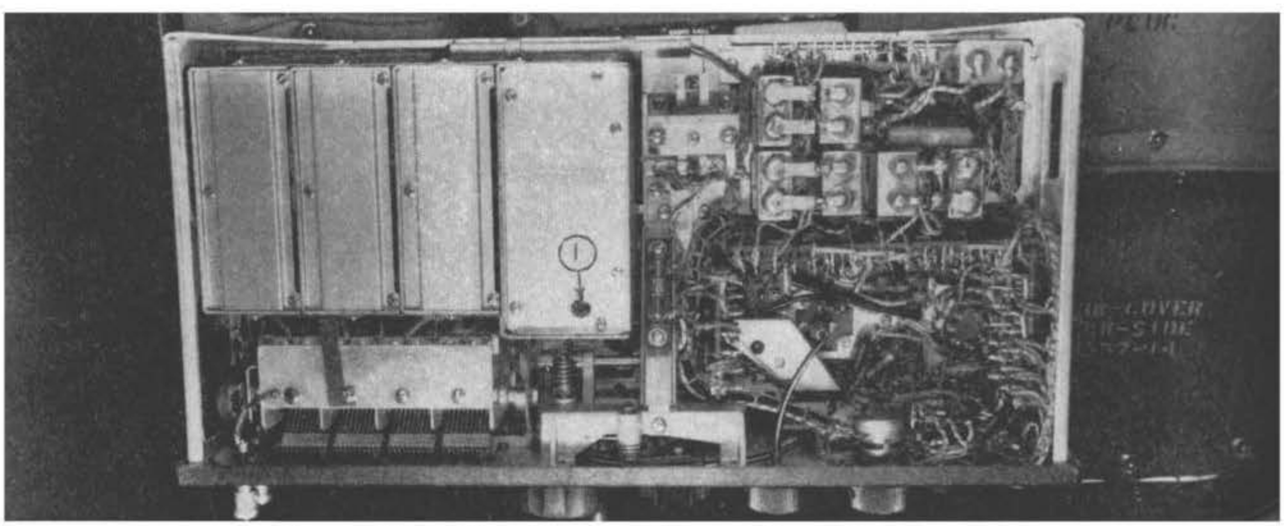


Figure 116. Liaison Receiver—Bottom View—Case Removed

post and to ground. This input signal frequency should be set quite accurately to the alignment frequency shown in the "Table of Alignment Data" for the band under test. With the tuning control set for the approximate alignment frequency, tune slowly around this point until the maximum response with the least signal input is obtained. Capacitively coupling the test oscillator to the grid of the first RF and second RF tubes should show a progressive decrease in output indicating the proper functioning of the particular RF stage or circuits preceding. If a decrease in response is noted when the signal input is capacitively coupled progressively from the grid of the first detector to the second and first RF grid caps and finally to the antenna post (with the 100 mmf. dummy antenna capacitor), the stage which indicates a decrease in response should be checked for circuit, ground, shorts, or defective components.

Alignment of RF Amplifier—

NOTE: For a general alignment start with the 200-500 KC Band No. 1.

In the RF alignment for any particular band the tuning control is adjusted for the alignment frequency (Table of Alignment Data) and the modulated test signal at this alignment frequency is coupled from the test oscillator to antenna post through the 100 mmf. dummy antenna. The three RF trimmers (Ant.; RF; and Det.) for this band are then adjusted for maximum output. A similar procedure is followed in the alignment of each band.

Alignment of Heterodyne Oscillator.

NOTE: For a general alignment start with the 200-500 KC Band No. 1.

The alignment of the Heterodyne Oscillator is necessary only when the tuning dial frequency calibration is in error by more than 0.5 per cent. To align the oscillator follow the same general procedure as was followed for the alignment of the RF amplifier. With the Band Switch on Band No. 1 (200-500 KC) and the Tuning Control set to the alignment frequency, couple the output of the modulated test oscillator (set at the alignment frequency) to the antenna post through the 100 mmf. dummy antenna. The oscillator trimmer for this band is adjusted for maximum audio output. Note that in Band No. 1 there are two such adjustments, one at the low frequency and the other at the high frequency end of the dial. A similar procedure is followed in the alignment of each band.

Weak or No Signals on Any One Band, Modulated Reception—The condition of satisfactory reception on several bands and weak or no signals on one or more bands, indicates the correct functioning of the IF and AF amplifiers and requires checking only the RF amplifier and heterodyne oscillator for the defective band or bands. The procedure outlined above should be followed for the defective band or bands.

Weak or No Signals on All Bands, CW Reception (Modulated Reception Normal)—Weak or no signals on all bands for CW reception with satisfactory modulated signal reception requires testing and alignment of the CW oscillator. Proceed as outlined in paragraphs "Alignment of IF Amplifier" and "Check and Alignment of CW Oscillator."

NOTE: Trimmer adjustments for Antenna, RF, Det. & Osc. can be readily located by reference to Figures 114, 115, and 116 in which item (1) is used as reference for these trimmers.

BLOCK TERMINAL VOLTAGE AND CURRENT VALUES

Test	Tube	Function	Block Terminal Number to	Analyzer Jacks
Plate Voltage	VT-86 VT-91 VT-93 VT-65 VT-152	RF & IF Ampl. 1st Det. 3rd IF RF Osc. Output	3 gnd	250 V ± V
	VT-70	2nd IF	2 gnd	250 V ± V
Screen Voltage	VT-86 VT-91 VT-152	RF & IF Ampl. 1st Det. Output	4 gnd	250 V ± V
	VT-71	2nd IF CW-osc.	3 gnd	250 V ± V
	VT-93	3rd IF	6 gnd	250 V ± V
Cathode Voltage	VT-86 VT-91 VT-65 VT-152	RF & IF Ampl. 1st Det. RF Osc. Output	8 gnd	10 V ± V
	VT-72	2nd IF CW-Osc.	6 gnd	10 V ± V
	VT-93	3rd IF, 2nd Det.	8 gnd	25 V ± V
Heater Voltage	VT-65 VT-86 VT-91 VT-93	RF Osc. 1st RF, 2nd RF 1st Det. 3rd IF	7 2	10 V ± V
	VT-86	1st IF	2 7	10 V ± V
	VT-70	2nd IF	1 7	10 V ± V
	VT-152	Output	7 2	10 V ± V
Triode Voltage	VT-70	CW Osc.	4 gnd	250 V ± V
Diode Voltage	VT-93	2nd Det.	5 gnd	100 V ± V
Plate Current	VT-86 VT-91 VT-65 VT-93	RF & IF Ampl. 1st Det. RF Osc. 3rd IF, 2nd Det.	3 Outside 3 Inside	10 ma. – ma.
	VT-152	Output	3 Outside 3 Inside	25 ma. – ma.
	VT-70	2nd IF CW-Osc.	2 Outside 2 Inside	5 ma. – ma.

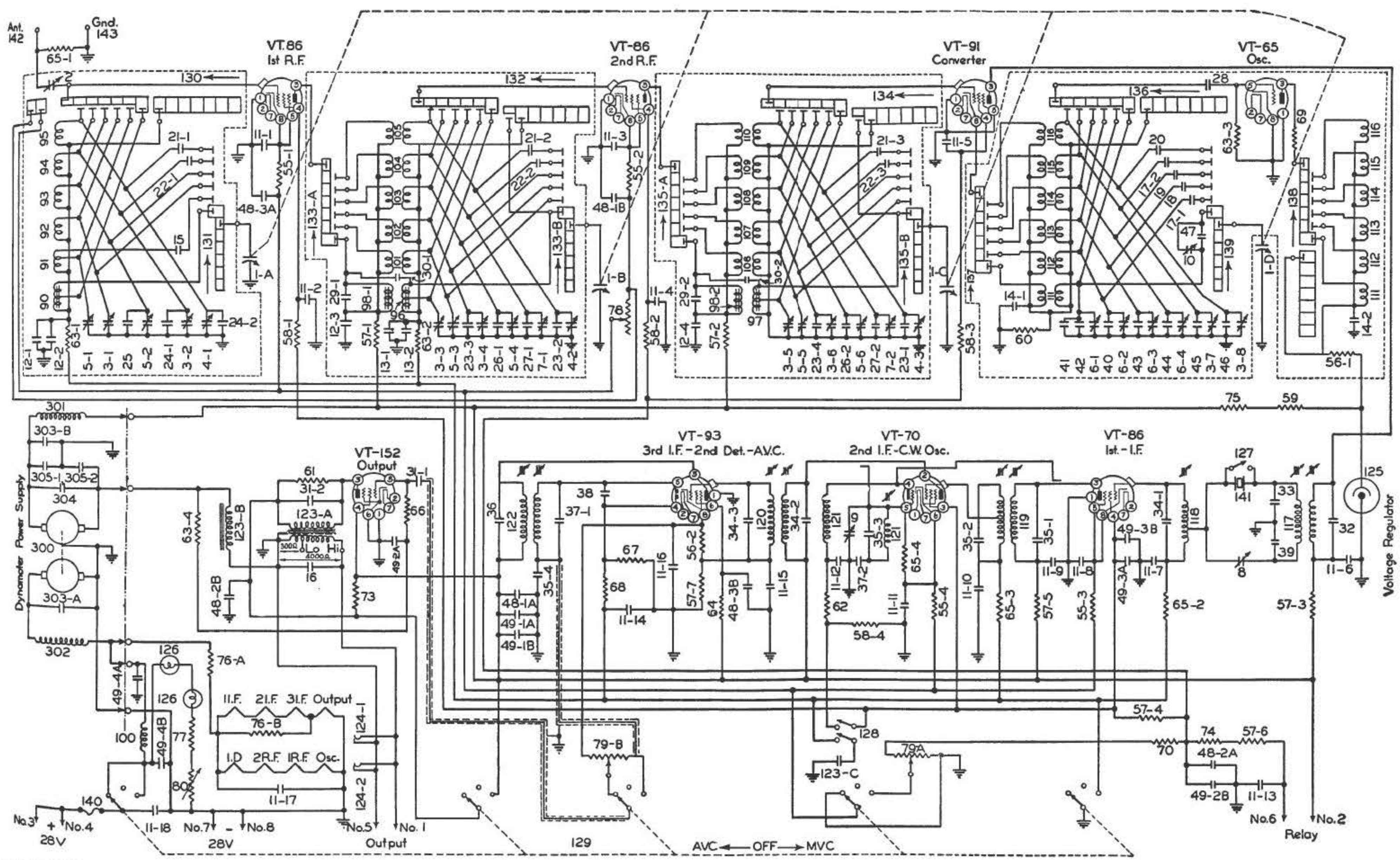


Figure 117. Radio Receiver BC-348-H: Schematic Circuit Diagram

Test	Tube	Function	Block Terminal Number to	Analyzer Jacks
Screen Current	VT-86 VT-91 VT-152	RF & IF Ampl. 1st Det. Output	 4 Outside 4 Inside	 5 ma. – ma.
	VT-70	2nd IF CW-Osc.	3 Outside 3 Inside	5 ma. – ma.
	VT-93	3rd IF, 2nd Det.	6 Outside 6 Inside	1 ma. – ma.

Measurements with Test Set I-56-A

GENERAL—The readings given in the Table of Alignment Data on Page 141 are typical values obtained on the Weston Model 665-2 Selective Analyzer (Test Set I-56-A). If all plugs seem to be securely in position with the dynamotor running and faulty or poor operation is obtained from the receiver, a careful check should first be made of the cables and plugs using the Model 564 Volt-Ohmmeter as outlined under "Detailed Tests on Radio Sets," of the Instruction Book for Test Set I-56-A. If all plug-in cable connections seem to be functioning properly, a test should be made of the tubes in the receiver, using the Model 685 tube tester as outlined in the paragraphs mentioned above. Should neither of these tests locate the difficulty, voltage and current or resistance measurements should be made as outlined in the following paragraphs:

Voltage and Current Measurements—Set up the receiver and a Model 665 Analyzer for operation as outlined under general voltage and current measurements. To obtain the

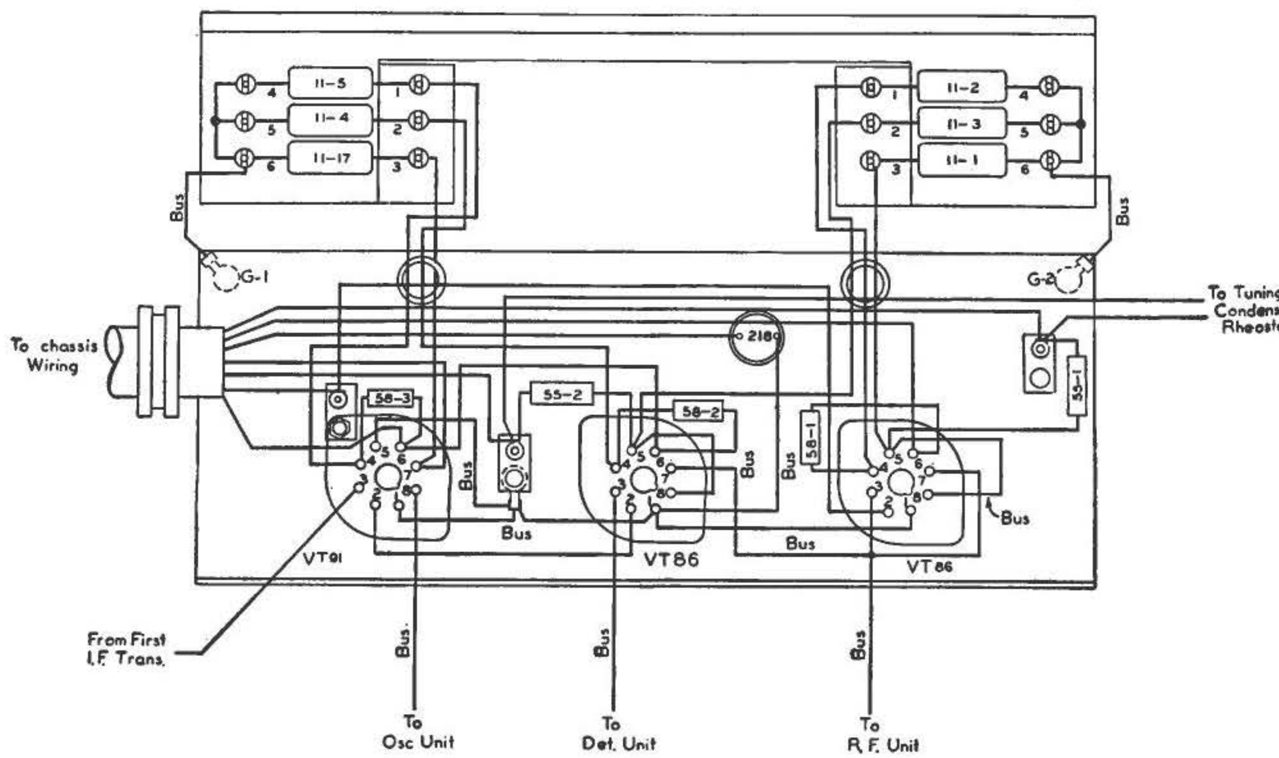


Figure 118. Radio Receiver BC-348-H: Wiring Diagram of Tube Shelf

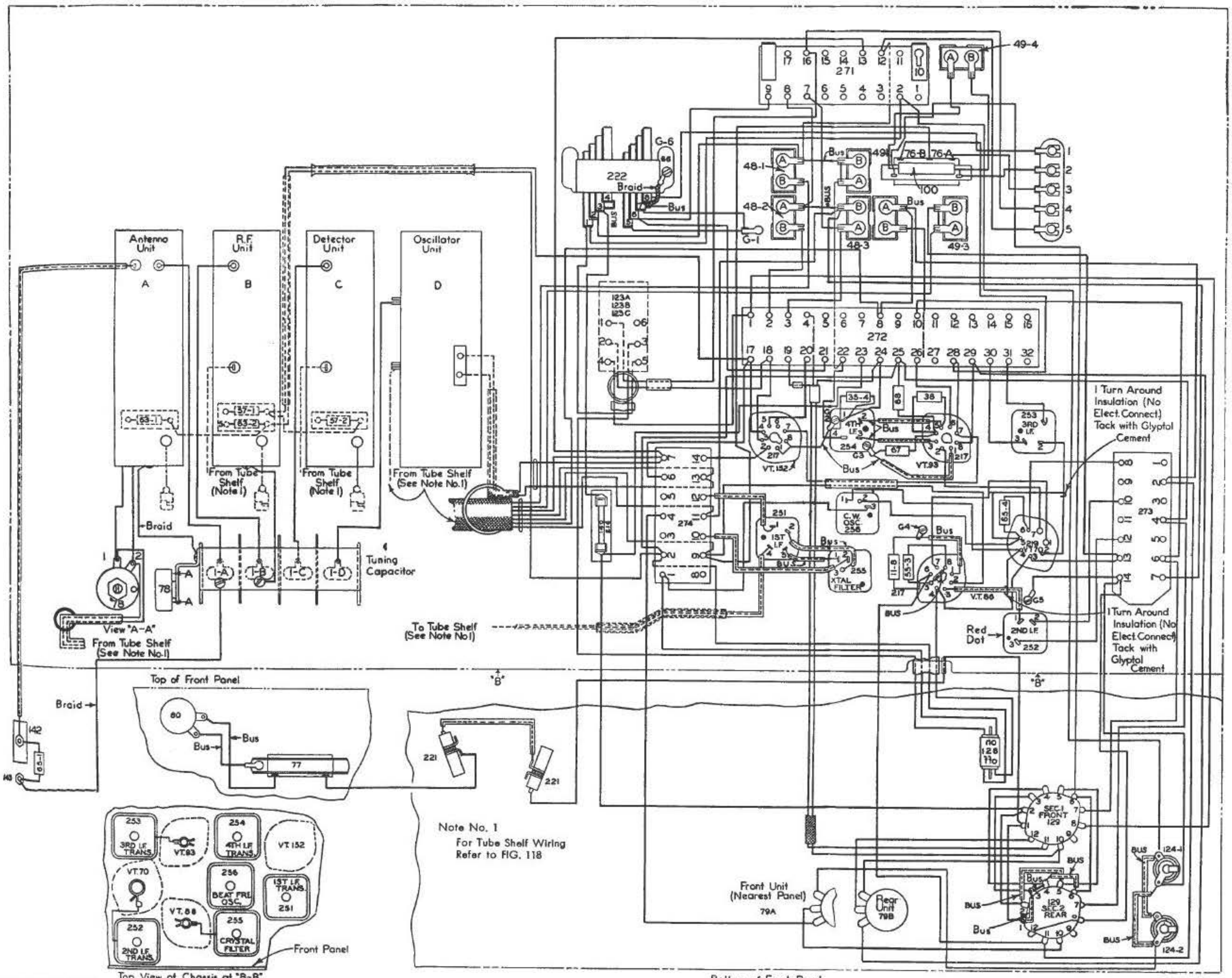


Figure 119. Radio Receiver BC-348-H: Wiring Diagram

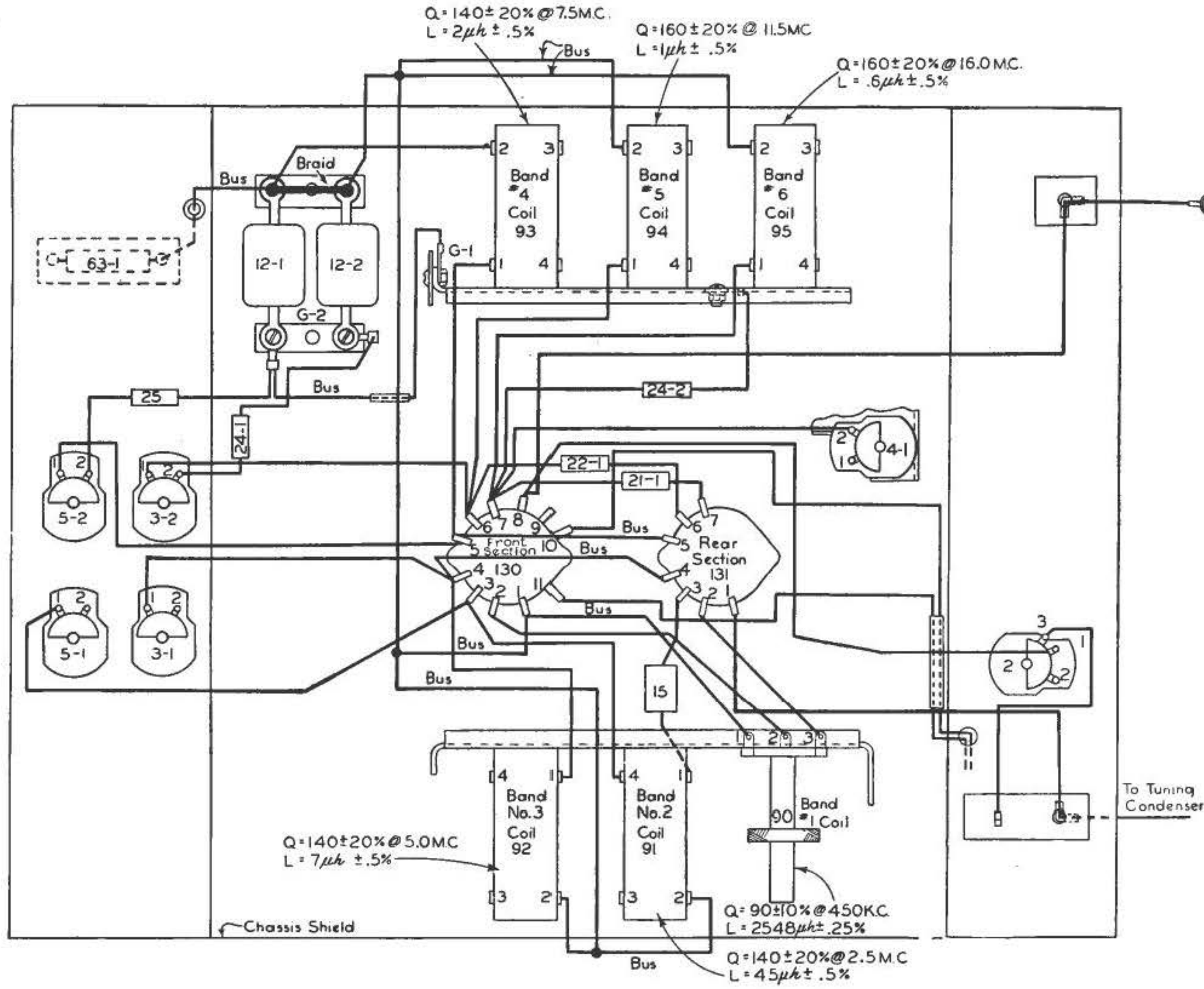


Figure 120. Radio Receiver BC-348-H: Wiring Diagram of Antenna Unit

various readings, connect the jumper leads from the socket selector block to the analyzer pin jacks in accord with the instructions given below.

Procedure:

1. Release the thumb screws and pull the complete chassis out of the case.
2. Power connections should be made to the plug socket at the rear of the receiver chassis.
3. Be sure the plug and tube top grid connections are secure when taking readings.
4. Keep the analyzer "AC-DC" switch on "DC."
5. Place the analyzer left-hand toggle switch in the "VOLTS-MA" position.
6. Connect the short jumper cables for the various tests as indicated in the table below.
7. Connect jumper cable from black terminal "GND" to receiver chassis.
8. Set the receiver control switch on the "MVC" position unless otherwise specified.
9. Set the receiver with the volume control at the maximum position (extreme clockwise).

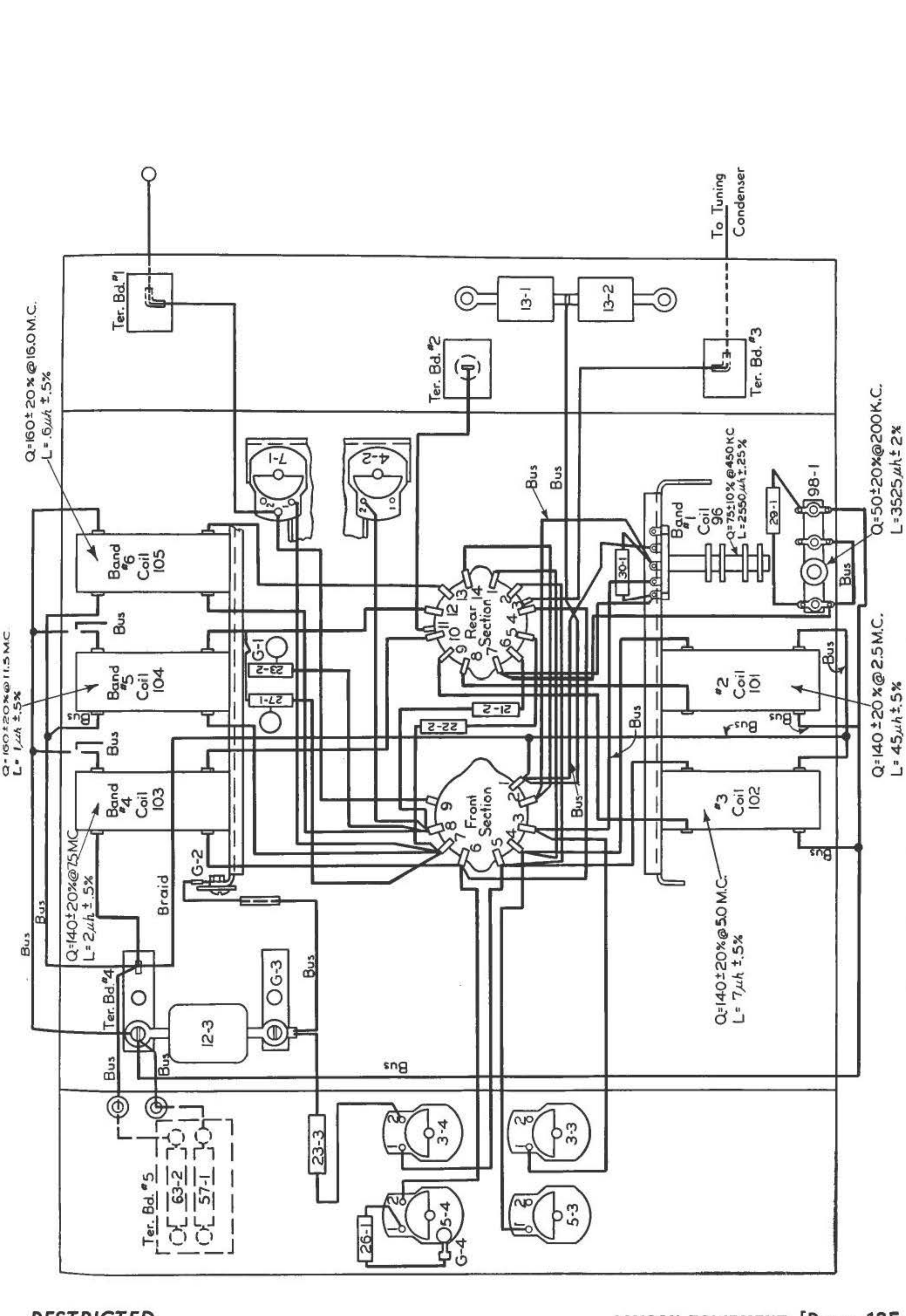


Figure 121. Radio Receiver BC-348-H: Wiring Diagram of R-F Unit

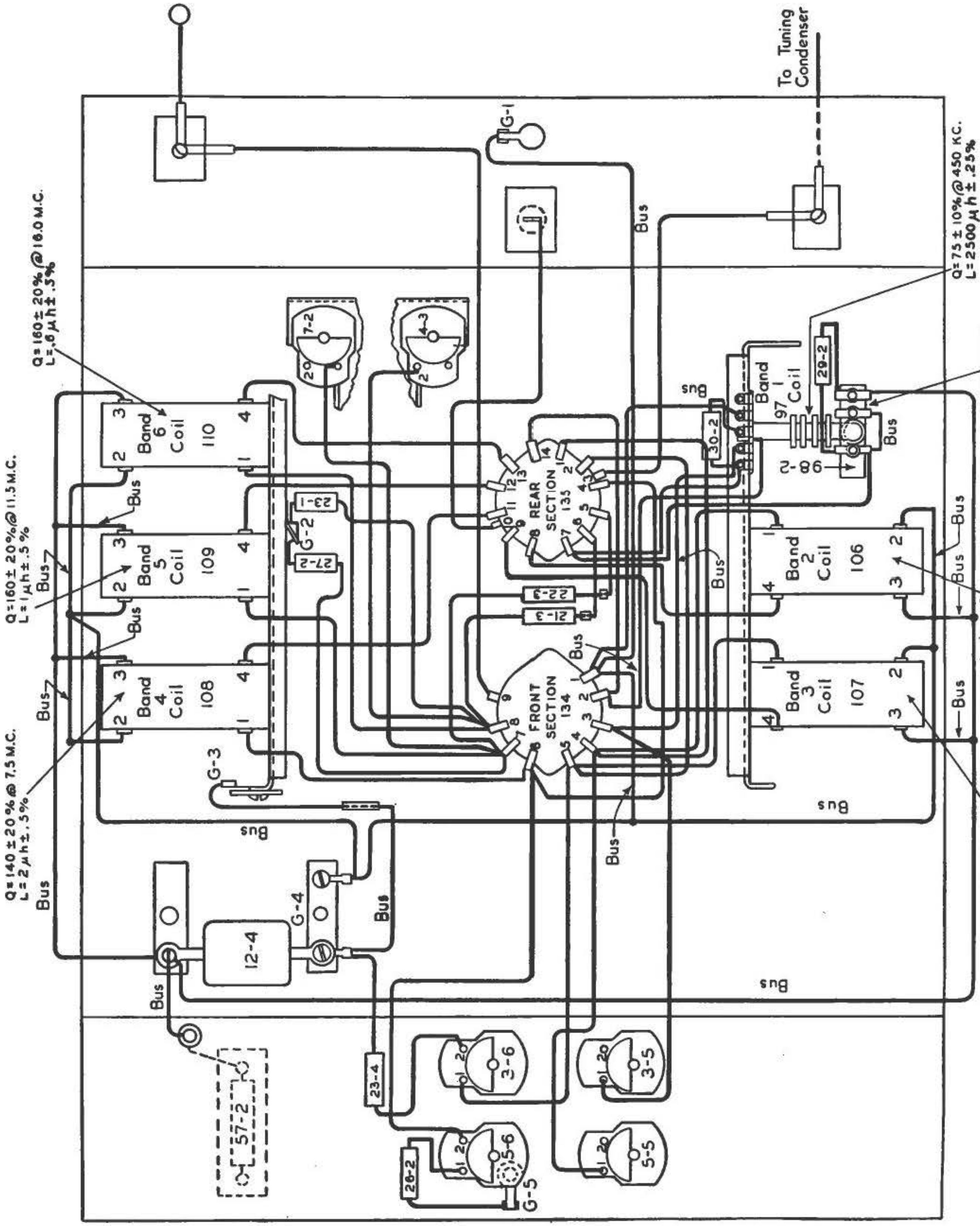


Figure 122. Radio Receiver BC-348-H: Wiring Diagram of Receiver Unit

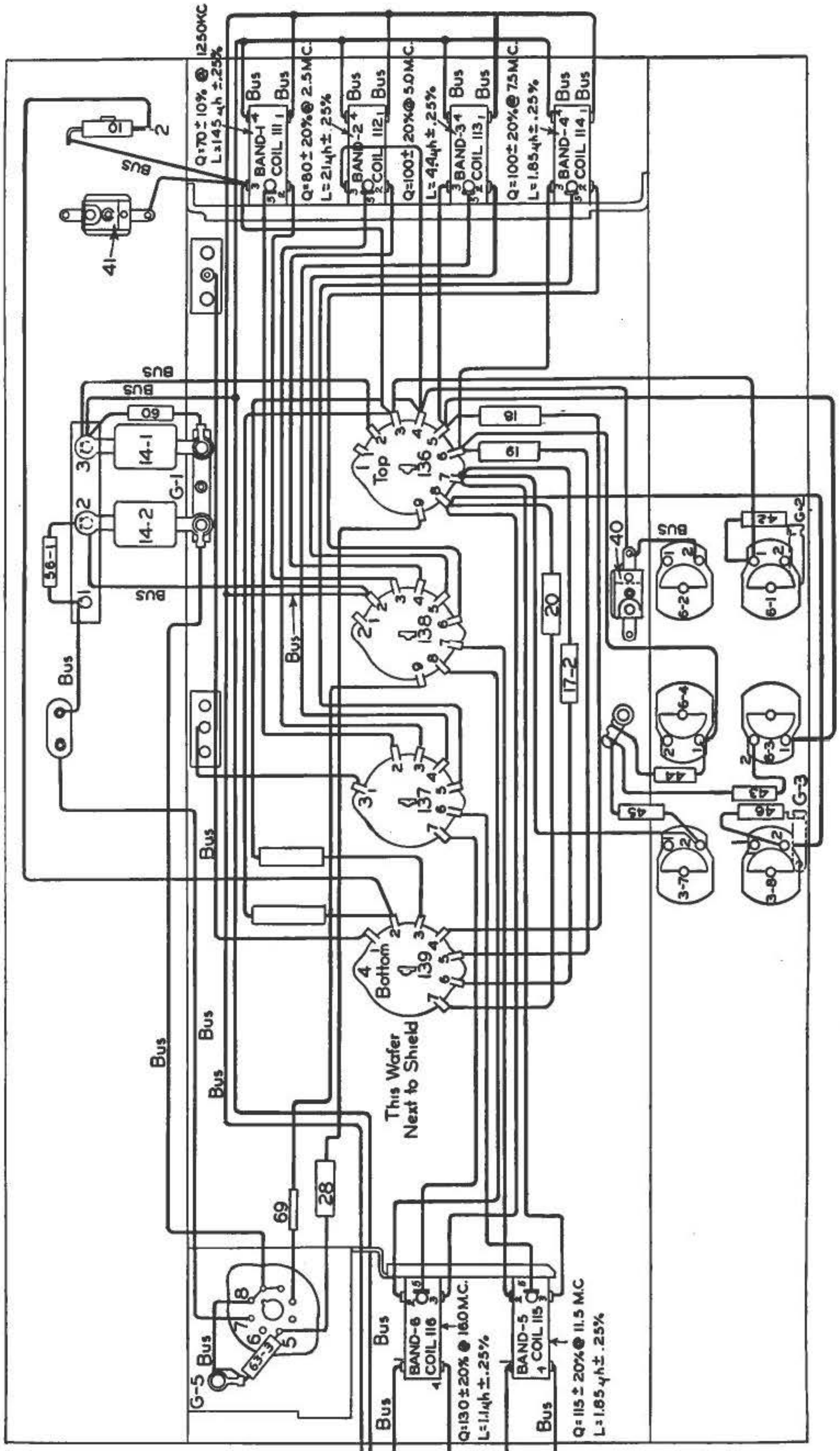


Figure 123. Radio Receiver BC-348-H: Wiring Diagram of Oscillator Unit

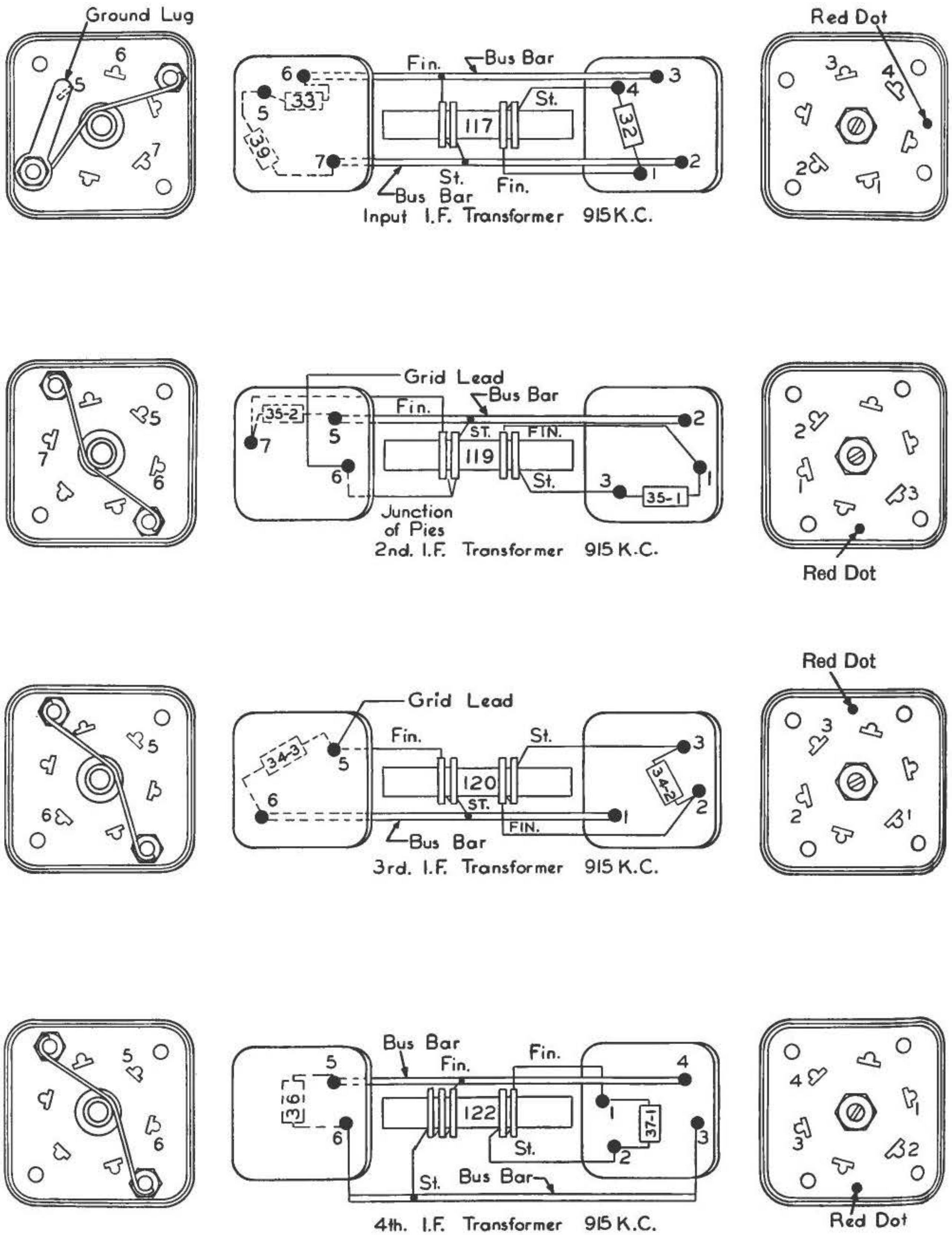


Figure 124. Radio Receiver BC-348-H: Wiring Diagram of I-F Transformers

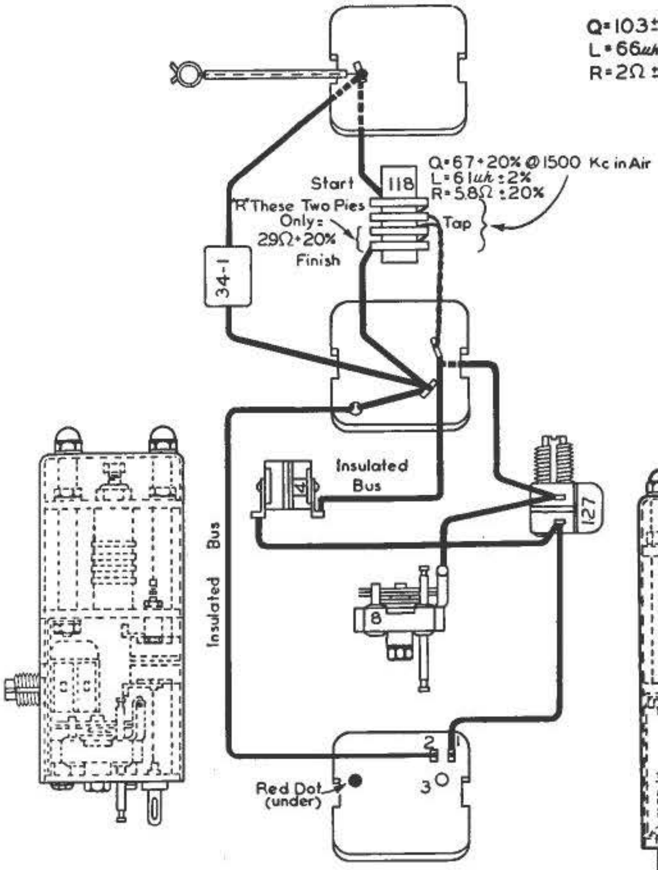


Figure 125. Radio Receiver BC-348-H: Wiring Diagram of Crystal Filter Unit

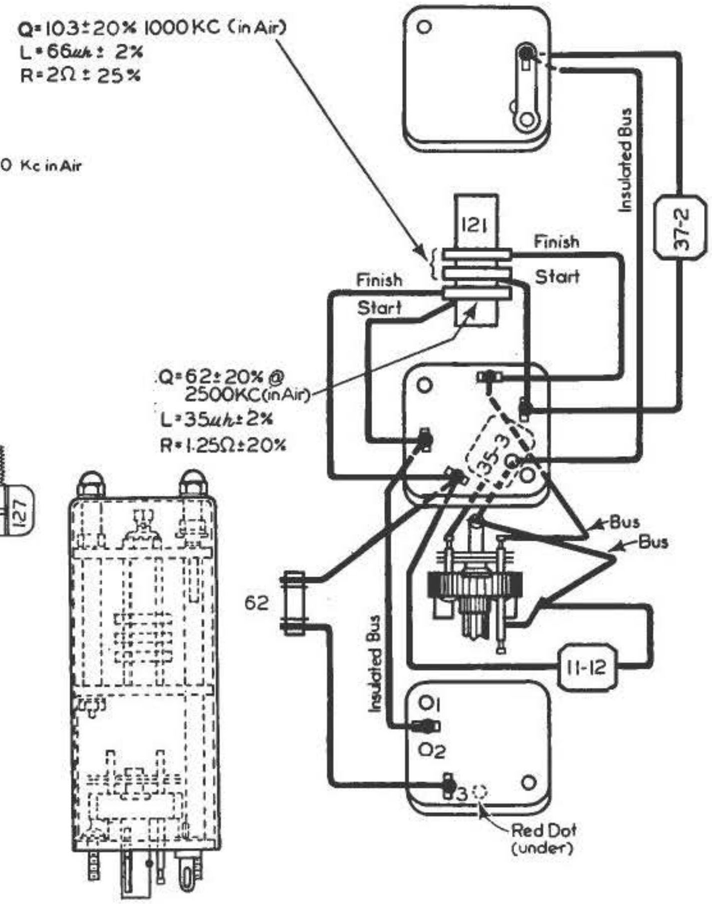


Figure 126. Radio Receiver BC-348-H: Wiring Beat Frequency Oscillator

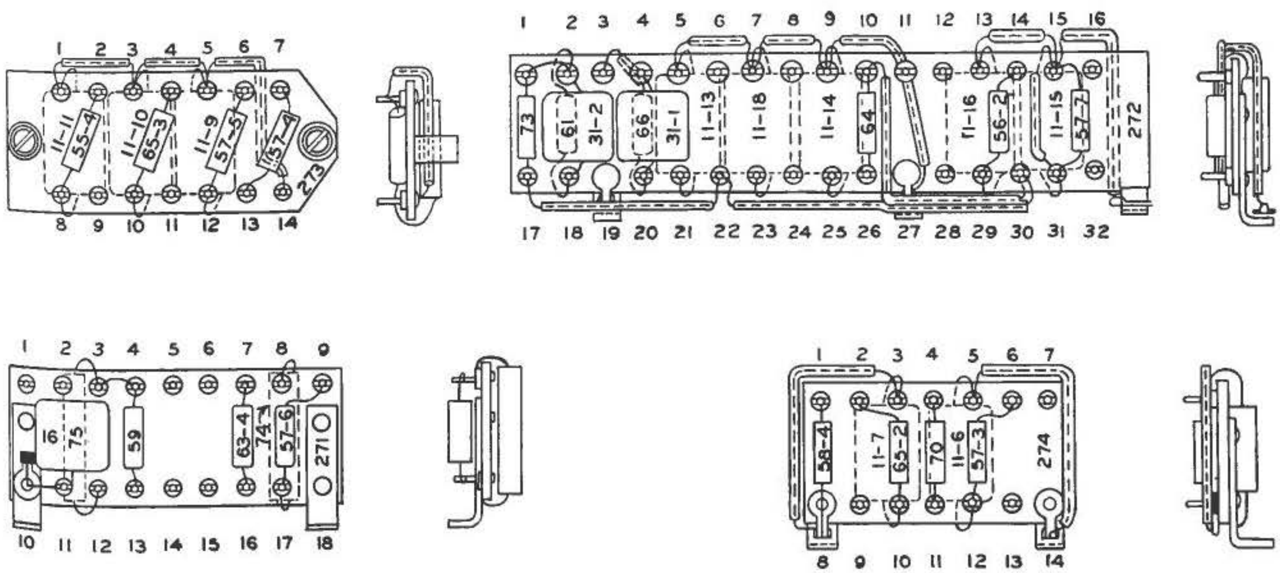


Figure 127. Radio Receiver BC-348-H: Wiring Beat Resistor Boards

10. Set the tuning control to 200 kc. (L-F end of Band 1); readings should deviate but slightly when switching to other bands with the tuning control remaining at the low frequency end of each band.

11. The CW oscillator should be "OFF" for the readings in Table A, page 141, and "ON" for the readings in Table B, page 142.

Resistance and Continuity Measurements—Remove the chassis from the cabinet and do not make any connections to the plug socket at the rear of the chassis. This procedure permits the operation of all switches without running the dynamotor and causing voltages to be built up across the various resistors and condensers. Any voltages set up by the dynamotor in the receiver would cause serious errors in reading on the ohmmeter ranges or might possibly damage the test instruments.

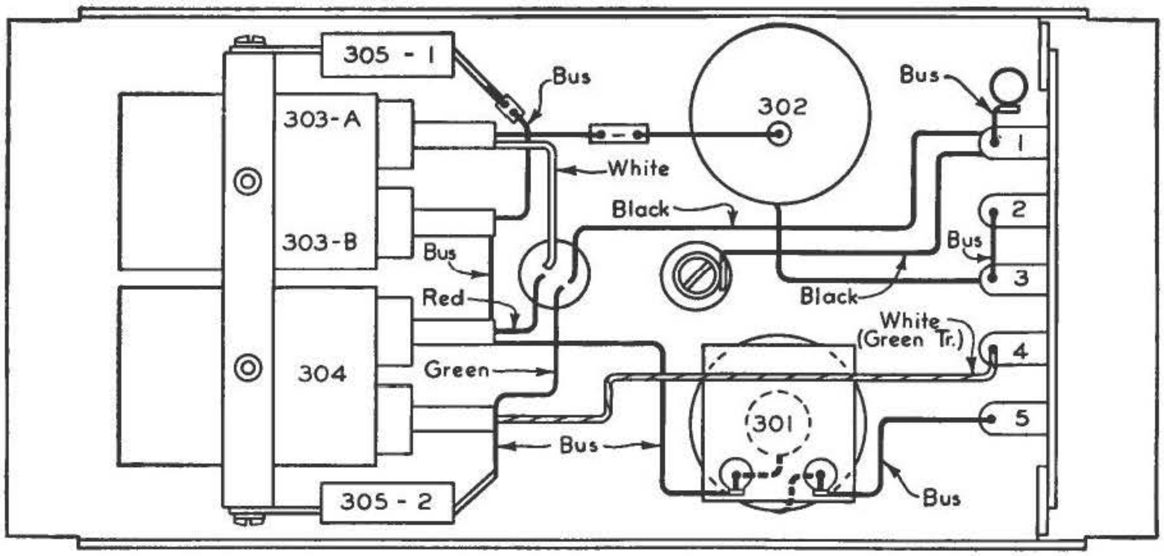


Figure 128. Radio Receiver BC-348-H: Wiring Beat Dynamotor Assembly

Procedure:

1. Set the receiver control switch to "MVC" unless otherwise specified.
2. Set the receiver with the volume control at the maximum position (extreme clockwise).
3. Set the tuning control of 200 kc. (L-F end of Band 1); readings should not deviate when switching to other bands with the tuning control remaining at the low-frequency end of each band.
4. The CW oscillator should be "OFF" for the readings in Table C and "ON" for the readings in Table D.
5. Shift the analyzer left-hand toggle switch to the ohms position.

Set up the Model 665 Analyzer for resistance and continuity measurements as outlined under "General Resistance and Continuity Tests" in the Test Set instruction book. Before taking a resistance reading on any range, short the two jumper leads plugged into the ohmmeter pin jacks and rotate the "battery adjustment" knob until the instrument pointer reads exactly full scale. Should it be found impossible to bring the pointer up to the top mark refer to the paragraphs on battery replacement under the heading "Maintenance" in the Test Set instruction book. Plug the pin tip end of the 3 foot clip lead into the block hole marked "GND" and clip the other end to the chassis. Connect one of the jumper leads between the remaining ground jack and one of the ohmmeter jacks on the required range. Connect the other jumper lead from the remaining ohmmeter range jack to the tube element under test. In general, ohmmeter readings will be most accurate when taken on the upper ⅔ of the scale, and, wherever possible, the range should be chosen that will give indications in this area.

Failure of Dial Lights—The two dial lamps are connected in series; hence the failure of either lamp does not indicate failure of both lamps. Removal of the dial light housing gives ready access to the lamps.

TABLE OF ALIGNMENT DATA

Band No.	Freq. Range Freq. Range	Alignment Frequency	Osc.	Trimmers* Det.	R.F.	Ant.
1	200-500 kc.	500 kc.	6-1	3-5	3-3	2**
		200 kc.	10			
2	1.5- 3.5 mc.	3.5 mc.	6-2	5-5	5-3	5-1
3	3.5- 6.0 mc.	6.0 mc.	6-3	3-6	3-4	3-1
4	6.0- 9.5 mc.	9.5 mc.	6-4	5-6	5-4	5-2
5	9.5-13.5 mc.	13.5 mc.	3-7	7-2	7-1	3-2
6	13.5-18.0 mc.	18.0 mc.	3-8	4-3	4-2	4-1

*Refer to Schematic Diagram and marked photographs for location. The alignment controls for the various bands are numbered on the chassis adjacent to the control. Controls for Band 1 are marked 1, those for 2 are marked 2, etc.

**Antenna alignment control.

NOTE: The readings given below are average values taken on receivers of this type using a 28 volt power supply. Meter indications within ± 10% of these values will in most cases indicate correct operations. The readings are taken with the tuning control set to the L-F end of the dial.

TABLE A. CW OSC. "OFF"

Stage	Tube	Plate Volts	Screen Volts	Cathode Volts	Heater Volts	M.A. Plate Current	M.A. Screen Current
1 RF.	VT-86	184	70	2.6	6.3	4.1	1.0
2 RF.	VT-86	177	86	3.2	6.3	4.8	1.3
1 Det.	VT-91	202	96	4.2	6.3	0.23	0.08
Osc.	VT-65	58	....	0.0	6.3	1.6	....
1 IF.	VT-86	182	82	3.1	6.5	4.7	1.2
2 IF.	VT-70	207	82	3.1	6.5	4.5	1.4
3 IF.	VT-93	207	72	21.0	6.5	2.5	0.6
Output	VT-152	197	207	0.0	6.5	18.0	3.2
2 Det.	VT-93 Diode	8.0					

TABLE B. CW OSC. "ON"

Stage	Tube	Plate Volts	Screen Volts	Cathode Volts	Heater Volts	M.A. Plate Current	M.A. Screen Current
1 RF.	VT-86	197	37	1.3	6.3	2.0	0.55
2 RF.	VT-86	188	65	2.3	6.3	3.7	1.0
1 Det.	VT-91	204	72	3.4	6.3	0.17	0.06
Osc.	VT-65	58	....	0.0	6.3	1.6	....
1 IF.	VT-86	195	44	1.6	6.5	2.3	0.5
2 IF.	VT-70	210	44	1.6	6.5	2.2	0.5
3 IF.	VT-93	210	72	21.0	6.5	2.5	0.6
Output	VT-152	198	210	0.0	6.5	23.5	3.6
CW Osc.	VT-70 Triode	18.0					

RESISTANCE TO GROUND (OHMS)

TABLE C. CW OSC. "OFF"

Stage	Tube	Cathode	Plate	Screen	"MVC" Grid	"MCV" Grid
1 RF.	VT-86	490	5,200	80,000	100,000	1.8 meg.
2 RF.	VT-86	480	5,200	75,000	100,000	1.8 meg.
1 Det.	VT-91	15,000	5,600	75,000	0	0
Osc.	VT-65	0	41,000	......	100,000	100,000
1 IF.	VT-86	520	5,600	70,000	500,000	1.8 meg.
2 IF.	VT-70	470	500	70,000	500,000	2.25 meg.
3 IF.	VT-93	6,200	500	180,000	5,000	5,000
Output	VT-152	0	1,080	480	700,000	....

TABLE D. CW OSC. "ON"

1 RF.	VT-86	490	5,200	20,000	100,000	1.8 meg.
2 RF.	VT-86	480	5,200	23,000	100,000	1.8 meg.
1 Det.	VT-91	15,000	5,600	23,000	0	0
Osc.	VT-65	0	41,000	......	100,000	100,000
1 IF.	VT-86	520	5,600	9,200	500,000	1.8 meg.
2 IF.	VT-70	470	500	9,200	500,000	2.25 meg.
3 IF.	VT-93	6,200	500	180,000	5,000	5,000
Output	VT-152	0	1,080	480	700,000	....
CW Osc.	VT-70	......	82,000	......	500,000	....
Det. Diode	VT-93	......	180,000	......	....	....
AVC Diode	VT-93	......	380,000	......	....	....

TABLE OF REPLACEABLE PARTS—BC-348-H

Name of Part	Ref. No.	Description	Function
Capacitor	1-A 1-B 1-C 1-D	A Section, 16 to 241 mmfd. B Section, 16 to 241 mmfd. C Section, 16 to 241 mmfd. D Section, 16 to 241 mmfd.	Main Tuning
Capacitor	2	Air Trimmer 75 mmfd. max.	Ant. Aligning
Capacitor	3-1	Air Trimmer 50 mmfd. max.	Ant. Trimmer
Capacitor	3-2	Air Trimmer 50 mmfd. max.	Ant. Trimmer
Capacitor	3-3	Air Trimmer 50 mmfd. max.	R.F. Trimmer
Capacitor	3-4	Air Trimmer 50 mmfd. max.	R.F. Trimmer
Capacitor	3-5	Air Trimmer 50 mmfd. max.	Det. Trimmer
Capacitor	3-6	Air Trimmer 50 mmfd. max.	Det. Trimmer
Capacitor	3-7	Air Trimmer 50 mmfd. max.	Osc. Trimmer
Capacitor	3-8	Air Trimmer 50 mmfd. max.	Osc. Trimmer
Capacitor	4-1	Air Trimmer 50 mmfd. max.	Ant. Trimmer
Capacitor	4-2	Air Trimmer 50 mmfd. max.	R.F. Trimmer
Capacitor	4-3	Air Trimmer 50 mmfd. max.	Det. Trimmer
Capacitor	5-1	Air Trimmer 25 mmfd. max.	Ant. Trimmer
Capacitor	5-2	Air Trimmer 25 mmfd. max.	Ant. Trimmer
Capacitor	5-3	Air Trimmer 25 mmfd. max.	R.F. Trimmer
Capacitor	5-4	Air Trimmer 25 mmfd. max.	R.F. Trimmer
Capacitor	5-5	Air Trimmer 25 mmfd. max.	Det. Trimmer
Capacitor	5-6	Air Trimmer 25 mmfd. max.	Det. Trimmer
Capacitor	6-1	Air Trimmer 25 mmfd. max.	Osc. Trimmer
Capacitor	6-2	Air Trimmer 25 mmfd. max.	Osc. Trimmer
Capacitor	6-3	Air Trimmer 25 mmfd. max.	Osc. Trimmer
Capacitor	6-4	Air Trimmer 25 mmfd. max.	Osc. Trimmer
Capacitor	7-1	Air Trimmer 25 mmfd. max.	R.F. Trimmer
Capacitor	7-2	Air Trimmer 25 mmfd. max.	Det. Trimmer
Capacitor	8	Air Trimmer 10 mmfd. max.	Crystal Filter Adj.
Capacitor	9	Air Trimmer 10 mmfd. max.	C.W. Osc. Adjustment
Capacitor	10	Ceramic Trimmer 5 to 30 mmfd.	Osc. Series Pad.
Capacitor	11-1	Paper 500 v. DC .01 mfd. ± 10% with leads	1st R.F. Cathode By-pass

TABLE OF REPLACEABLE PARTS—BC-348-H—Continued

Name of Part	Ref. No.	Description	Function
Capacitor	11-2	Paper 500 v. DC .01 mfd. ± 10% with leads	1st R.F. Screen By-pass
Capacitor	11-3	Paper 500 v. DC .01 mfd. ± 10% with leads	2nd R.F. Cathode By-pass
Capacitor	11-4	Paper 500 v. DC .01 mfd. ± 10% with leads	2nd R.F. Screen By-pass
Capacitor	11-5	Paper 500 v. DC .01 mfd. ± 10% with leads	1st DET. Screen By-pass
Capacitor	11-6	Paper 500 v. DC .01 mfd. ± 10% with leads	1st I.F. Transformer By-pass
Capacitor	11-7	Paper 500 v. DC .01 mfd. ± 10% with leads	Crystal Transformer By-pass
Capacitor	11-8	Paper 500 v. DC .01 mfd. ± 10% with leads	1st I.F. Cathode By-pass
Capacitor	11-9	Paper 500 v. DC .01 mfd. ± 10% with leads	1st I.F. Plate By-pass
Capacitor	11-10	Paper 500 v. DC .01 mfd. ± 10% with leads	2nd I.F. By-pass
Capacitor	11-11	Paper 500 v. DC .01 mfd. ± 10% with leads	2nd I.F. Cathode By-pass
Capacitor	11-12	Paper 500 v. DC .01 mfd. ± 10% with leads	C.W. Osc. Plate By-pass
Capacitor	11-13	Paper 500 v. DC .01 mfd. ± 10% with leads	Plug Terminal By-pass
Capacitor	11-14	Paper 500 v. DC .01 mfd. ± 10% with leads	AVC By-pass
Capacitor	11-15	Paper 500 v. DC .01 mfd. ± 10% with leads	3rd I.F. Transformer By-pass
Capacitor	11-16	Paper 500 v. DC .01 mfd. ± 10% with leads	3rd I.F. Cathode By-pass
Capacitor	11-17	Paper 500 v. DC .01 mfd. ± 10% with leads	Heater By-pass
Capacitor	11-18	Paper 500 v. DC .01 mfd. ± 10%	Battery By-pass
Capacitor	12-1	Mica 500 v. DC .01 mfd. ± 10% with lugs	Ant. Coil By-pass
Capacitor	12-2	Mica 500 v. DC .01 mfd. ± 10% with lugs	Ant. Coil By-pass
Capacitor	12-3	Mica 500 v. DC .01 mfd. ± 10% with lugs	1st R.F. Plate By-pass
Capacitor	12-4	Mica 500 v. DC .01 mfd. ± 10% with lugs	2nd R.F. Plate By-pass
Capacitor	13-1	Mica 500 v. DC .01 mfd. ± 10% with lugs	R.F. Coil By-pass
Capacitor	13-2	Mica 500 v. DC .01 mfd. ± 10% with lugs	R.F. Coil By-pass
Capacitor	14-1	Mica 500 v. DC .01 mfd. ± 10% with lugs	1st Det. Cathode By-pass
Capacitor	14-2	Mica 500 v. DC .01 mfd. ± 10% with lugs	Osc. Plate By-pass
Capacitor	15	Mica 500 v. DC .01 mfd. ± 10% with leads	Antenna Series Pad
Capacitor	16	Mica 500 v. DC .005 mfd. ± 10% with leads	Audio Frequency Secondary By-pass
Capacitor	17-1	Mica 500 v. DC 500 mmfd. ± 1½% with leads	Osc. Series
Capacitor	17-2	Mica 500 v. DC 500 mmfd. ± 1½% with leads	Osc. Series

TABLE OF REPLACEABLE PARTS—BC-348-H—Continued

Name of Part	Ref. No.	Description	Function
Capacitor	18	Mica 500 v. DC 1700 mmfd. ± 2% with leads	Osc. Series
Capacitor	19	Mica 500 v. DC 2650 mmfd. ± 2% with leads	Osc. Series
Capacitor	20	Mica 500 v. DC 210 mmfd. ± 1½% with leads	Osc. Series
Capacitor	21-1	Mica 500 v. DC 200 mmfd. ± 1% with leads	Ant. Series
Capacitor	21-2	Mica 500 v. DC 200 mmfd. ± 1% with leads	R.F. Series
Capacitor	21-3	Mica 500 v. DC 200 mmfd. ± 1% with leads	Det. Series
Capacitor	22-1	Mica 500 v. DC 400 mmfd. ± 1½% with leads	Ant. Series
Capacitor	22-2	Mica 500 v. DC 400 mmfd. ± 1½% with leads	R.F. Series
Capacitor	22-3	Mica 500 v. DC 400 mmfd. ± 1½% with leads	Det. Series
Capacitor	23-1	Mica 500 v. DC 40 mmfd. ± 5% with leads	Det. Shunt
Capacitor	23-2	Mica 500 v. DC 40 mmfd. ± 5% with leads	R.F. Shunt
Capacitor	23-3	Mica 500 v. DC 40 mmfd. ± 5% with leads	R.F. Shunt
Capacitor	23-4	Mica 500 v. DC 40 mmfd. ± 5% with leads	Det. Shunt
Capacitor	24-1	Mica 500 v. DC 25 mmfd. ± 5% with leads	Ant. Shunt
Capacitor	24-2	Mica 500 v. DC 25 mmfd. ± 5% with leads	Ant. Shunt
Capacitor	25	Mica 500 v. DC 65 mmfd. ± 5% with leads	Ant. Shunt
Capacitor	26-1	Mica 500 v. DC 95 mmfd. ± 5% with leads	R.F. Shunt
Capacitor	26-2	Mica 500 v. DC 95 mmfd. ± 5% with leads	Det. Shunt
Capacitor	27-1	Mica 500 v. DC 70 mmfd. ± 5% with leads	R.F. Shunt
Capacitor	27-2	Mica 500 v. DC 70 mmfd. ± 5% with leads	Det. Shunt

Name of Part	Ref. No.	Description	Function
Capacitor	28	Mica 500 v. DC 100 mmfd. ± 5% with leads	Osc. Grid
Capacitor	29-1	Mica 500 v. DC 1250 mmfd. ± 10% with leads	R.F. Primary Shunt
Capacitor	29-2	Mica 500 v. DC 1250 mmfd. ± 10% with leads	Det. Primary Shunt
Capacitor	30-1	Mica 500 v. DC 2 mmfd. ± ½ mmfd. with leads	R.F. Coupling
Capacitor	30-2	Mica 500 v. DC 2 mmfd. ± ½ mmfd. with leads	Det. Coupling
Capacitor	31-1	Mica 500 v. DC 1500 mmfd. ± 10% with leads	Audio Coupling
Capacitor	31-2	Mica 500 v. DC 1500 mmfd. ± 10% with leads	Audio Transformer Primary Shunt
Capacitor	32	Mica 500 v. DC 200 mmfd. ± 5% with leads	1st I.F. Primary Tuning
Capacitor	33	Mica 500 v. DC 300 mmfd. ± 5% with leads	1st I.F. Secondary Tuning
Capacitor	34-1	Mica 500 v. DC 260 mmfd. ± 5% with leads	Crystal Transformer Tuning
Capacitor	34-2	Mica 500 v. DC 260 mmfd. ± 5% with leads	3rd I.F. Primary
Capacitor	34-3	Mica 500 v. DC 260 mmfd. ± 5% with leads	3rd I.F. Secondary Tuning
Capacitor	35-1	Mica 500 v. DC 240 mmfd. ± 5% with leads	2nd I.F. Primary Tuning
Capacitor	35-2	Mica 500 v. DC 240 mmfd. ± 5% with leads	2nd I.F. Secondary Tuning
Capacitor	35-3	Mica 500 v. DC 240 mmfd. ± 5% with leads	C.W. Osc. Tuning
Capacitor	35-4	Mica 500 v. DC 240 mmfd. ± 5% with leads	2nd Det. By-pass
Capacitor	36	Mica 500 v. DC 47 mmfd. ± 5% with leads	4th I.F. Primary Tuning
Capacitor	37-1	Mica 500 v. DC 150 mmfd. ± 5% with leads	4th I.F. Secondary Tuning
Capacitor	37-2	Mica 500 v. DC 150 mmfd. ± 5% with leads	C.W. Osc. Grid
Capacitor	38	Mica 500 v. DC 75 mmfd. ± 5% with leads	Diode Coupling

TABLE OF REPLACEABLE PARTS—BC-348-H—Continued

Name of Part	Ref. No.	Description	Function
Capacitor	39	Mica 500 v. DC 750 mmfd. ± 5% with leads	1st I.F. Secondary Tuning
Capacitor	40	Mica 500 v. DC 6 mmfd. ± .2 mmfd. with lugs	Osc. Temperature Compensating
Capacitor	41	Mica 500 v. DC 3.8 mmfd. ± .2 mmfd. with lugs	Osc. Temperature Compensating
Capacitor	42	Ceramic 500 v. DC 20 mmfd. ± 5% with leads	Osc. Temperature Compensating
Capacitor	43	Ceramic 500 v. DC 65 mmfd. ± 5% with leads	Osc. Temperature Compensating
Capacitor	44	Ceramic 500 v. DC 90 mmfd. ± 3% with leads	Osc. Temperature Compensating
Capacitor	45	Ceramic 500 v. DC 35 mmfd. ± 5% with leads	Osc. Temperature Compensating
Capacitor	46	Ceramic 500 v. DC 40 mmfd. ± 5% with leads	Osc. Temperature Compensating
Capacitor	47	Ceramic 500 v. DC 85 mmfd. ± 3% with leads	Osc. Series
Capacitor	48-1A	Paper 250 v. DC .5 mfd. ± 15%	4th I.F. Transformer Filter
Capacitor	48-1B	Paper 250 v. DC .5 mfd. ± 15%	Noise Comp. Filter
Capacitor	48-2A	Paper 250 v. DC .5 mfd. ± 15%	Screen Supply Filter
Capacitor	48-2B	Paper 250 v. DC .5 mfd. ± 15%	Output Plate Filter
Capacitor	48-3A	Paper 250 v. DC .5 mfd. ± 15%	Volume Control Filter
Capacitor	48-3B	Paper 250 v. DC .5 mfd. ± 15%	3rd I.F. Screen Filter
Capacitor	49-1A	Paper 250 v. DC .5 mfd. ± 15%	4th I.F. Transformer Filter
Capacitor	49-1B	Paper 250 v. DC .5 mfd. ± 15%	4th I.F. Transformer Filter
Capacitor	49-2A	Paper 250 v. DC .5 mfd. ± 15%	Output Grid Filter
Capacitor	49-2B	Paper 250 v. DC .5 mfd. ± 15%	Screen Supply Filter
Capacitor	49-3A	Paper 250 v. DC .5 mfd. ± 15%	1st I.F. Screen Filter
Capacitor	49-3B	Paper 250 v. DC .5 mfd. ± 15%	1st I.F. Screen Filter
Capacitor	49-4A	Paper 250 v. DC .5 mfd. ± 15%	Battery Filter
Capacitor	49-4B	Paper 250 v. DC .5 mfd. ± 15%	Battery Filter
Resistor	55-1	Insul. 470 ohms ± 10% ½ watt	1st R.F. Cathode
Resistor	55-2	Insul. 470 ohms ± 10% ½ watt	2nd R.F. Cathode
Resistor	55-3	Insul. 470 ohms ± 10% ½ watt	1st I.F. Cathode

TABLE OF REPLACEABLE PARTS—BC-348-H—Continued

Name of Part	Ref. No.	Description	Function
Resistor	55-4	Insul. 470 ohms ± 10% ½ watt	2nd I.F. Cathode
Resistor	56-1	Insul. 1000 ohms ± 10% ½ watt	Osc. Plate
Resistor	56-2	Insul. 1000 ohms ± 10% ½ watt	3rd I.F. Cathode
Resistor	57-1	Insul. 4700 ohms ± 10% ½ watt	1st R.F. Plate
Resistor	57-2	Insul. 4700 ohms ± 10% ½ watt	2nd R.F. Plate
Resistor	57-3	Insul. 4700 ohms ± 10% ½ watt	1st Det. Plate
Resistor	57-4	Insul. 4700 ohms ± 10% ½ watt	1st I.F. Screen
Resistor	57-5	Insul. 4700 ohms ± 10% ½ watt	1st I.F. Plate
Resistor	57-6	Insul. 4700 ohms ± 10% ½ watt	Bleeder
Resistor	57-7	Insul. 4700 ohms ± 10% ½ watt	3rd I.F. Cathode
Resistor	58-1	Insul. 10,000 ohms ± 10% ½ watt	1st R.F. Screen
Resistor	58-2	Insul. 10,000 ohms ± 10% ½ watt	2nd R.F. Screen
Resistor	58-3	Insul. 10,000 ohms ± 10% ½ watt	1st Det. Screen
Resistor	58-4	Insul. 10,000 ohms ± 10% ½ watt	C.W. Osc. Bleeder
Resistor	59	Insul. 12,000 ohms ± 10% ½ watt	Voltage Regulator Series
Resistor	60	Insul. 15,000 ohms ± 10% ½ watt	1st Det. Cathode
Resistor	61	Insul. 56,000 ohms ± 10% ½ watt	Output loading
Resistor	62	Insul. 68,000 ohms ± 10% ½ watt	C.W. Osc. Plate
Resistor	63-1	Insul. 100,000 ohms ± 10% ½ watt	1st R.F. Grid
Resistor	63-2	Insul. 100,000 ohms ± 10% ½ watt	2nd R.F. Grid
Resistor	63-3	Insul. 100,000 ohms ± 10% ½ watt	Osc. Grid
Resistor	63-4	Insul. 100,000 ohms ± 10% ½ watt	Output Grid Filter
Resistor	64	Insul. 180,000 ohms ± 10% ½ watt	3rd I.F. Screen
Resistor	65-1	Insul. 470,000 ohms ± 10% ½ watt	Antenna protective
Resistor	65-2	Insul. 470,000 ohms ± 10% ½ watt	1st I.F. Grid
Resistor	65-3	Insul. 470,000 ohms ± 10% ½ watt	2nd I.F. Grid
Resistor	65-4	Insul. 470,000 ohms ± 10% ½ watt	C.W. Osc. Grid
Resistor	66	Insul. 560,000 ohms ± 10% ½ watt	Output Grid
Resistor	67	Insul. 1.5 megohms ± 10% ½ watt	AVC Diode
Resistor	68	Insul. 220,000 ohms ± 10% ½ watt	AVC Filter

TABLE OF REPLACEABLE PARTS—BC-348-H—Continued

Name of Part	Ref. No.	Description	Function
Resistor	69	Insul. 75 ohms ± 10% ½ watt	Osc. Compensating
Resistor	70	Insul. 47,000 ohms ± 10% ½ watt	Bleeder
Resistor	73	Insul. 2400 ohms ± 5% ½ watt	Output Plate
Resistor	74	Insul. 10,000 ohms ± 10% 1 watt	Bleeder
Resistor	75	Insul. 27,000 ohms ± 10% 1 watt	Voltage Regulator
Resistor	76-A	Insul. 3 ohms ± 10% 1.5 watts	Filament
Resistor	76-B	Insul. 190 ohms ± 10% 1.9 watts	Filament
Resistor	77	Insul. 60 ohms ± 10% 3.7 watts	Lamp Series 60¼ A
Resistor	78	Variable 3500 ± 10% to 10 ohms .1 watt	Noise Compensator
Resistor	79-A	Volume Control Front Unit 20,000 ohms ± 10% to 10 ohms .2 watt	M.V.C.
Resistor	79-B	Volume Control Back Unit 350,000 ohms ± 10% to 50 ohms .2 watt	A.V.C.
Resistor	80	Variable 200 ohms ± 10% 4 watts	Dial Lamp Control
Inductance	90	Antenna Band 1	1st R.F. Tuned Circuit
Inductance	91	Antenna Band 2	1st R.F. Tuned Circuit
Inductance	92	Antenna Band 3	1st R.F. Tuned Circuit
Inductance	93	Antenna Band 4	1st R.F. Tuned Circuit
Inductance	94	Antenna Band 5	1st R.F. Tuned Circuit
Inductance	95	Antenna Band 6	1st R.F. Tuned Circuit
Inductance	96	R.F. Band 1	1st R.F. to 2nd R.F. Coupling
Inductance	97	1st Det. Band 1	2nd R.F. to 1st Det. Coupling
Inductance	98-1	R.F. Band 1	Plate Load 1st R. F.
Inductance	98-2	Det. Band 1	Plate Load 2nd R.F.
Inductance	100	R.F. Choke	Power Supply Filter
Transformer	101	R.F. Band 2	1st R.F. to 2nd R.F. Coupling
Transformer	102	R.F. Band 3	1st R.F. to 2nd R.F. Coupling
Transformer	103	R.F. Band 4	1st R.F. to 2nd R.F. Coupling
Transformer	104	R.F. Band 5	1st R.F. to 2nd R.F. Coupling
Transformer	105	R.F. Band 6	1st R.F. to 2nd R.F. Coupling
Transformer	106	1st Det. Band 2	2nd R.F. to Det. Coupling

TABLE OF REPLACEABLE PARTS—BC-348-H—Continued

Name of Part	Ref. No.	Description	Function
Transformer	107	1st Det. Band 3	2nd R.F. to Det. Coupling
Transformer	108	1st Det. Band 4	2nd R.F. to Det. Coupling
Transformer	109	1st Det. Band 5	2nd R.F. to Det. Coupling
Transformer	110	1st Det. Band 6	2nd R.F. to Det. Coupling
Transformer	111	Osc. Band 1	Osc. to 1st Det. Coupling
Transformer	112	Osc. Band 2	Osc. to 1st Det. Coupling
Transformer	113	Osc. Band 3	Osc. to 1st Det. Coupling
Transformer	114	Osc. Band 4	Osc. to 1st Det. Coupling
Transformer	115	Osc. Band 5	Osc. to 1st Det. Coupling
Transformer	116	Osc. Band 6	Osc. to 1st Det. Coupling
Transformer	117	1st I.F.	1st Det. to Crystal Coupling
Transformer	118	Crystal Filter	Crystal to 1st I.F. Coupling
Transformer	119	2nd I.F.	1st I.F. to 2nd I.F. Coupling
Transformer	120	3rd I.F.	2nd I.F. to 3rd I.F. Coupling
Transformer	121	C.W. Osc.	Grid & Plate Coupling
Transformer	122	4th I.F.	3rd I.F. to 2nd Det. Coupling
Transformer	123-A	Audio	Output
Choke	123-B	Audio Frequency	Filter
Capacitor	123-C	Paper 400 v. DC .05 mfd. ± 10%	C.W. Osc. Time Constant
Jack	124-1	Single Circuit	Headphone
Jack	124-2	Single Circuit	Headphone
Regulator	125	Neon Bulb Type RCA 991	Osc. Plate Voltage Regulator
Lamp	126	6 to 8 volts Type 44 (LM-27)	Dial Lights
Switch	127	SPST Type	Crystal Filter (in-out)
Switch	128	DPST Type	C.W. Osc. (on-off)
Switch	129	2 position, 2 wafer type	AVC-off-MVC
Switch	130	6 position, 1 wafer	Band Switch Antenna Unit
Switch	131	6 position, 1 wafer	Band Switch Antenna Unit
Switch	132	6 position, 1 wafer	Band Switch R.F. Unit
Switch	133-A 133-B	6 position, 1 wafer Band Switch	R.F. Unit

TABLE OF REPLACEABLE PARTS—BC-348-H—Continued

Name of Part	Ref. No.	Description	Function
Switch	134	6 position, 1 wafer	Band Switch Det. Unit
Switch	135-A 135-B	6 position, 1 wafer	Band Switch Det. Unit
Switch	136	6 position, 1 wafer	Band Switch Osc. Unit
Switch	137	6 position, 1 wafer	Band Switch Osc. Unit
Switch	138	6 position, 1 wafer	Band Switch Osc. Unit
Switch	139	6 position, 1 wafer	Band Switch Osc. Unit
Fuse	140	5 amp. 25 v. Type FU-35	Primary Protective
Crystal Ass'y	141	915 Kc crystal mounted in case	I.F. Filter
Binding Post	142	Panel	Antenna Connection
Binding Post	143	Panel	Ground Connection
Handle	201	Panel	Carrying
Lever	202	Control	AVC-OFF-MVC
Knob	203	Control	Antenna Alignment Cond. Crystal Switch, Dial Lamp Control, and Volume Control
Knob	204	Control	C.W. Osc. Freq. Control
Thumb Screws	205	Dial Window	Holds Dial Window
Knob	206	Control	Band Change
Knob	207	Control	Main Tuning Cond.
Cover	208	Panel	Permits Access to Tube Shelf
Special Screw	209	Shouldered	Main Tuning Cond.
Special Screw	210	Shouldered Flathead	Dynamotor Assem. to Mounting Plate
Special Screw	211	Captive	Dynamotor Assembly
Special Screw	212	Slotted Hex Head	Dial Assembly to Chassis
Special Screw	213	Shouldered	Secures Plug to Mounting Plate
Cover	214	Plate with Captive	Covers Tube in Osc. Unit
Shield	215	Tube, Special	Shield for Tube VT 70
Fuse Clip Assembly	216	Laminated Phenolic Strip with Fuse Clips	Power Fuse
Socket	217	Tube, Octal Type	For Tubes VT86 and VT152 VT91 and VT65 VT93

TABLE OF REPLACEABLE PARTS—BC-348-H—Continued

Name of Part	Ref. No.	Description	Function
Socket	218	Bayonet Type, Special	For Voltage Regulator Tube
Socket	219	Tube, 7 Prong	For Tube VT 70
Socket	221	Lamp	For Dial Lamp
Fitting	222	8 Pole, Male (SO-104)	Power Connections
1st I.F. Transformer Assembly	251	Complete with Shield Can. Includes 32, 33, 39, and 117	1st Det. to 1st I.F. Coupling
2nd I.F. Transformer Assembly	252	Complete with Shield Can. Includes 35-1, 35-2, and 119	1st I.F. to 2nd I.F. Coupling
3rd I.F. Transformer Assembly	253	Complete with Shield Can. Includes 34-2, 34-3, and 120	2nd I.F. to 3rd I.F. Coupling
4th I.F. Transformer Assembly	254	Complete with Shield Can. Includes 36, 37-1, and 122	3rd I.F. to 2nd Det. Coupling
Crystal Filter Assembly	255	Complete with Shield Can. Includes 8, 34-1, 118, 127, and 141	I. F. Selectivity
C.W. Osc. Assembly	256	Complete with Shield Can. Includes 9, 11-12, 35-3, 37-2, 62, and 121	C.W. Reception
Antenna Unit Assembly	257	Complete with Shield Can. Includes 2, 3-1, 3-2, 4-1, 5-1, 5-2, 12-1, 12-2, 15, 21-1, 22-1, 24, 25, 63-1, 72, 90, 96, 92, 93, 94, 95, 130, and 131	Ant. to 1st R.F. Tube Coupling
R.F. Unit Assembly	258	Complete with Shield Can. Includes 3-3, 3-4, 4-2, 5-3, 5-4, 7-1, 12-3, 13-1, 13-2, 21-2, 22-2, 23-2, 23-3, 26-1, 27-1, 29-1, 30-1, 57-1, 63-2, 91, 96, 98-1, 101, 102, 103, 104, 105, 132, and 133	1st R.F. to 2nd R.F. Tube Coupling
Det. Unit. Assembly	259	Complete with Shield Can. Includes 3-5, 3-6, 4-3, 5-5, 5-6, 7-2, 12-4, 21-3, 22-3, 23-1, 23-4, 26-2, 29-2, 27-2, 30-2, 57-2, 97, 98-2, 106, 107, 108, 109, 110, 134, and 135	2nd R.F. to 1st Det. Tube Coupling
Osc. Unit Assembly	260	Complete with Shield Can. Includes 3-7, 3-8, 6-1, 6-2, 6-3, 6-4, 10, 14-1, 14-2, 17-1, 17-2, 18, 19, 20, 28, 40, 41, 42, 43, 44, 45, 46, 47, 56-1, 60, 63-3, 69, 111, 112, 113, 114, 115, 116, 136, 137, 138, 139, 214, and 217	Heterodyne Osc. to 1st Det. Coupling
Resistor Board	271	17 Terminal	Supports Parts 16, 57-6, 59, 63-4, 74 and 75
Resistor Board	272	32 Terminal	Supports Parts 11-13, 11-14, 11-15, 11-16, 11-18, 31-1, 31-2, 57-7, 56-2, 61, 64, 66, and 73

TABLE OF REPLACEABLE PARTS—BC-348-H—Continued

Name of Part	Ref. No.	Description	Function
Resistor Board	273	14 Terminal	Supports Parts 11-9, 11-10, 11-11, 55-4, 57-4, 57-5, and 65-3
Resistor Board	274	14 Terminal	Supports Parts 11-6, 11-7, 57-3, 58-4, 65-2, and 70
Dial Mechanism	276	Complete with Mask, Index Gear Drive, Stop and Detent Mechanism	Frequency Indicator Tuning Condenser Drive
Dynamotor	300	27.9 v., 1.23 amp.; 220 v., .070 amp. 4400 RPM, DM-28-M	Motor Generator
Choke	301	RF	Dynamotor Filter
Choke	302	R.F.	Dynamotor Filter
Capacitor	303-A	Paper 250 v. DC .5 mfd. ± 20%	Dynamotor Filter
Capacitor	303-B	Paper 250 v. DC .5 mfd. ± 20%	Dynamotor Filter
Capacitor	304	Paper 400 v. DC 1.0 mfd. ± 20%	Dynamotor Filter
Capacitor	305-1	Mica 500 v. DC .01 mfd. ± 10%	Dynamotor Filter
Capacitor	305-2	Mica 500 v. DC .01 mfd. ± 10%	Dynamotor Filter
Armature	306	Part of Ref. 300	Dynamotor
Bearing (Set of 2)	307	Part of Ref. 300	Dynamotor
Brush & Spring	308	Part of Ref. 300	Pos. H.V.
Brush & Spring	309	Part of Ref. 300	Neg. H.V.
Brush & Spring	310	Part of Ref. 300	Pos. L.V.
Brush & Spring	311	Part of Ref. 300	Neg. L.V.
End Bell	315	Part of Ref. 300	Low Voltage End Bearing
End Bell	316	Part of Ref. 300	High Voltage End Bearing
Field Windings	317 318	Part of Ref. 300. Field Windings (available in pairs only)	Dynamotor
Tie Bars	319	Part of Ref. 300	Holds Items 315 and 316 to Frame
Brush Caps	320	Part of Ref. 300	Holds Brushes
Grommet	321	Part of Ref. 300	Protects Terminal Wires
Gasket	322	Part of Ref. 300	Prevents Leakage of Lubricant
Plate	323	Part of Ref. 300	Bearing Retainer
Cover	324	Part of Ref. 300	Dust Cover
Bracket & Gear & Assembly	350	Pair of Beveled Gears & Coupling	Drives Band Change Switch

TABLE OF REPLACEABLE PARTS—BC-348-H—Continued

Name of Part	Ref. No.	Description	Function
Coupling	351	Flanged Collar with Rectangular Slot	Coupling Band Change Knob Shaft to Item 350
Coupling Slide	352	Disc with two Rectangular Keys	Slide Between 2 or Item 351
Window Frame Assembly	353	Removable Cast Housing Which Holds Dial Crystal	Covers Dial Lamps
Friction Spreader	355	Phosphorus Bronze Spring	Prevents Controls from Turning Under Vibration
Jack Cover Assembly	356	Spring Actuated Cover	Seals Jack Openings
Bushing	357	Threaded Bushing	Holds Handle to Panel and Provides Bearing for Thumb Screw
Nut	358	Special Locking Nut	Holds Item 357
Thumb Screw Assembly	359	No. 10-24 x 9 9/32 Long (Less Knob)	Holds Chassis in Cabinet
Nut	360	Special Locking Nut	Holds Upper End of Handles
Flexible Shaft and Coupling	361	5½ Inches Long, Including Couplings, Special	Operates B.F.O. Control
Extension Shaft	362	Special Shaft 0.594 Inches Long	Operates Crystal "On-Off" Switch
Shaft & Coupling Assembly	363	Flexible Shaft with Insulated Coupling	Operates Antenna Trimmer
Switch Shaft	364	Flat Shaft	Operates Band Switch
Dial Mask Assembly	366	Plate with Cutouts	Mask Undesired Dial Scales
Dial Assembly	367	Calibrated Circular Dial with Hub and Large Spur Gear	Gives Frequency Setting
Stop Arm Assembly	368	Lever with Roller and Pawl	Stops Condenser at End of Travel
Index Plate	369	Phosphorus Bronze Strip Painted Red	Dial Scale Index
Stop	370	Cast Bushing with Key	Stops Stop Arm
Stud	371	Shouldered Stud Threaded No. 4-40 One End	Pivot Pin for Part 368
Guide Assembly	372	Arm and Roller Assembly	Engages Index Wheel for Switch Location
Spring	373	Coiled Spring	Operation of Indexing Arm Item 372
Gear and Pinion Assembly	374	Spur Gear & Pinion Assembly	Idler Reduction Gear Between Tuning Shaft and Dial

TABLE OF REPLACEABLE PARTS—BC-348-H—Continued

Name of Part	Ref. No.	Description	Function
Pinion	375	Pinion (Pinned to Tuning Shaft)	Dial Drive Pinion Meshing with Item 374
Worm	376	Worm, Single Pitch	Drives Cross Shaft of Condenser Drive
Gear Assembly	377	Split Worm Wheel	Part of Condenser Drive Train
Pinion and Bushing Assembly	378	Pinion on Cross Shaft	Drives Tuning Condenser Gear
Spring	379	Torsion Spring	Holds Item 368
"C" Washer	380	"C" Washer	Against Dial used to Retain Items 372 and 374
FT-154-H	399	Mounting Base Assembly	Supports Receiver
Mounting Plate Assembly	400	Part of Reference 399	Supports Item 401
Base and Stiffener Assembly	401	Part of Reference 399	Supports Receiver and Plug—Item 403 or 404
Cap Screw	402	¼—20 x 1$\frac{1}{16}$ Long	Holds Items 400 and 401 together
Fitting	403	8 Pole Female Power Connector PL-P103	Make connection to Exterior Equipment
Fitting	404	8 Pole Female Power Connector PL-Q103	Make connection to Exterior Equipment
Jack Block	405	Part of Reference 403 and 404 Numbered 1 and 5	Holds Contactors
Jack Block	406	Part of Reference 403 and 404 Numbered 2 and 6	Holds Contactors
Jack Block	407	Part of Reference 403 and 404 Numbered 3 and 7	Holds Contactors
Jack Block	408	Part of Reference 403 and 404 Numbered 4 and 8	Holds Contactors
Jack Housing Assembly	409	Part of Reference 403 and 404	Houses Jack Blocks
Fitting (Right Angle)	410	Part of Reference 404	Cable Protection and Shielding
Fitting (Straight)	411	Part of Reference 403	Cable Protection and Shielding
Contact Spring Assembly	412	Part of Reference 403 and 404	Contact
Jack Housing Cover	413	Part of Reference 403 and 404	Covers Jack Block Terminals
Cover	414	Part of Reference 257	Top

TABLE OF REPLACEABLE PARTS—BC-348-H—Continued

Name of Part	Ref. No.	Description	Function
Cover	415	Part of Reference 257	Bottom
Shield	416	Part of Reference 257	Side and Ends
Cover	417	Part of Reference 258	Top
Cover	418	Part of Reference 258	Bottom
Shield	419	Part of Reference 258	Side and Ends
Cover	420	Part of Reference 259	Top
Cover	421	Part of Reference 259	Bottom
Shield	422	Part of Reference 259	Side and Ends
Cover	423	Part of Reference 260	Top
Cover	424	Part of Reference 260	Bottom
Cover	425	Part of Reference 260	Side
Shield	426	Part of Reference 260	Side and Ends
Tube Guide	433	Cylindrical Socket for Tube Base	Supports Tube and Tube Shield VT 70
Shield Can.	435	Part of Reference 251	1st I.F. Transformer Assembly Shield
Shield Can.	436	Part of Reference 252	2nd I.F. Transformer Assembly Shield
Shield Can.	437	Part of Reference 253	3rd I.F. Transformer Assembly Shield
Shield Can.	438	Part of Reference 254	4th I.F. Transformer Assembly Shield
Shield Can.	439	Part of Reference 255	Crystal Filter Assembly Shield
Shield Can.	440	Part of Reference 256	C.W. Osc. Assembly

FREQUENCY METER BC-211-D

SAFETY NOTICE: This equipment is extremely accurate and sensitive and should be handled as a precision instrument. Under no circumstances should the antenna terminal of Frequency Meter BC-211-D be conductively connected to any part of the radio transmitter or radio receiver being measured. Do not tighten the dial lock more than necessary as excessive tightening will cause the dial setting to be disturbed.

FUNCTIONING OF PARTS

FREQUENCY METER BC-221-D

1. Frequency Meter BC-221-D (See Figures 129 & 131) contains a crystal controlled oscillator used as a reference standard; a heterodyne oscillator having two fundamental

Figure 129. Frequency Meter Set SCR-211-D and Carrying Case

tuning ranges which, with their useful harmonics, are calibrated to provide continuous coverage from 125 to 20,000 KC; a high gain detector provided with means for coupling to each of three sources of excitation; and an audio frequency amplifier. There are seven operating controls (See Figure 131); a POWER switch 29, which breaks both the filament and plate supplies; an output PHONES jack 15 with a series filament supply switch built integral therewith; a CRYSTAL oscillator switch 28; a two-position FREQUENCY BAND switch 27 for the heterodyne oscillator; the heterodyne oscillator worm and gear tuning control (1) together with its DIAL UNITS and DIAL HUNDREDS scales; the CORRECTOR control (2); and the output GAIN control 26. All of these controls are mounted on the front panel of the frequency meter chassis, which is completely housed within the upper compartment of a portable aluminum cabinet in which batteries and spare parts are also carried. An antenna plug 31 and the 3-contact power input plug 34, Figures 136, 137 and 138, on the chassis, engage with corresponding jacks on the cabinet when the chassis is secured in place.

The antenna jack 32, Figure 133, is connected directly to an antenna terminal post 33 on the top of the cabinet, and the power input jack 35 is connected through cabling to a battery terminal board 36 in a lower compartment. Provision is made for installing the batteries in this lower compartment, access to which may be had through a hinged door at the rear Figure 130. Calibration Book MC-177-D (See

Figure 129) is mounted within a dual hinged door assembly at the top front of the cabinet. This door covers the frequency meter panel when closed, and supports the calibration book at a convenient angle for use when opened. The spare calibration book is carried in the top compartment on the left of the meter chassis, access to which may be had by removing the meter chassis from the cabinet (See Figure 133). The spare crystal unit is mounted on the underside of the frequency meter chassis (See Figure 132), while the spare set of vacuum tubes and two special wrenches for the No. 6 and No. 8 Bristo set screws used in the assembly of the equipment are stored in the spare parts compartment at the bottom front of the cabinet (See Figure 134).

2. The cathode, inner grid, and anode grid of the type 6A7 tube (See Figure 140) constitute the active elements of the crystal controlled oscillator, which operates at the fixed frequency of 1000 KC when the CRYSTAL switch (28) Figure 131 is placed in the ON position. The circuit is of a design which generates considerable harmonic energy in order that it may be employed to calibrate the heterodyne oscillator at several points over its entire range. The necessary plate circuit impedance is built up across an untuned inductance (18) Figures 137 and 140, which is housed in a rugged bakelite case thoroughly sealed against moisture. Likewise, the crystal unit 19 Figure 136 is supplied in a hermetically sealed and evacuated metal holder which provides permanent protection against humidity, corrosion, and dirt. A small type metal tube envelope is employed in the construction of this holder, so that it plugs into standard octal tube socket (14) Figure 136 in mounting. The cut of the crystal and the internal construction of the holder are such that, under any conditions of barometric pressure, humidity, voltage, vibration, shock or tilt, only the specified output frequency and the harmonics thereof are obtained. The crystal is ground for operation at a normal temperature of plus 20° C. The temperature coefficient of the combined crystal, holder, and circuit, as expressed in percentage of the frequency is less than 0.0001 per cent per degree C. as measured over an ambient range of 80°.

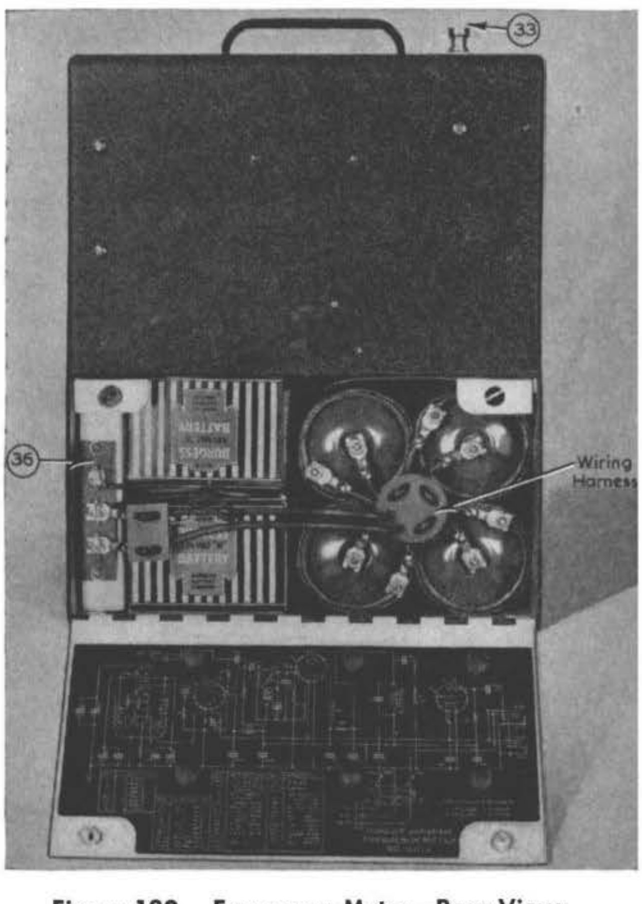


Figure 130. Frequency Meter—Rear View Showing Battery Compartment

3. Tube VT-77 is used in an electron coupled circuit as the heterodyne oscillator (Figure 140). As previously stated, there are two continuously variable ranges which may be manually selected by the FREQUENCY BAND switch (27) Figure 131. In the low frequency position, a funda-

mental range of 125 to 250 KC is employed; which, by calibrating the 1st, 2nd, 4th, and part of the 8th harmonics, gives continuous coverage throughout the range from 2000 to 20,000 KC. The two inductors (16) and (17) (See Figures 139 and 140), in the tuned circuits, are wound on ceramic forms and thoroughly sealed against moisture. Tuning over both fundamental ranges is accomplished by a single variable capacitor (1), having a low temperature coefficient, augmented by the variable corrector capacitor (2), and the adjustable low and high frrequency trimmer capacitors (3) and (4) respectively, all shown on Figures 135 and 139. The main tuning capacitor (1) is capable of continuous rotation in either direction and the dial assembly includes a 100/1 ratio worm gear drive mechanism so that 50 revolutions of the vernier dial are required for 180° rotation of the main scale (on the capacitor shaft). The main, or DIAL HUNDREDS scale is engraved with 50 divisions over its useful 180° sector; and the vernier is marked with 100 DIAL UNITS division over the entire 360°. The arrangement thus provides 5000 effective readable divisions of which the calibrated ranges occupy approximately the portion between 250 and 4750 (See Figure 142). Backlash in the gear mechanism has been reduced to less than one-half of one division on the vernier scale, and a dial lock is provided to prevent any accidental movement of the dial after the desired setting has been obtained.

4. The heterodyne oscillator circuits are calibrated from the crystal at a temperature of plus 20° C, and the dial settings of the successive harmonics (crystal check points) are noted along the calibration. The temperature coefficient of each range of the heterodyne oscillator, expressed in percentage of frequency, is less than 0.002 per cent per degree C, as measured over a range of 80° C. The corrector capacitor (2), which is connected in parallel with (1), makes it possible to reset the heterodyne oscillator to agreement with the crystal calibration at any harmonic for any ambient temperature

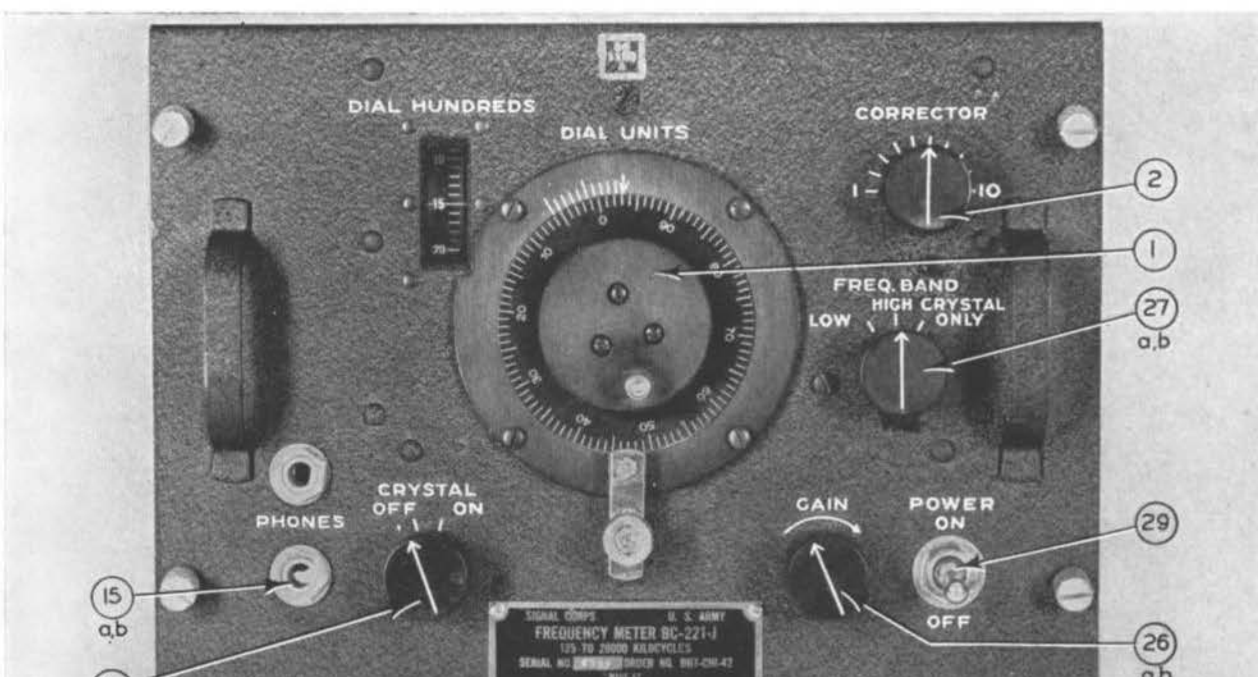


Figure 131. Frequency Meter BC-221-D, Chassis, Front View

between the limits of minus 30° and plus 50° C. Thus, after the tube filaments have been lighted for at least 20 minutes, and the heterodyne has been corrected to the nearest crystal check point, the heterodyne oscillator is capable of being reset to within plus or minus 500 cycles or 0.01% of the absolute, whichever is the greater, for any frequency in the calibrated range. Once set, the emitted frequency of the heterodyne oscillator will not vary by more than .01% or 500 cycles, whichever is the greater, under the most unfavorable combined influences due to 10% changes in filament and/or plate voltage, errors in calibration, crystal grinding errors, and ± 5° variations of ambient temperature between minus 30° and plus 50° C, provided that the heterodyne oscillator is corrected to the nearest crystal check point at intervals not exceeding fifteen minutes.

5. It was previously stated that the three inner elements of the type 6A7 tube are used in the crystal oscillator circuit. The remaining elements of this tube (comprising the control grid, screen grid and plate) are used as a high gain screen grid detector, to which, by structure, the crystal oscillator is electronically coupled. The R-F voltage developed across the load resistor 21-2 in the plate output circuit of the electron coupled heterodyne oscillator is coupled to the control grid of this detector through a small fixed capacitor 5-1 (See Figure 139). The antenna plug (31) mounted on the chassis, is also coupled to the control grid of the detector, through the coupling capacitor 5-2 (in series with 5-1). As a result of these three coupling means, and

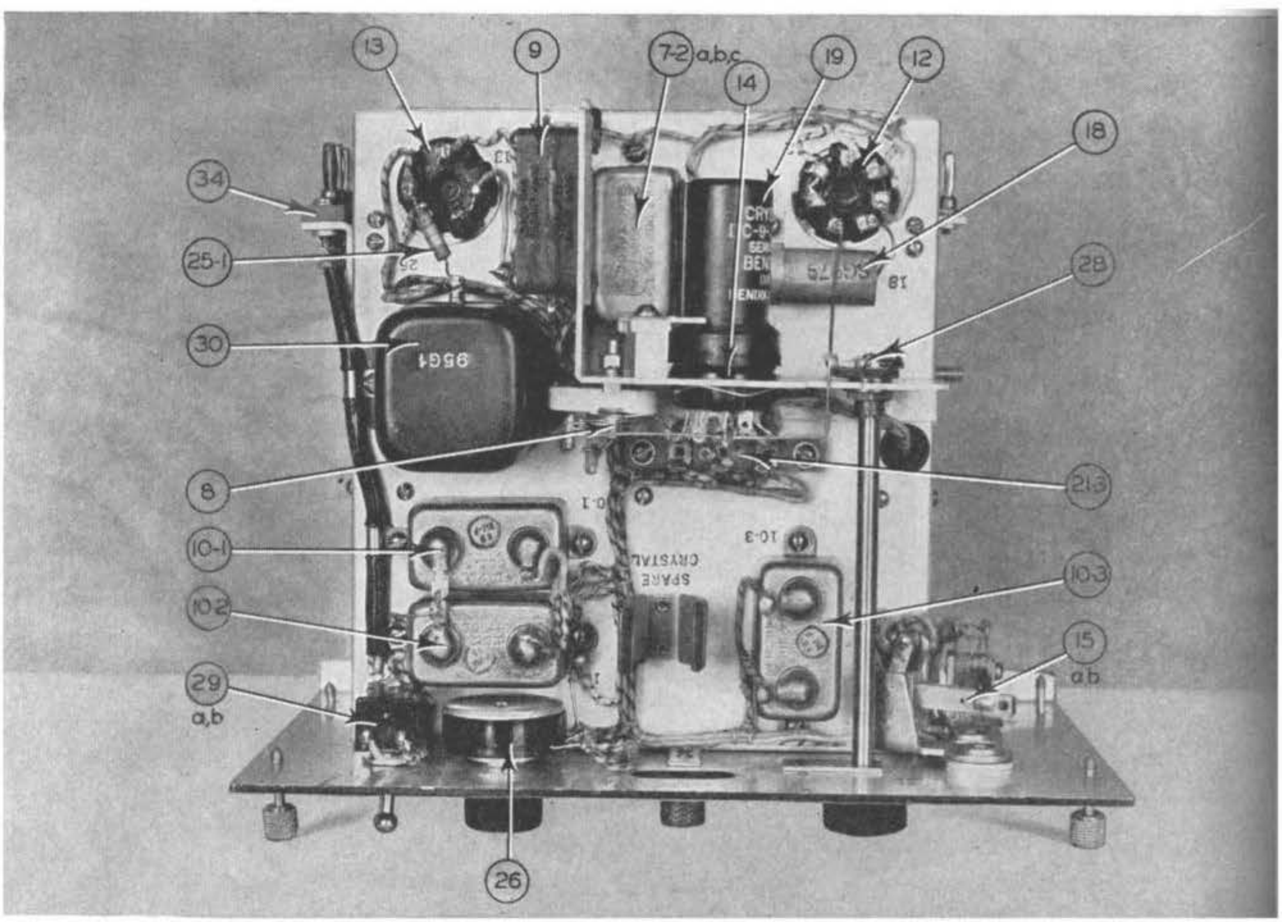


Figure 132. Frequency Meter BC-221-D, Chassis, Bottom View

dependent on the position of the CRYSTAL switch, the detector functions to mix the heterodyne oscillator output either with the fundamental and successive harmonics of the crystal oscillator, or with the radio transmitter frequency to be measured. When CRYSTAL switch is thrown to OFF position, crystal (19) and its shunt resistor 21-3 are short circuited and inner grid of type 6A7 tube is grounded (See Figure 140).

6. The detector plate works into an audio choke (30) Figure 132, which is by-passed by the capacitor (8) Figure 137, and the beat frequency voltages built up across it are coupled through capacitor (9) Figure 132 and the GAIN control potentiometer (26) to the grid of Tube VT-76 returns to ground through the potentiometer (26), the desired bias potential being obtained by connecting the cathode to the positive side of the filament. The plate of Tube VT-76 returns to the positive plate supply through the load resistor 25-1, the latter being by-passed to ground through capacitor 10-2. The plate of Tube VT-76 is also coupled to the PHONES jack (15) through capacitor 10-3, so that no DC potentials are present in the output. The characteristics of the output circuit are such that either high impedance (15,000 ohms) or low impedance (2500 ohms) headsets may be used without any change-over adjustments being required.

7. In the detector and audio amplifier combination, the output impressed across the phones is essentially a linear function of the input voltage for the output range of 1.0 to 6.0 milliwatts (beat frequency of 300 cycles). Regardless of whether the heterodyne oscillator is beating with energy from an external source of radio frequency or with the crystal calibrator, the following minimum outputs will be available:

   (1) **Beat Note Frequency Output**

100 Cycles	3.8 Milliwatts
500 Cycles	6.0 Milliwatts
1000 Cycles	3.0 Milliwatts

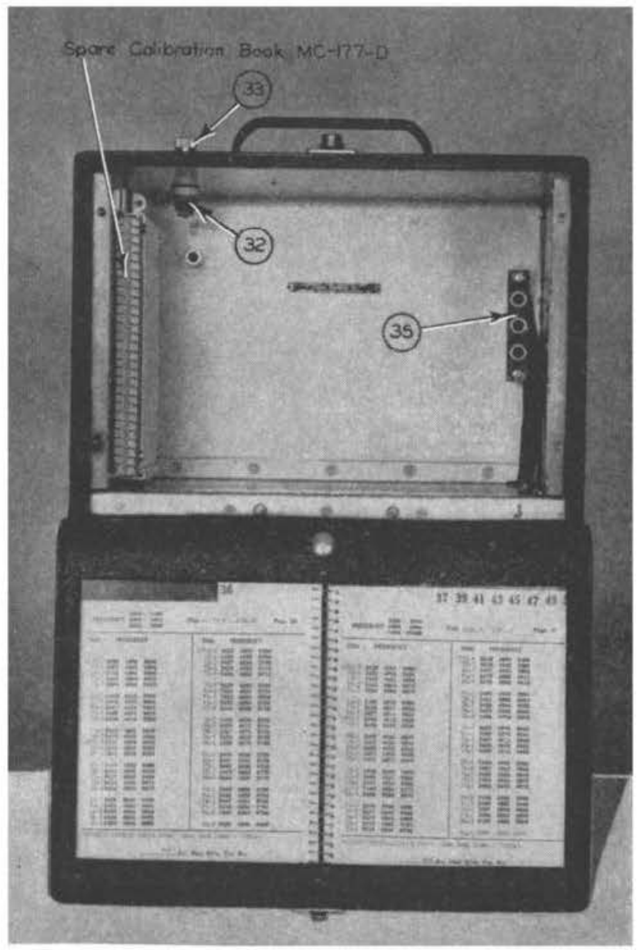


Figure 133. Frequency Meter BC-221-D, Front View with Chassis Removed

8. It was previously stated that the antenna plug (31) is coupled to the control grid of the detector through capacitors 5-2 and 5-1 respectively, in series. By further reference to Figure 139 and 140, it will be seen that the antenna plug (31) is also coupled directly to the heterodyne oscillator output through capacitor 5-2 alone. Thus, the antenna post (33) serves the dual purpose of a detector input terminal for the measurement of frequencies of external

origin and of a heterodyne oscillator output terminal for use in calibrating receivers. When the unit is employed for the latter purpose, 2000 microvolts or more of radio frequency energy will be available between the antenna terminal and ground (the chassis) at any frequency within the calibrated range.

9. All power required for the operation of this unit is introduced through the battery terminal board (36) Figure 130. The common negative filament and negative plate battery leads are connected to the middle terminal thereof, which is grounded to the chassis. A fabricated wiring harness is provided for intercell and filament battery to terminal board connections. The section (29a) of the POWER switch closes the positive 6-volt supply terminal (A +) to the vacuum tube filaments through the auxiliary switch (15) (when the headset plug is inserted into the PHONES jack); and section (29b) connects the positive 135-volt supply terminal (B +) to all plate and screen circuits. Since the door assembly containing the calibration book cannot be closed when the headset plug is in place, the A batteries cannot be inadvertently discharged when the set is decommissioned, even if the power switch is left in the ON position.

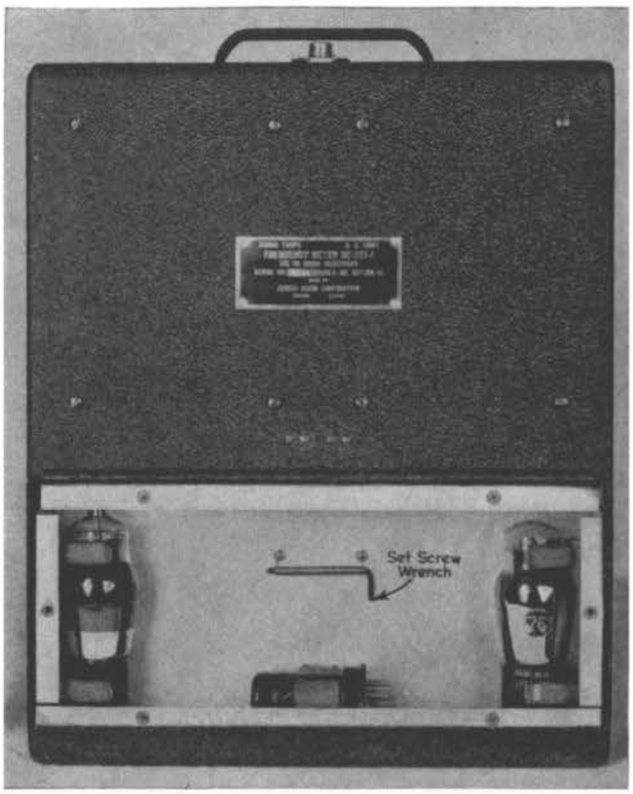


Figure 134. Frequency Meter BC-221-D—Front View Showing Spare Parts Compartment

10. The performance of this unit has been developed to a degree where no "locking in" will occur between the heterodyne oscillator and any source of RF with which it may be coupled, at any difference or beat frequency down to 5 cycles per second in the low fundamental range or down to 50 cycles per second in the high fundamental range. Although the phones become rapidly less efficient in audibly reproducing beat tones below 100 cycles per second, characteristic "rushes" coincident with the rise and fall of the beat frequency pulses are aurally recognizable well below the low frequency limit of audibility.

VACUUM TUBES—The vacuum tubes employed in this equipment, and their maximum operating characteristics, are shown in the following tabulation:

Reference Designation	VT-77	6A7	VT-76
Function:	Heterodyne Oscillator	Crystal Osc. & Detector	AF Amplifier
Type:	Triple Grid Amplifier	Pentagrid Converter	Super Triode

Signal Corps Type Nomenclature:	Tube VT-77	None	Tube VT-76
Nearest Com'l. Equivalent:	77	6A7	76
Base:	Small 6 pin	Small 7 pin	Small 5 pin
Heater Voltage (Ef):	6.3 V	6.3 V	6.3 V
Control Grid Voltage (Eg1):	−3.0 V	−3.0 V	−13.5 V
Screen Voltage (Eg2):	100.0 V	100.0 V	
Plate Voltage (Ep1):	250.0 V	250.0 V	250.0 V
Anode Grid Voltage (Ep2):		200.0 V	
Heater Current (If):	330.0 ma	330.0 ma	330.0 ma
Screen Current (Ig2):	0.5 ma	2.2 ma	
Plate Current (Ip1):	2.3 ma	3.5 ma	5.0 ma
Anode Grid Current (Ip2):		4.0 ma	
Mutual Conductance (Lm):	1250 μmho	520 μmho	1450 μmho

CALIBRATION BOOK MC-177-D—The low frequency fundamental range of the heterodyne oscillator is calibrated at each one-tenth kilocycle between 125 and 250 KC, or a total of 1251 points. Likewise, the high frequency fundamental range is calibrated in increments of one kilocycle between 2000 and 4000 KC, or a total of 2001 points. These fundamental frequencies are printed on the successive pages of the calibration book, together with a list of the second, fourth, and eighth harmonics thereof for the low range, and the second, fourth, and portions of the fifth harmonics for the high range. The dial

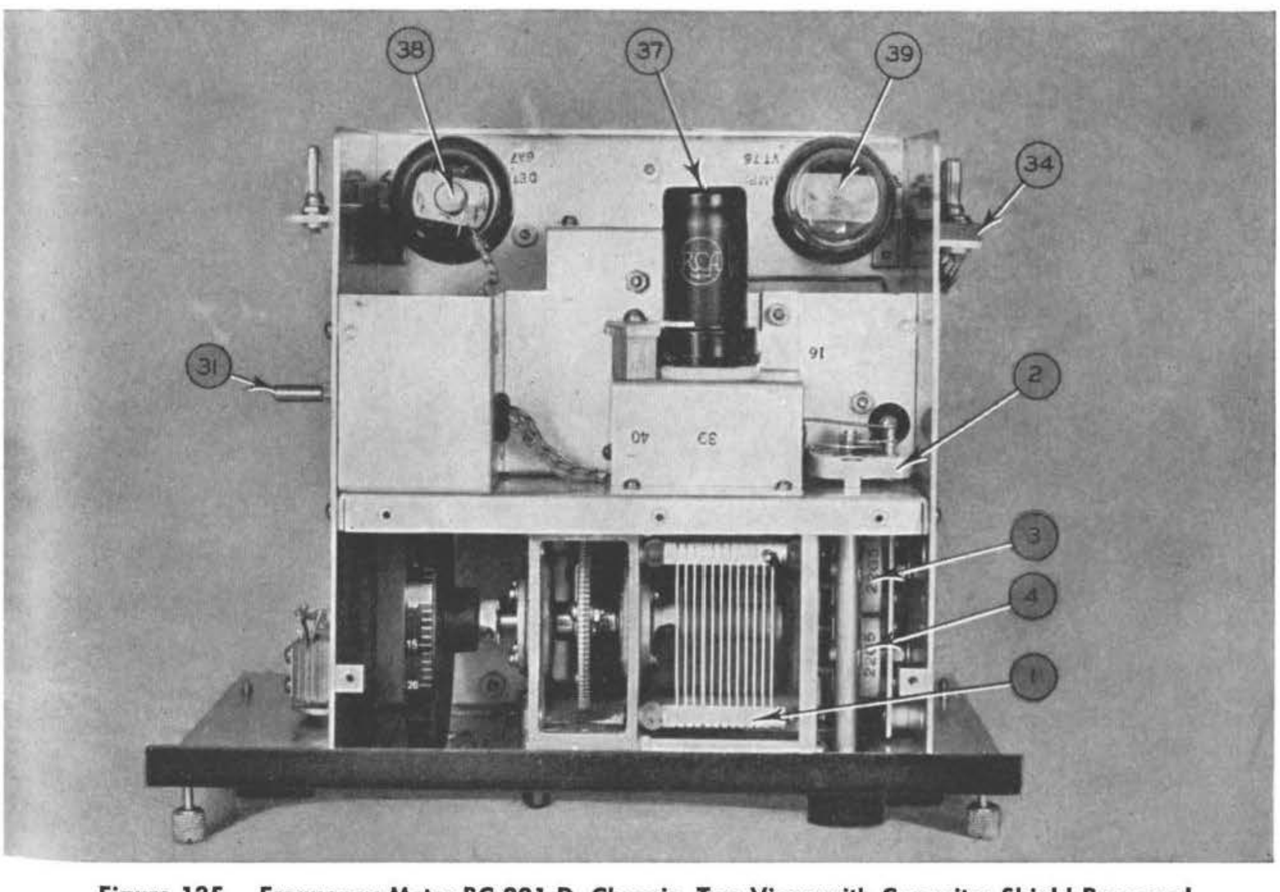


Figure 135. Frequency Meter BC-221-D, Chassis, Top View with Capacitor Shield Removed

settings, as determined by individual calibration, are then typed in opposite each such group. All figures representative of ordinary frequencies and their dial settings are both printed and typed in black while those which refer to the crystal oscillator and its harmonics (crystal check points) are shown in red. The nearest crystal check points are also shown in red across the bottom of each page, and the first and last frequencies and dial settings tabulated thereon are indicated across the top.

INSTALLATION

Batteries—Batteries necessary for operation must be installed before the equipment can be made ready for use. The frequency meter chassis should be removed from the cabinet while the batteries are being connected.

Four Batteries BA-23 and six Batteries BA-2 will be required. Open the battery compartment in the lower rear of the frequency meter cabinet and loosen the binderhead screw on the right hand outer side in order to release the metal strap provided for securing the filament battery. The four batteries BA-23 should then be inserted under the strap and pushed well forward with their terminal posts facing the rear of the cabinet. Prior to tightening the securing strap, hold the wiring harness in such a position that the two lugs of the main cables align with the A and A−/B − terminals on the battery terminal board, and position the four batteries so that their terminal posts match up with the individual battery lugs on the harness (the eight terminals on the circumference of a circle (See Figure 130). The securing strap should then be tightened with the batteries in this position. The six Batteries BA-2 should then be assembled in two layers of three tiers each, with the top layer inverted (after interconnecting their respective terminal leads in series). See that the minus and plus 135-volt leads are free for connection to their respective terminals on the

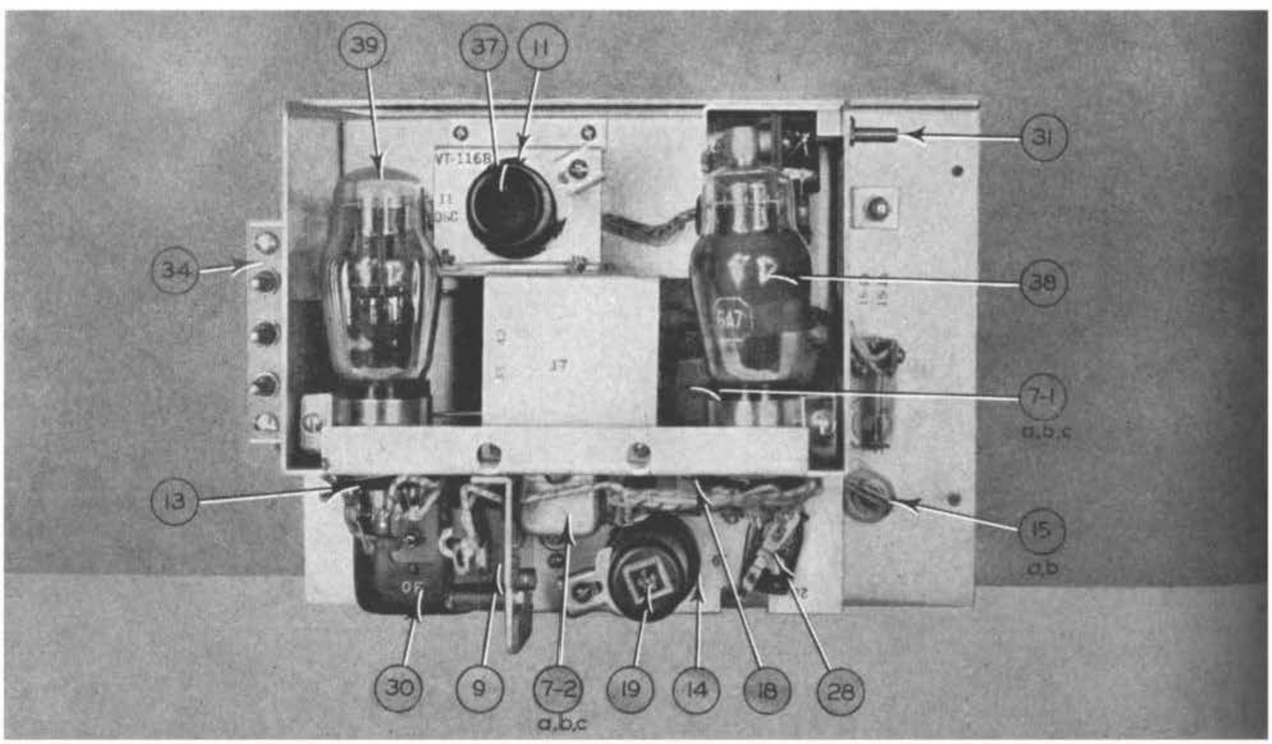


Figure 136. Frequency Meter BC-221-D, Chassis Rear View

terminal board. Insert the batteries in the cabinet, connect them to the terminal board, and install the filament battery wiring harness.

Prior to replacing the frequency meter chassis, check the battery connections for 6-volt and 135-volt meter readings, respectively, at the battery terminal board.

Antenna—A short antenna must be provided for coupling to the receivers and transmitters which are to be adjusted. This should preferably be a rigid wire, such as No. 12 B. & S. hard drawn bus, not over 2 to 3 feet long. This wire should be secured to the antenna terminal on the top of the frequency meter cabinet and so bent that its remote end will run parallel, and close, to the transmitter or receiver antenna lead. Where conditions will not permit this arrangement, such as in an airplane, a flexible insulated pick-up wire may be employed, with means provided to prevent its becoming a hazard during flight. One

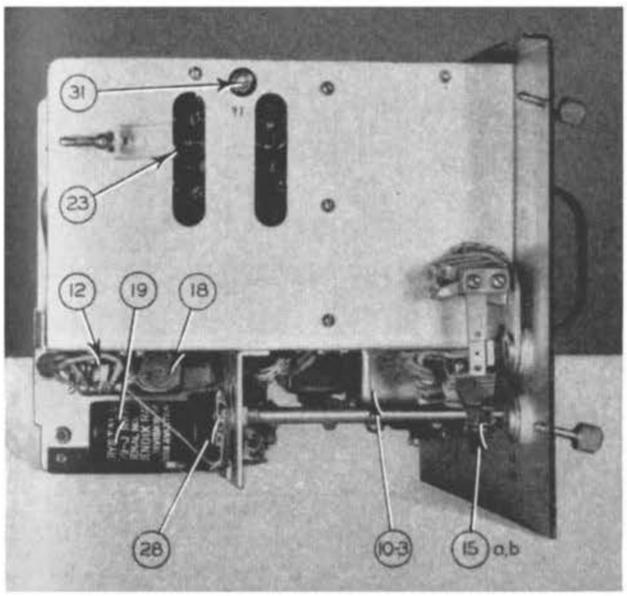


Figure 137. Frequency Meter BC-221-D, Chassis, Left Side

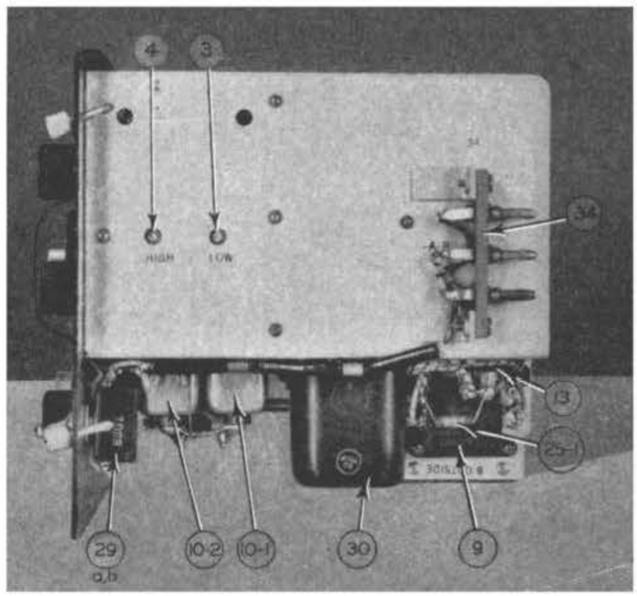


Figure 138. Frequency Meter BC-221-D, Chassis, Right Side

end should be skinned and secured to the antenna terminal on the frequency meter. Then, if the remote end is fitted with a completely taped test clip (jaws dulled), it will be possible to secure the lead at various coupling points, as desired, without grounding or contacting thereto. Under no circumstances should the antenna terminal of Frequency Meter BC-221-D be conductively connected to any part of the transmitter or receiver being measured.

Headset—Plug a headset P-18 or P-20 in the PHONES jack; then turn the POWER and CRYSTAL switches to the "ON" positions. Allow the vacuum tube filaments to heat for at least 20 minutes. The equipment will then be ready for use.

OPERATION

Correcting to Calibration

1. Before attempting to make any frequency adjustments, the heterodyne oscillator should always be corrected to agree with the calibration through comparison with

the crystal oscillator in the crystal check point nearest to the frequency desired. Comparison between the crystal and heterodyne oscillator may be made at many points over the calibrated range by using the fundamental or harmonic frequencies of either or both oscillators. Comparison between the two oscillators is obtained by rotating the heterodyne tuning control through a portion of the scale range corresponding to the crystal check point desired, and noting the beat tones as heard in the headset when plugged into the PHONES jack.

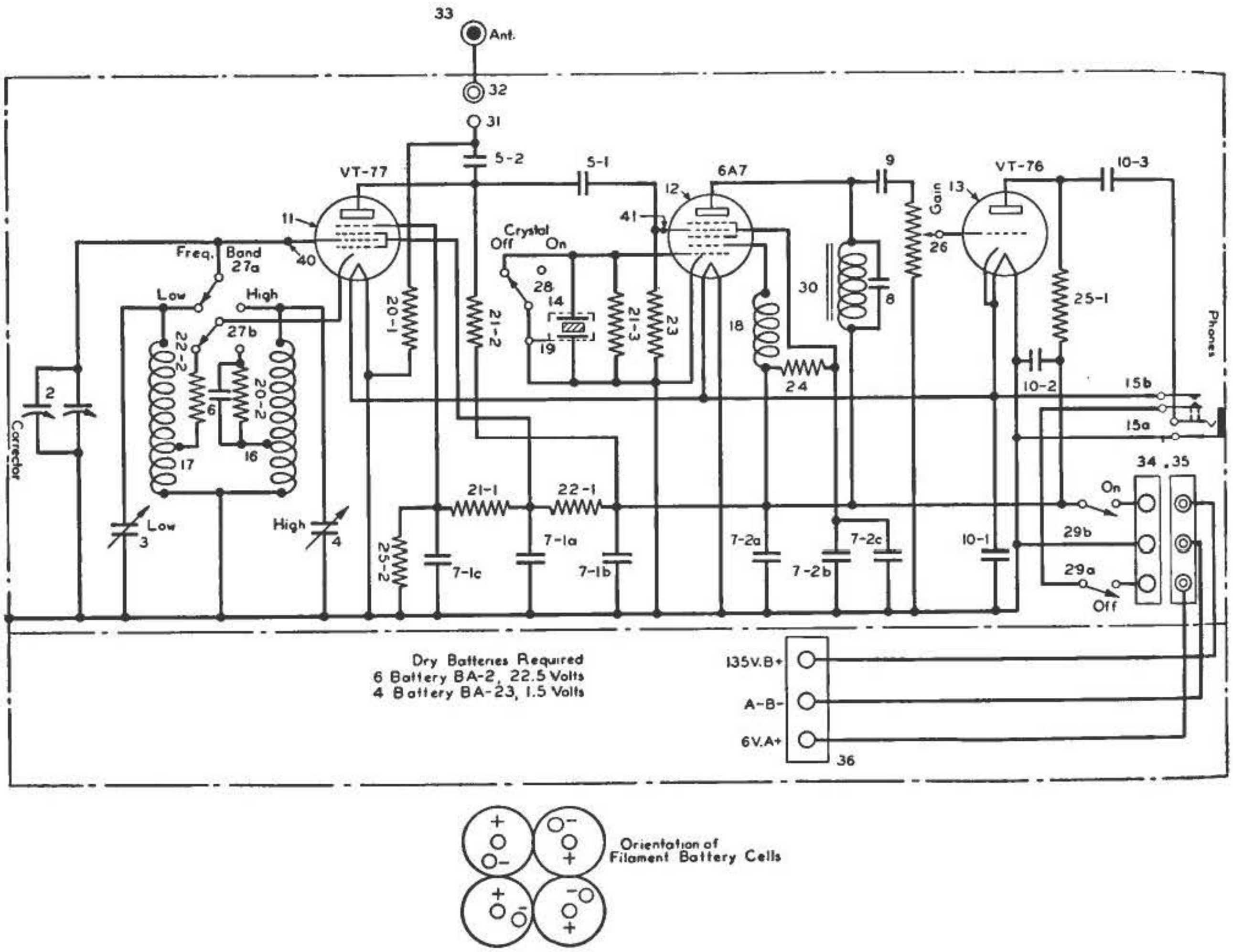


Figure 139. Frequency Meter BC-221-D, Schematic Diagram

2. To correct the heterodyne oscillator preparatory to setting on any desired frequency within the calibrated range, proceed as follows:
   a. From the HIGH or LOW frequency indices (the black pages between pages 26 and 27 of the charts supplied with the frequency meter) determine in which band the desired frequency is located, and set the FREQUENCY BAND switch to correspond.
   b. Also, from the frequency indices, ascertain on which page the desired frequency is listed, and turn to it. The crystal check point nearest the desired frequency will be found in Figure 142, together with its dial setting.

c. Set the heterodyne oscillator dials to agree with this crystal check point dial setting (CRYSTAL and POWER switches "ON"). A beat note should be heard in the phones, as a complete absence of beat note can result only from three possible conditions, i.e., when the heterodyne oscillator is exactly on calibration; when it is so far off calibration that the beat frequency is above audibility; and when the equipment is defective. However, if no beats are heard, either of the first two of these conditions may be determined by rotating the CORRECTOR dial (See Figure 129 and 131) to where the beats become audible, and noting the direction of change. If the third condition is the cause, no beats should be heard at any point in the complete heterodyne oscillator range.

d. With the heterodyne oscillator dials on the desired crystal check point setting; the heterodyne oscillator frequency should be adjusted as close to the crystal oscillator frequency as possible, by rotation of the CORRECTOR dial only. After the operator has become familiar with the equipment, it will be found that this adjustment can be precisely made to practically zero beat. All "locking in" tendencies have been minimized, and characteristic "rushes" due to the rise and fall of the beat frequency peaks are aurally recognizable well below the lower limit of audible tone

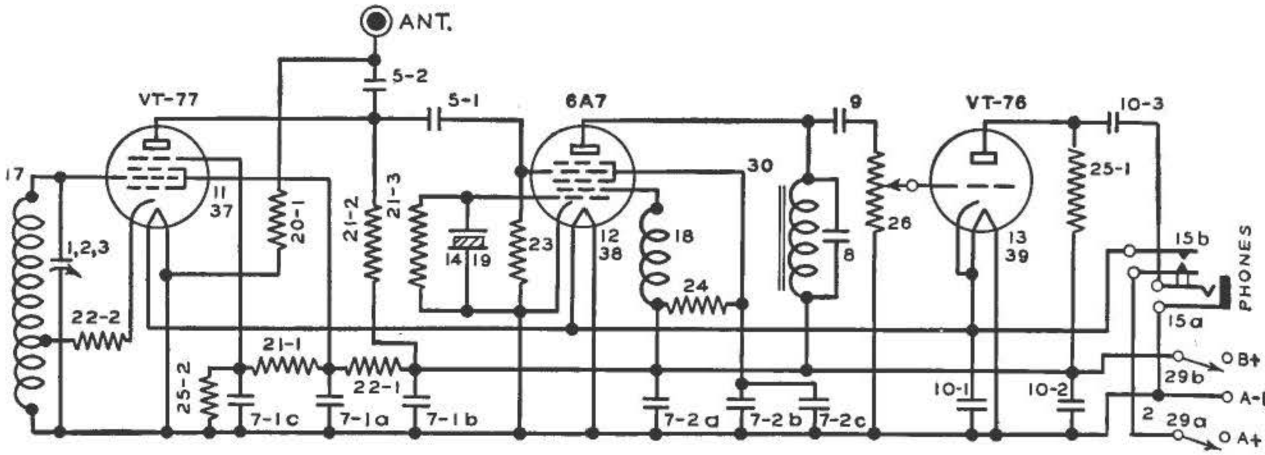
Accuracy of Calibration—When corrected as described above, the heterodyne oscillator frequency will agree with the calibration throughout the range of frequencies to which this particular crystal check point applies, provided that: the ambient temperature does not vary by more than ± 5°C; the filament voltage and plate voltage do not vary individually or collectively by more than ± 10°C and the frequency measurements under any or all of the conditions stated above are made not later than 15 minutes after correction.

READJUSTMENT OF TRIMMER CAPACITORS—It may be found that the heterodyne oscillator cannot be corrected to agree with the calibration as explained before, particularly if the frequency meter is being used in a locality where either extreme condition of humidity prevails. **Under such conditions, and then only,** it becomes necessary to reset the heterodyne trimmer capacitors 3 and 4. Access to the trimmer adjusting screws may be obtained through the holes marked LOW and HIGH on the right hand wall of the frequency meter chassis after it has been removed from the cabinet (See Figure 138). The chassis should be conveniently placed on a firm foundation to the right and in front of the cabinet, and the respective power input plugs and jacks should be interconnected with laboratory test leads. A small screwdriver will be required to make these adjustments, the necessary procedure being as follows:

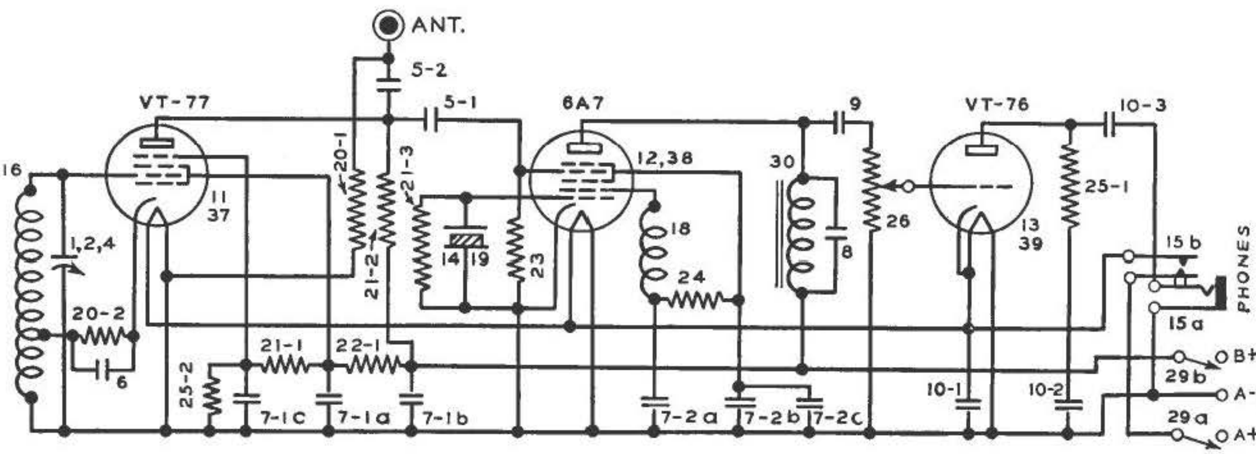
1. Place the unit in operation, with the FREQUENCY BAND switch set to LOW. Allow at least ten minutes for warm-up before proceeding.

2. Set the DIAL UNITS and DIAL HUNDREDS scales to agree with the reading given for 250 KC on page 26 of the calibration book. Set the CORRECTOR dial at midscale (4.5 divisions).

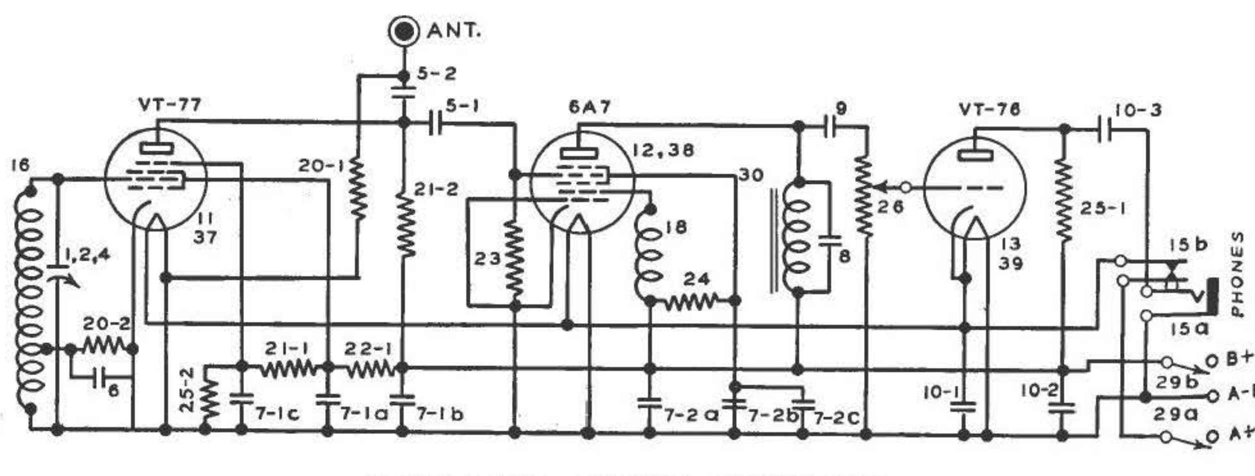
3. After making sure that the dials are set correctly as in above paragraph, rotate the trimmer capacitor (3) Figure 138 towards the right with a small screwdriver, while listening in the phones, until the heterodyne oscillator is set to zero beat of a strong beat with the crystal calibrator.



A-LOW BAND, CRYSTAL SWITCH ON



B-HIGH BAND, CRYSTAL SWITCH ON



C-HIGH BAND, CRYSTAL SWITCH OFF

Figure 140. Frequency Meter BC-221-D, Fundamental Circuits

4. Check the ability of the CORRECTOR Capacitor (2) Figure 131, to reset to zero beat all crystal check points listed on the black pages between pages 26 and 27 of the calibration book, proceeding as outlined in paragraph 1 under operation.
5. If the unit cannot be corrected at all of the crystal check points in the low band with the trimmer adjustment that was made with the CORRECTOR dial set at 4.5 for 250 KC, the processes outlined in (3) and (4) should be repeated, with the CORRECTOR dial set to 6 divisions for 250 KC.
6. By following this procedure, a setting of the low frequency trimmer will be found where it will be possible with the CORRECTOR capacitor to reset the unit to zero beat at all crystal check point readings given for the low band in the calibration book.
7. Repeat the above described processes with the FREQUENCY BAND switch set to the high frequency band and the DIAL UNITS and DIAL HUNDREDS scales set to agree with the reading given for 4000 KC on page 67 of the calibration book. Set the trimmer capacitor 4 Figure 138 to the position where it is possible with the CORRECTOR capacitor to reset to zero beat at all crystal check points listed for the high frequency band.

BEAT POINT IDENTIFICATION—It was stated that "comparison between the crystal and heterodyne oscillator may be made at many points over the calibrated range through the employment of the fundamental or harmonic frequencies of either or both oscillators." When correcting the heterodyne oscillator to calibration, it will be found that there are numerous beat points at various harmonic combinations which are not listed as crystal check points in the calibration book. In most cases, the intensity of these unlisted beat points is relatively low. In order that there may be no confusion as to the actual crystal check points, however, the beat points encountered at the various lowest harmonic combinations of the two oscillators (and the relative outputs for a typical Frequency Meter BC-221-D, with 6.0 volt filament and 135.0-volt plate supplies, GAIN control set at maximum) are given in the following tabulation. The calibrated crystal check points are marked with asterisks (*):

BEAT POINT

(Het. Fund. Freq.)	Approximate Dial setting	Lowest Het. Har.	Lowest Crystal Harmonic	Relative Output M. W. (500 CPS Beat)
Low Band				
125.00*	0226	8	1	22.5
128.21	0370	39	5	1.1
129.03	0404	31	4	2.0
130.43	0460	23	3	5.1
131.57	0504	38	5	1.3
133.33	0569	15	2	12.7
135.13	0615	37	5	1.3
136.36	0677	22	3	4.6
137.93	0731	29	4	2.4
138.88	0785	36	5	0.1
142.85*	0899	7	1	31.0

BEAT POINT—Continued

(Het. Fund. Freq.)	Approximate Dial setting	Lowest Het. Har.	Lowest Crystal Harmonic	Relative Output M. W. (500 CPS Beat)
Low Band				
147.05	0997	34	5	1.2
148.14	1075	27	4	4.1
150.00	1138	20	3	8.7
151.51	1169	33	5	2.4
153.84	1268	13	2	21.5
156.25	1349	32	5	2.6
157.89	1405	19	3	9.7
160.00	1477	25	4	4.7
161.29	1520	31	5	2.9
166.67*	1705	6	1	23.7
172.41	1898	29	5	3.4
173.91	1950	23	4	5.6
176.47	2038	17	3	11.5
178.57	2109	28	5	3.3
181.81	2218	11	2	25.2
185.18	2301	27	5	1.4
187.50	2414	16	3	15.8
190.47	2515	21	4	7.4
192.31	2579	26	5	4.3
200.00*	2846	5	1	33.0
208.33	3053	24	5	2.4
210.53	3220	19	4	9.8
214.28	3359	14	3	20.2
217.39	3472	23	5	5.5
222.22*	3655	9	2	20.2
230.76	3979	13	3	21.4
235.29	4158	17	4	13.0
238.09	4269	21	5	7.4
250.00*	4762	4	1	30.4
High Band				
2000*	0406	1	2	45.4
2125	0694	8	17	3.8
2143	0733	7	15	7.3
2166.6*	0783	6	13	12.5
2200	0853	5	11	22.9
2250*	0957	4	9	28.0
2286	1031	7	16	2.7
2333.3*	1130	3	7	32.2
2375	1216	8	19	1.0
2400	1268	5	12	11.2
2429	1326	7	17	1.2
2500*	1476	2	5	37.3
2571	1624	7	18	2.4
2600	1683	5	13	12.5
2625	1734	8	21	1.0
2666.6*	1820	3	8	31.5
2714	1918	7	19	1.1

BEAT POINT—Continued

(Het. Fund. Freq.)	Approximate Dial setting	Lowest Het. Har.	Lowest Crystal Harmonic	Relative Output M. W. (500 CPS Beat)
High Band				
2750*	1991	4	11	21.3
2800	2095	5	14	4.3
2833	2163	6	17	0.7
2857	2212	7	20	0.3
2875	2249	8	23	0.1
3000*	2502	1	3	40.0
3125	2729	8	25	0.5
3143	2757	7	22	0.9
3167	2842	6	19	4.5
3200	2911	5	16	9.3
3250*	3014	4	13	20.7
3286	3089	7	23	1.3
3333.3*	3190	3	10	28.0
3375	3278	8	27	0.2
3400	3331	5	17	3.8
3429	3391	7	24	0.5
3500*	3545	2	7	34.0
3571	3699	7	25	0.3
3600	3762	5	18	3.4
3625	3816	8	29	0.2
3666.6*	3907	3	11	25.0
3714	4011	7	26	0.3
3750*	4090	4	15	9.0
3800	4201	5	19	2.4
3833	4275	6	23	0.5
3857	4328	7	27	0.2
3875	4368	8	31	0.1
4000*	4651	1	4	34.5

RADIO TRANSMITTER ADJUSTMENTS—Briefly, the method of adjusting a radio transmitter to a desired frequency consists of zero beating the transmitter frequency with the proper heterodyne oscillator frequency, effecting the comparison by means of a headset plugged into the PHONES jack (15) Figure 131 located on the front panel of the frequency meter. The CRYSTAL switch (28) Figure 131 should be in the "OFF" position during the process.

Specifically, the procedure is as follows:

1. Correct the heterodyne oscillator to calibration at the crystal check point nearest to the desired frequency, as explained.
2. Turn the CRYSTAL switch to "OFF."
3. Turn the frequency meter tuning control (1) Figure 131 to the dial setting of the desired frequency, as given in the calibration book. Do not disturb the CORRECTOR (2) Figure 131, capacitor adjustment as made in (1).

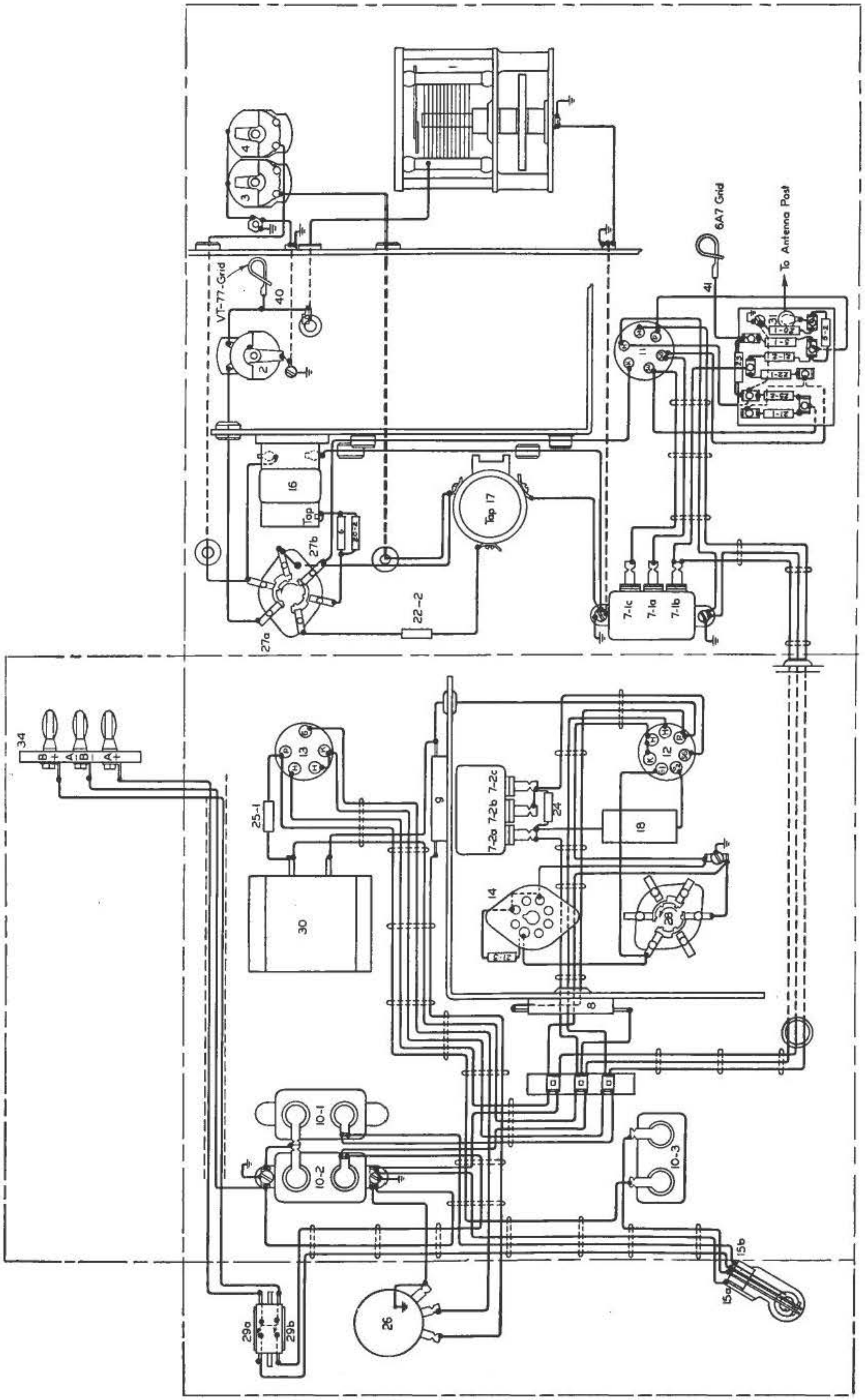


Figure 141. Frequency Meter BC-221-D, Chassis, Wiring Diagram

4. With the frequency meter antenna loosely coupled to the transmitter output, tune the radio transmitter to give an audible beat in the phones.
5. Adjust the GAIN control (26) Figure 131, to obtain a comfortable signal level in the headphones.
6. Tune the radio transmitter to zero beat with the frequency meter.
7. NOTE: For greater accuracy, operations (2) to (6) should be accomplished in the shortest possible interval following operation (1), otherwise changes in voltage or temperature or both, may cause the frequency meter to drift.

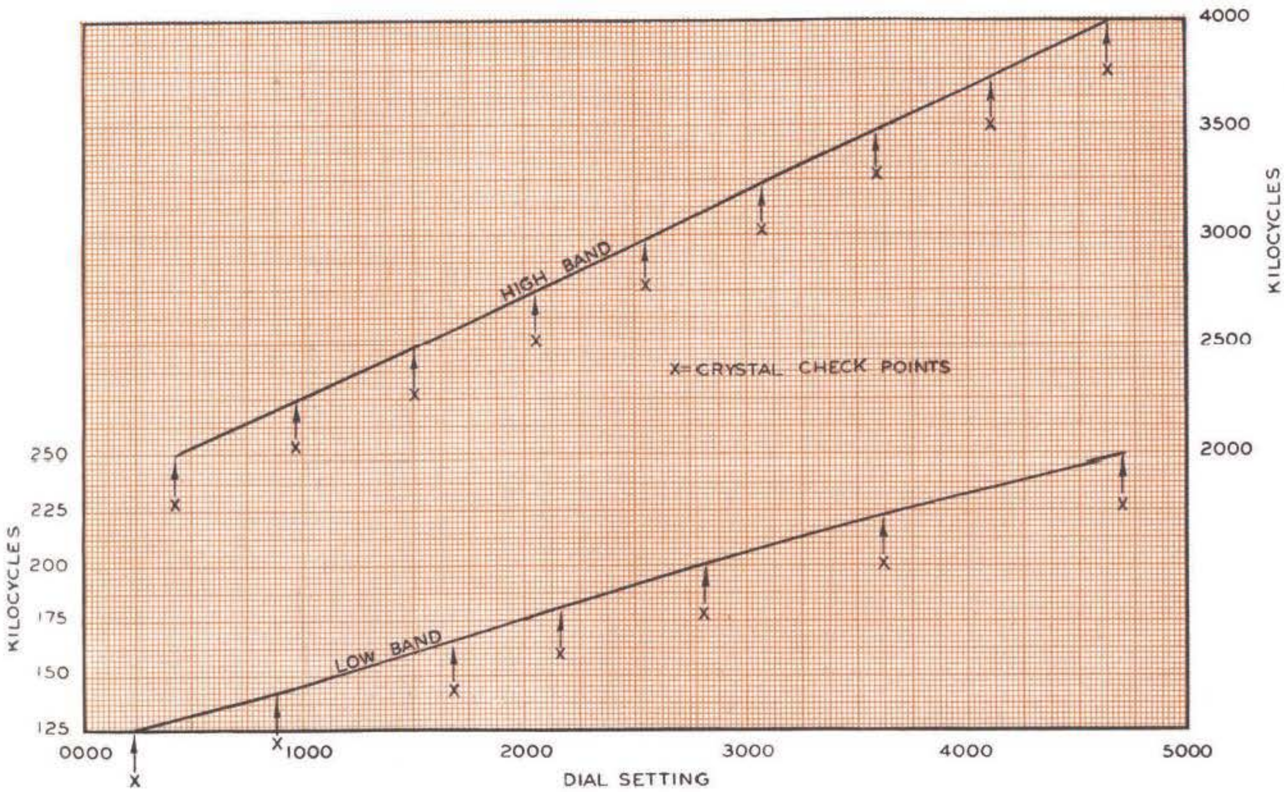
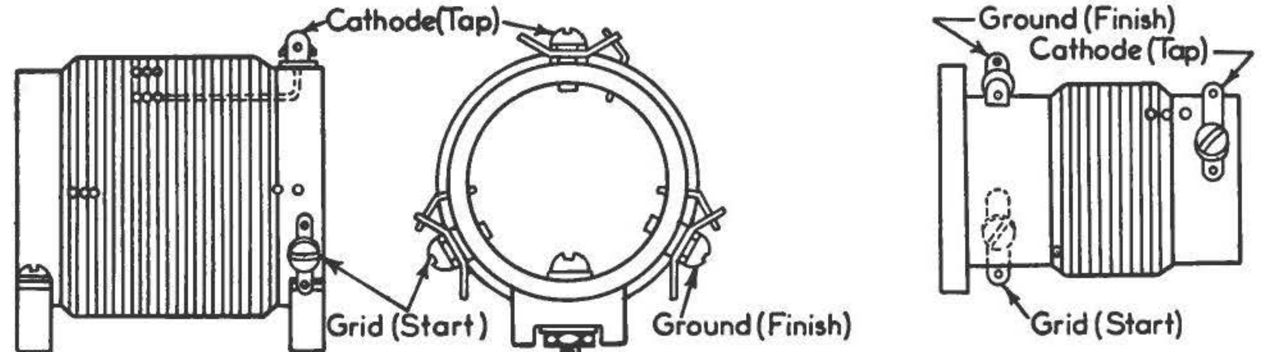


Figure 142. Typical Heterodyne-Oscillator Tuning Curves

RADIO RECEIVER ADJUSTMENTS—The method of adjusting a radio receiver to a desired frequency consists of tuning it to the proper heterodyne oscillator output frequency, and effecting the comparison by means of a pair of headphones connected to the receiver output circuit. The method varies with the character of signal reception involved, as detailed below.

1. To tune a CW RADIO receiver to a desired frequency, proceed as follows:
   a. Correct the heterodyne oscillator to calibration at the crystal check point nearest the desired frequency.
   b. Turn the CRYSTAL switch (28) Figure 131 to "OFF" and change over to a separate headset connected to the receiver output jack. Be sure to leave the headset for the frequency meter unit inserted in the jack (15) Figure 131 provided, other-



Low Frequency Coil, 17

540 Turns of No. 7/42 Litz SSC Wire, Close Wound, 6 Bank Winding with Tap 325 Turns from Grid End.

Inductance 9.05 to 9.23 MH

Q 60 at 77 KCS and 111 at 154 KCS.

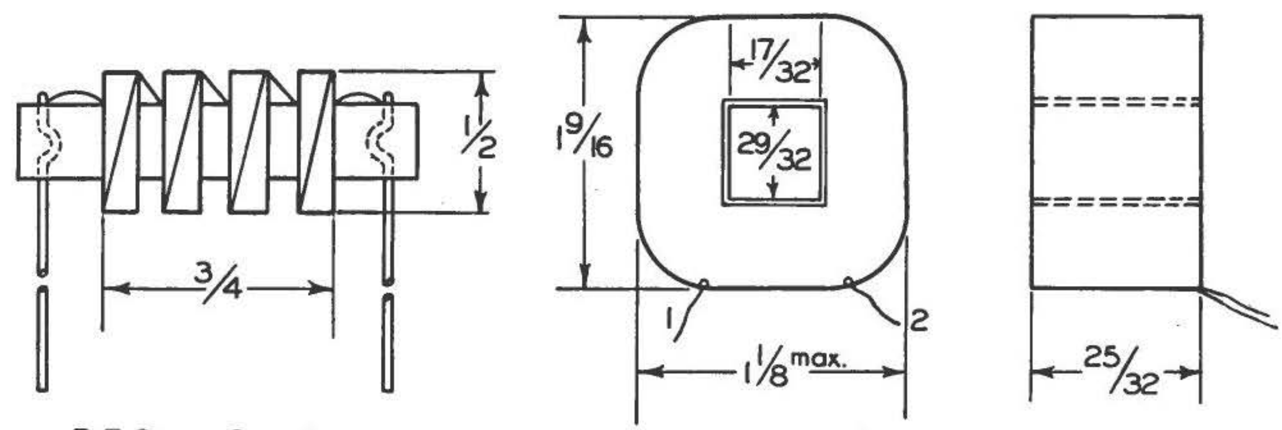
High Frequency Coil, 16

35 1/4 Turns of No. 28 DSC Copper Wire, Close Wound, Tap 26 1/2 Turns from Grid End.

Inductance 36.983 to 37.168 MMH

Q99 at 1250 KCS and 121 at 2500 KCS.

Above Coils Boiled in Superla Wax and Cold Dipped in Halowax



R.F. Choke Coil, 18

Universal Machine Setting

S.T. 1/8 Cam 116-60 Gainer 25

4 PI Winding Each PI 189 Turns

Inductance 1.7 MH ± 3%

D.C. Resistance 40 Ω Max.

Current Carrying Capacity .125 A

Audio Choke Coil, 30

Lamination: Allegheny EI-21 Audio "A", .014" Thick, 7/8" Stack, Stacked 3 Groups with 20 per Group, "E" for Keepers. Test Voltage 1500 V. rms between Core and Coil. B and S No. 41 E. Wire Wound over .030" Spiral Spool. 11,600 Total Turns with 187 Turns per Layer Making 62 Layers with a Wire Traverse of 21/32"

Insulation: Between Layers Single Thickness of .0006" Kraft, Over Coil Double Thickness of .005" Gummed Grey Kraft.

Figure 143. Frequency Meter BC-221-D, Coil Winding Data

wise the filament circuit will be opened and the frequency meter rendered inoperative.

c. Turn the frequency meter tuning control (1) Figure 131 to the dial setting of the desired frequency, as given in the calibration book and lock the dial. Do not disturb the CORRECTOR capacitor adjustment as made in paragraph on Trimmer Adjustment.

d. With the frequency meter antenna loosely coupled to the radio receiver antenna lead, tune the radio receiver to give an audible signal.

e. Adjust the radio receiver tuning to that side of zero beat which results in best reception conditions for the particular operator concerned.

f. NOTE: Make all adjustments and take all readings in the shortest possible time to assure that temperature or voltage changes will not affect the correctness of frequency meter calibration.

1. To tune MCW receiver to a desired frequency, the following procedure applies:

a. Correct the heterodyne oscillator to calibration at the crystal check point nearest to the desired frequency.

b. Turn the frequency meter tuning control (1) Figure 131 to the dial setting of the desired frequency as given in the calibration book. Do not disturb the CORRECTOR capacitor adjustment as made in paragraph on trimmer adjustment.

c. Turn the CRYSTAL switch (28) Figure 131 to "OFF."

d. Adjust the local unmodulated radio transmitter (but capable of being modulated) to zero beat with the frequency meter.

e. Change over to a separate headset connected to the receiver output jack, modulate the radio transmitter output and tune the receiver for maximum undistorted response. Be sure to leave the headset for the frequency meter unit inserted in the jack provided, otherwise the filament circuit will be opened and the frequency meter rendered inoperative.

FREQUENCY MEASUREMENTS

1. Frequency Meter Set SRC-211-D may also be employed for accurately measuring a frequency emitted from an external source, whether it be of local or remote origin, provided that such frequency lies within the calibrated range.

2. If it is desired to measure accurately the emitted frequency of an adjacent radio transmitter or oscillator, the frequency of which is approximately known, the heterodyne oscillator is first corrected to the crystal check point nearest to the approximately known frequency, as previously explained. Couple the frequency meter antenna loosely to the source and turn the CRYSTAL switch (28) Figure 131 to "OFF." The actual frequency is then determined by turning the frequency meter tuning control (1) Figure 131, to the zero beat point found nearest the setting given for the approximate frequency, and reading from the frequency column, opposite the resultant dial setting, in the calibration book.

3. If it is desired to measure accurately the unknown frequency of an adjacent radio transmitter or oscillator, it may be first roughly determined with the aid of an absorption type wave-meter, following which the actual frequency is determined as explained in paragraph 2 above.

4. When it is desired to measure accurately a frequency of remote origin, the signal is first tuned in on a radio receiver, and the approximate frequency noted from the radio receiver calibration. The heterodyne oscillator is next corrected to calibration at the nearest crystal check point. The CRYSTAL switch (28) Figure 131, is then turned to "OFF," the frequency meter antenna is loosely coupled to the radio receiver antenna lead, and the frequency meter tuning control (1) Figure 131, is turned until its signal is heard on the radio receiver headset. If the signal in question is CW in character, the receiver is tuned to zero beat with the incoming signal, and the frequency meter is then tuned to zero beat with the radio receiver. If the signal is modulated the receiver is first adjusted for maximum response in the MCW condition, after which it changed over for CW reception and the frequency meter is tuned to zero beat with this position of tuning on the receiver. In both cases, the frequency read from the appropriate column in the calibration book (for the resultant frequency meter dial setting) is the frequency of the signal in question.

MAINTENANCE—General—Frequency Meter BC-221-D is ruggedly constructed to withstand the shocks and strains which may be expected in military service. **Nevertheless, this equipment is extremely accurate and sensitive, and is therefore deserving of the careful handling normally accorded to precision instruments.**

Servicing—Normally, the only servicing required should be the replacement of batteries and vacuum tubes. This should be done at regular intervals, dependent on the amount of usage to which the equipment is subjected. It is further recommended that a single drop of Pioneer Ball Bearing Oil for Aircraft Instruments No. 2, or equal, be placed on the bearing races occasionally. Do not lubricate any other part of the equipment.

Resistors—The cartridge resistors supplied in this equipment are marked in accordance with the RMA Standard Color Code. The body color indicates the first figure of the resistance value, the colored end represents the second figure, and the color of the center stripe determines the number of ciphers to follow the first two figures:

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

Tube Voltages—The following tabulation, showing vacuum tube terminal voltages with respect to ground (chassis), is typical for Frequency Meter BC-221-D, with 6.0 volt filament and 135 volt plate supply, GAIN control set at maximum.

Socket	Voltage to Ground		
Terminal	VT-77	6A7	VT-76
Filament 1	6.0	6.0	0.0
Filament 2	0.0	0.0	6.0
Cathode	20.0	0.0	6.0
Inner Grid	None	− 10.0	None
Anode Grid	None	132.0	None
Control Grid	0.0	− 0.2	0.0
Screen	100.0	58.0	None
Suppressor	23.0	None	None
Plate	134.0	125.0	103.0

NOTE: The above values were obtained with a voltmeter having a resistance of 1000 ohms per volt, with a headset plugged into the PHONES jack and the various switches on Frequency Meter BC-221-D set to the following positions:

Switch	Position
FREQ. BAND	LOW
CRYSTAL	ON
POWER	ON

TROUBLE LOCATION AND REMEDY DATA—If the Frequency Meter BC-221-D fails to operate, the following procedure should be followed to determine and eliminate the cause of failure.

1. Check the operating control settings and for position of the knobs on their respective shafts.
2. Check the headset by removing and inserting in the phone jack. A click should be heard in the headset when inserted in the circuit.
3. Check the operation of the heterodyne oscillator by introducing an external signal of known frequency. A beat note should be heard in the headset when the heterodyne oscillator is tuned to this frequency. This same procedure applies to either band.
4. If the heterodyne oscillator is operating satisfactorily, check the crystal oscillator circuit operation by setting the heterodyne oscillator to a crystal check point and turning the crystal switch on and off. A beat note should be heard in the headset when the crystal is turned on. If no beat is heard, set the frequency band switch to the other band, set the heterodyne oscillator to a crystal check point, and repeat the operation described above. If no beat note is heard under either condition, the crystal oscillator circuit is inoperative.

If no indication of operation is noted from the above checks, remove the unit from the case and check the battery potentials on the jack strip (35), Figure 139, in the rear of the case. The voltages should check to within the following limits:

A-B − to B +	121.5 to 135 volts DC
A-B − to A +	5.4 to 6.0 volts DC

If the voltages check within specified limits and the equipment still does not operate, interconnect the jack strip (35) with the plug strip (34) by means of a patch cord, and set up the unit for operation outside its case. The following procedure should be followed to locate and isolate the cause of failure:

1. With the gain control set to maximum (full clockwise rotation), touch the center lug of the gain control (26) with the point of a screwdriver. A click or hum should be heard in the headset.
2. Repeat above procedure touching the grid cap of the type 6A7 tube. A click or hum should again be heard in the headset.
3. Repeat above procedure touching the grid cap Tube VT-77. A distinct click should be heard in the headset.

If trouble is indicated by one of the above checks, the tube in the circuit in which trouble is indicated should be replaced and the procedure repeated. If the trouble still persists, check the tube socket terminal voltages of the tubes. These values should check to within ± 10% of the values given in paragraph on tube voltages. Should any of the tube socket terminal voltages be outside of the required limits, the set should be disconnected and the circuit components checked, using the data in paragraph on "Continuity Test Table of Resistance to Ground" as a reference.

If, after a defect has been localized, the circuit components found to be in good condition, the unit is still not functioning properly, the wiring should be checked for continuity. Inspect the unit for broken or frayed insulation in the wiring, and loose or corroded connections to the components. Check the switch, jack, plug, and tube socket contacts for loose or corroded connections. Check the tube socket clamps for tightness. If the unit functions normally except that the output is below normal, check the residual magnetism of the headphones. There should be enough residual magnetism present to hold the diaphragm in place when the retaining cap is removed and when no current is flowing through the phones.

CONTINUITY TEST TABLE OF RESISTANCES TO GROUND—The resistance values should agree to within ± 10% of the values given in the table below. All measurements are made from the indicated terminal to ground. During the measurements the power switch should be set to "OFF," the crystal switch to set "ON," the headset should be plugged in the jack, and all tubes should be plugged in their sockets. ALL POWER SUPPLY CONNECTIONS SHOULD BE DISCONNECTED DURING THESE TESTS.

Tube Sockets			
	Tube VT-77	**Type 6A7**	**Tube VT-76**
Pin No. 1	0 ohms	0 ohms	0 ohms
Pin No. 2	125,000 ohms	80,000 ohms	90,000 ohms
Pin No. 3	65,000 ohms	78,000 ohms	0-500,000 ohms (Pot.)
Pin No. 4	15,000 ohms	75,000 ohms	0 ohms
Freq. Band Switch			
	Low	High	
Pin No. 5	10,000 ohms	5000 ohms	50,000 crystal switch ON 0 crystal switch OFF
Pin No. 6	0 ohms		0
Pin No. 7			0

Freq. Band Switch		
Low	High	
Cap 50 ohms	Approx. 1	1 Megohm

External antenna post to ground 5,000 ohms.

Set the power switch to "ON" and measure the resistance from the terminals of terminal board (34) Figure 139, to ground.

B +	– 75,000 ohms
A – B –	– 0 ohms
A +	– infinity ohms (with headset removed from jack)
	– ohms (with headset in jack)

With a set of headphones plugged into the phone jack, check the resistance across the terminals of the phone jack (15a) (See schematic diagram, Figure 139). The resistance indicated should be equal to the resistance of the headset (usually marked on the case of each telephone receiver). The resistance should be infinity with the phones removed from the jack.

The foregoing procedure will furnish a fairly complete continuity check of the unit. Generally, a low reading will indicate a short circuit, in which case check associated capacitor; and a high reading will indicate either a burned out resistor, a loose connection or an open circuit. If the tubes are removed from circuit, or if the tube filaments are burned out, the following tube socket terminals will have a resistance reading of infinity to ground: Tube VT-76 No. 4 and No. 5, Tube VT-77 No. 1, and commercial type tube 6A7 No. 1.

Inductor Data—Detailed winding information may be found in Figure 143, for the following inductors:

Symbol	Function
16	High Frequency Inductor
17	Low Frequency Inductor
18	RF Choke
30	Audio Choke

TABLE OF REPLACEABLE PARTS

Ref. No.	Stock No.	Name	Description	Function	Mfr.	Drawing Numbers	
						Bendix	Sig. Corps
1		Capacitor	0.00015 μf, variable, air dielectric with a 5 μμf, thermal compensator	Heterodyne Tuning	Bendix	AC55780-1	
2		Capacitor	2 μμf, variable, air dielectric, special	Het'dyne Corrector	Hamm	A18927	
3		Capacitor	10 μμf, adjustable, air dielectric, special	LF Heterodyne Trimmer	Hamm	A18922	
4		Capacitor	10 μμf, adjustable, air dielectric, special	HF Heterodyne Trimmer	Hamm	A18922	
5-1		Capacitor	10 μμf ± 10%, 500 volts, molded mica, Type 1468	Heterodyne Coupling	Aerovox	A18935-1	
5-2		Capacitor	10 μμf, ± 10%, 500 volts, molded mica, Type 1468	Antenna Coupling	Aerovox	A18935-1	
6		Capacitor	250 μμf, ± 10%, 500 volts, molded mica, Type 1468	HF Heterodyne Cathode By-pass	Aerovox	A25784-1	
7-1a, 1b, 1c		Capacitors	0.1 x 0.1 x 0.1 μf, + 14%, − 6%, 200 volts, paper dielectric, wax impregnated	Heterodyne Screen, Plate and Suppressor By-pass	Aerovox	A18933-1	
7-2a, 2b, 2c		Capacitors	0.1 x 0.1 x 0.1 μf + 14%, − 6%, 200 volts, paper dielectric, wax impregnated	Crystal Anode and Detector, Screen By-pass	Aerovox	A18933-1	
8		Capacitor	0.001 μf ± 10%, 600 volts, molded mica, Type 1455	Detector Plate By-pass	Aerovox	A18936-1	
9		Capacitor	0.02 μf ± 10%, 600 volts, molded mica, Type 1455	Audio Input Coupling	Aerovox	A18936-2	
10-1		Capacitor	0.5 μf + 14%, − 6%, 200 volts, paper dielectric, wax impregnated	Filament By-pass	Aerovox	A18932-1	
10-2		Capacitor	0.5 μf + 14%, − 6% 200 volts, paper dielectric, wax impregnated	Audio Plate By-pass	Aerovox	A18932-1	
10-3		Capacitor	0.5 μf + 14%, − 6%, 200 volts, paper dielectric, wax impregnated	Audio Output Coupling	Aerovox	A18932-1	

11		Tube Socket	6-contact, Type S6	VT-77 Socket	Amphenol	A18955-3	
12		Tube Socket	7-contact, small, Type S7S	6A7 Socket	Amphenol	A18955-4	
13		Tube Socket	5-contact, Type S5	VT-76 Socket	Amphenol	A18955-2	
14		Crystal Socket	8-contact, octal, isolantite, Type XC8	Crystal Socket	National	AA12338	
15a-b		Telephone Jack & Filament Switch	Single circuit, filament control, Type 703	Telephone Jack and Filament Switch	Yaxley	A18946	
16		Inductor	Assembly, for details see note (1)	Heterodyne HF	Bendix	AA17560	
17		Inductor	Assembly, for details see note (2)	Heterodyne LF	Bendix	AA17559	
18		Choke	1.7 MH ± 5%, universal winding, sealed	Crystal Anode RF	Bendix	AA19690	
19		Crystal Unit	Assembly, for details see note (3), Type DC-9-C	Crystal and Container	Bendix	AC57360	
20-1	3Z452-8	Resistor RS-128	5000 Ω ± 10%, ½W, metallized, insulated, Type BT-½	RF Output Terminating	IRC	A11207-23	SC-D-970
20-2	3Z4528	Resistor RS-128	5000 Ω ± 10%, ½W, metallized, insulated, Type BT-½	Heterodyne HF Cathode	IRC	A11207-23	SC-D-970
21-1	3Z4531	Resistor RS-131	50,000 Ω ± 10%, ½W, metallized, insulated, Type BT-½	Heterodyne Screen Bleeder	IRC	A11207-42	SC-D-970
21-2	3Z4531	Resistor RS-131	50,000 Ω ± 10%, ½W, metallized, insulated, Type BT-½	Heterodyne Plate	IRC	A11207-42	SC-D-970
21-3	3Z4531	Resistor RS-131	50,000 Ω ± 10%, ½W, metallized, insulated Type BT-½	Crystal Bias	IRC	A11207-42	SC-D-970
22-1	3Z4529	Resistor RS-129	10,000 Ω ± 10%, ½W, metallized, insulated Type BT-½	Heterodyne Screen Dropping	IRC	A11207-29	SC-D-970
22-2	3Z4529	Resistor RS-129	10,000 Ω ± 10%, ½W, metallized, insulated, Type BT-½	Heterodyne LF Cathode	IRC	A11207-29	SC-D-970
23	3Z4534	Resistor RS-134	1.0 Megohm ± 10%, ½W, metallized, insulated, Type BT-½	Detector Grid Leak	IRC	A11207-57	SC-D-970
24	3Z4540	Resistor RS-140	30,000 Ω ± 10%, ½W, metallized, insulated, Type BT-½	Detector Screen	IRC	A11207-39	SC-D-970

TABLE OF REPLACEABLE PARTS—Continued

Ref. No.	Stock No.	Name	Description	Function	Mfr.	Drawing Numbers	
						Bendix	Sig. Corps
25-1	3Z4609	Resistor RS-209	15,000 Ω ± 10%, ½W, metallized, insulated, Type BT-½	Audio Plate Load	IRC	A11207-34	SC-D-970
25-2	3Z4609	Resistor RS-209	15,000 Ω ± 10%, ½W, metallized, insulated, Type BT-½	Heterodyne Suppressor	IRC	A11207-34	SC-D-970
26		Potentiometer	500,000 Ω ± 10%, 1W, impregnated strip, curve No. 1, Type 72-106	Gain Control	Centralab	A18948	
27a, b		Switch	DPDT, rotary, special	Frequency Band	Oak	C56544-1	
28		Switch	DPDT, rotary, single pole used, special	Crystal On-Off	Oak	C56544-2	
29a, b		Switch	DPST, (on-off) toggle, Type 20902	Power On-Off	H & H	A18947	
30		Choke	450H ± 10%, 1MA DC	Audio	Bendix	AA16988-1	
31		Plug	Single contact	Antenna	Bendix	A18986	
32, 33		Terminal Post	Screw plunger type, assembly, for details see note (4)	Antenna Terminal	Bendix	AR95415	
34		Plug	3-contact	Power Input	Bendix	AA18994-1	
35		Jack	3-contact	Power Input	Bendix	AA25002-1	
36		Terminal Board	3-contact, screw terminals	Battery	Bendix	AA25732-1	
37	2T77	Tube VT-77	Triple grid, Type 77	Het'dyne Oscillator	RCA	None Per	Spec. 71-777
38		Tube	Pentagrid converter, Commercial Type 6A7	Crystal Oscillator and Detector	RCA	None	
39	2T76	Tube VT-76	Super triode, Type 76	Audio Amplifier	RCA	None Per	Spec. 71-776
40, 41		Grid Clips	Spring release, Type 24	For Tube VT-77, 6A7	National	A221-1	
		Knob	Knurled grip	Corrector	Bendix	A18956-1	
		Knob	Knurled grip	Volume Control	Bendix	A18956-1	

		Knob	Knurled grip	Band Switch	Bendix	A18956-1	
		Knob	Knurled grip	Crystal Switch	Bendix	A18956-1	
		Ring Assembly	Mounting plate, two used	For Fastening Dee Ring to Cabinet	Bendix	A11756	
		Ring Assembly	Dee ring, two used	For attaching Strap	Bendix	A10363	
		Bushings	Isolantite, used in pairs	ST-19-A to Cabinet			
		Bushings	Isolantite, used in pairs	Feed Through	Am. Lava	A18945	
		Supports	Isolantite, used in pairs	Wire Supports	Am. Lava	A1693	
		Plugs	Banana type, three used	Power	Johnson	A25191-2	
		Jacks	For banana plugs, three used	Power	Johnson	A25190	
		Wire	Lenz RF	Hook-up	Lenz	A12972-95	
		Cable	Rubber covered, single conductor No. 18, Type S-600 V. W. P.	Battery	Simplex	AC56508	
b.		Note No. (1) Heterodyne oscillator high frequency			Bendix	AA17560-1	
		Coil assembly, wax impregnated			Bendix	BM-101	
		Coil form, isolantite			Am. Lava	A2021	
		Wire, No. 28 DSC copper			Belden	A16376-28	
c.		Note No. (2) Heterodyne oscillator low frequency			Bendix	AA17559-1	
		Coil assembly, wax impregnated			Am. Lava	BM-101	
		Coil form, isolantite			Am. Lava	A1867	
		Mounting blocks, two used			Am. Lava	A1697	
		Wire, 7-42 Litz SSC			Acme	A326	
d.		Note No. (3) Crystal Unit DC-9-D			Bendix	AC57360-2	Spec. 71-811
		Adjustable electrode			Bendix	A1601	

TABLE OF REPLACEABLE PARTS—Continued

Ref. No.	Stock No.	Name	Description	Function	Mfr.	Drawing Numbers	
						Bendix	Sig. Corps
		Holder-plate electrode			K-K	A29427	
		Crystal, 1 MC, A cust, BM-53			Bendix	A1846	
		Fixed electrode			Bendix	A29426	
		Shell, Type 6J5 tube			Raytheon	A100012	
		Header, metal tube, two leads			Raytheon	AA29397	
		Insulator			Bendix	A1583	
		Base, octal tube			Raytheon	A3178	
3.		Note No. (4) Antenna terminal post assembly			Bendix	AR95415	
		Spring			Bendix	A25606	
		Spacer			Bendix	A7254	
		Guide pin			Bendix	A7255	
		Post, screw plunger type			Eby	A10236	
		Bushings, isolantite, pair			Am. Lava	A18945	
		Washer, untreated fishpaper			W.E.& M. Co.	A25046-1	
		Washer, untreated fishpaper, pair			W.E.& M. Co.	A10859-1	

IDENTICAL AND INTERCHANGEABLE ITEMS

Ref. No.	Stock No.	Name	Description	Function	Mfr.	Bendix	Sig. Corps
3, 4		Capacitors	10μμf, adjustable, air dielectric, special	Trimmers	Hamm	AA18922	
5-1, 5-2		Capacitors	10μμf, ± 10%, 500 volts, molded mica, Type 1468	Coupling	Aerovox	A18935-1	
7-1a, 1b, 1c		Capacitor	0.1 x 0.1 x 0.1 μf, + 14% −6%, 200 volts, paper dielectric, wax impregnated	By-pass	Aerovox	A18933-1	

10-1, 2, 3		Capacitors	0.5 μf + 14%, −5%, 200 volts, paper dielectric, wax impregnated	By-pass and Coupling	Aerovox	A18932-1	
20-1, 2	3Z4528	Resistors RS-128	5000 Ω ± 10%, ½W, metallized, insulated, Type BT-½		I.R.C.	A11207-23	SC-D-970
21-1, 2, 3	3Z4531	Resistors RS-131	50,000 Ω ± 10%, ½ W, metallized, insulated, Type BT-½		I.R.C.	A11207-42	SC-D-970
22-1, 2	3Z4529	Resistors RS-129	10,000 Ω ± 10%, ½W, metallized, insulated, Type BT-½		I.R.C.	A11207-29	SC-D-970
25-1, 2	3Z4309	Resistors RS-209	15,000 Ω ± 10%, ½W, metallized, insulated, Type BT-½		I.R.C.	A11207-34	SC-D-970
40, 41		Grid Clips	Spring release, Type 24	For Tube VT-77	National	A1221-1	
		Knobs	Knurled grip, four used	Type 6A7	Bendix	A18956-1	
		Ring Assembly	Mounting plate, two used	For Fastening Dee Ring to Cabinet	Bendix	A11756	
		Ring Assembly	Dee Ring, two used	For attaching Strap ST-19-A to Cabinet	Bendix	A10363	
		Bushings	Isolantite, used in pairs	Feed through	Am. Lava	A19845	
		Supports	Isolantite, used in pairs	Wire supports	Am. Lava	A1693	
		Plugs	Banana type, three used	Power	Johnson	A25191-2	
		Jacks	For banana plugs, three used	Power	Johnson	A25190	

LIST OF SPARE PARTS

The following spare parts are supplied inside the cabinet of each Frequency Meter BC-211-D:

Reference	Name	Quantity	Mfr.
19	Crystal Unit DC-9-D	1	Bendix
37, 38, 39	Vacuum tubes	1 set*	R.C.A.
MC-177-D	Calibration Book MC-177-D (Untyped)	1	Bendix

*A second spare set is shipped in bulk.

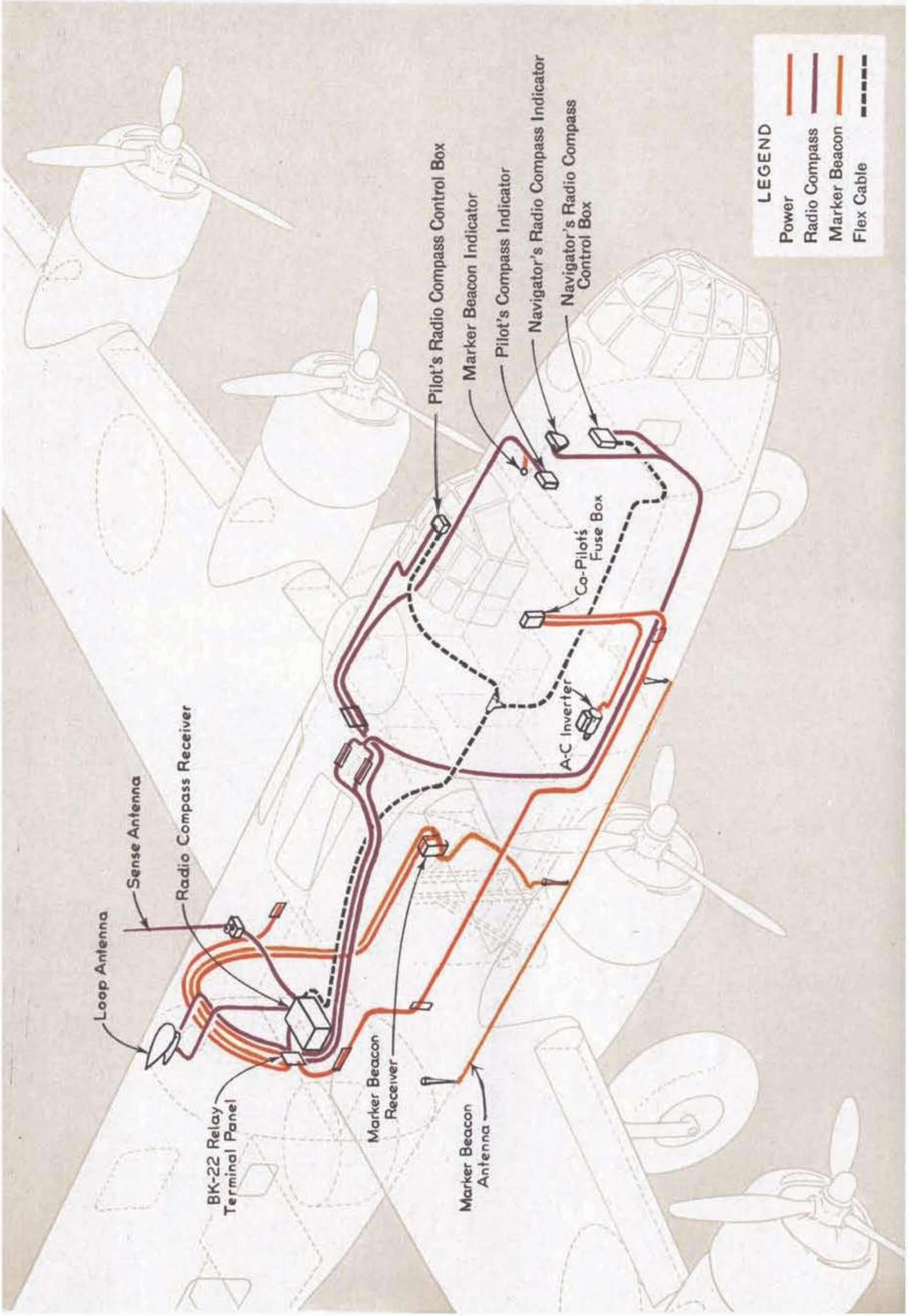
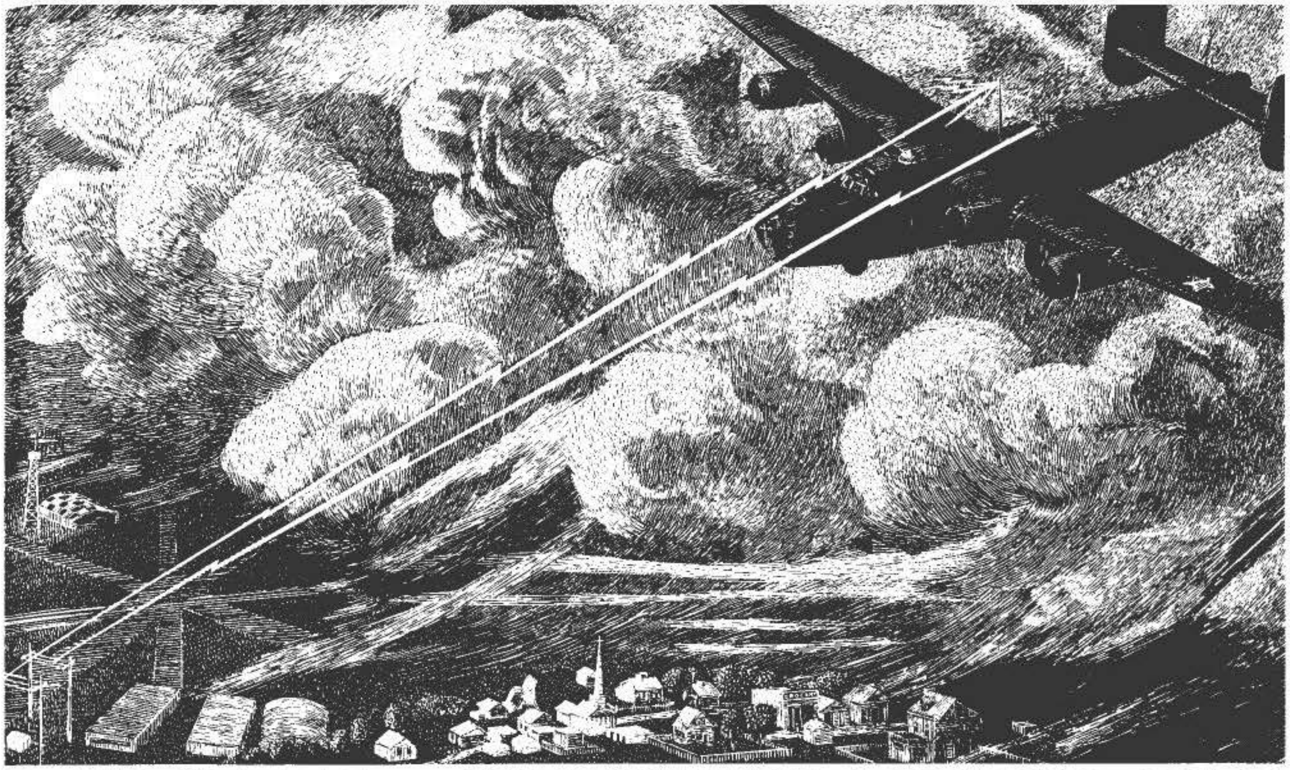


Figure 144. General Location of Compass and Marker Beacon Equipment and Main Cable Routing



Chapter V

RADIO COMPASS EQUIPMENT

RADIO COMPASS EQUIPMENT SCR-269-C—Unit 4—The SCR 269-A equipment consists of the following:

Unit 4-1 One BC-433-C Receiver located over the bomb bay and aft of the wing center section. Frequency range 200 to 1750 KC Figure 147.

4-2 Two BC-434-A Remote Control Boxes. One on forward side of bulkhead.

4-6 Compass receiver Remote Control Box at Station 1.0 for Navigator, Figure 146, and one topside above Pilot's Pedestal for use of Pilot or Co-Pilot Figure 148.
Three MC-124 flexible shafts, for remote control.
One MC-203 Flexible shaft "T" connector.

4-3 One 1-81-A Pilot's Indicator on Pilot's Panel. Figure 24.

4-4 One 1-82-A Navigator's Indicator—bulkhead at Station 1.0 above Navigator's Table, Figure 146.

4-5 One BK-22-A Relay terminal panel in junction panel box alongside of radio receiver, above bomb bay. Figure 149.

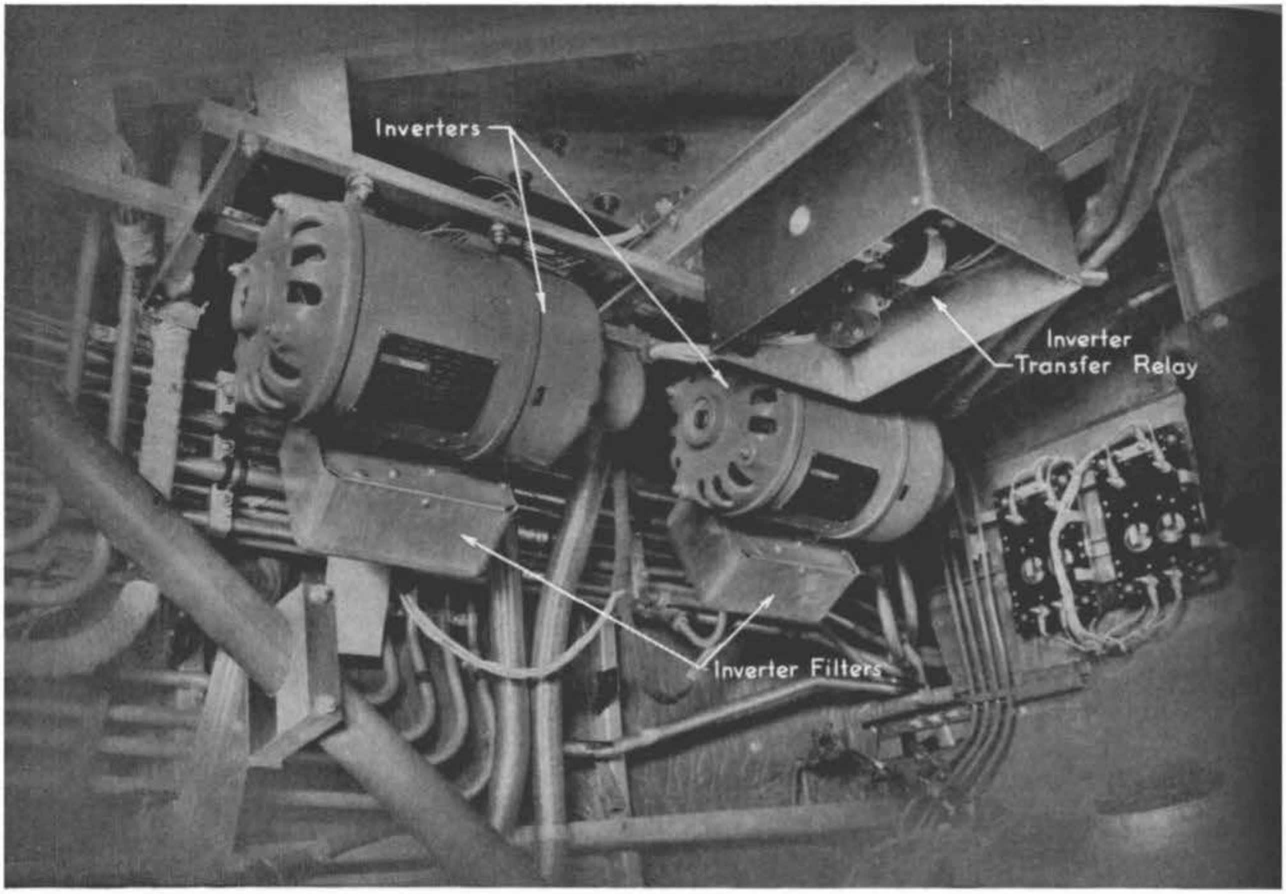


Figure 145. Inverter Installation Under Flight Deck

One LP-21-A Rotatable Loop in streamline housing, topside of ship at aft end of bomb bay.

One CD-365 Cord, connecting loop and receiver.

The radio compass receiver, Figure 147, is a 15 tube superheterodyne receiver using 24 to 28 volts DC for operation of the relays and 110 volts AC at 400 cycles for operation of the radio circuits. This 110V is supplied by the inverters, Figure 145, which are under the flight deck and which also supply the power for the various autosyn instruments and the fluorescent and instrument lighting. The LP-21-A loop is electrically driven and may be controlled from either of the two remote control boxes. The output of the compass receiver connects through the interphone system and hence can be heard at any interphone station in the airplane.

Radio Compass Operation—The radio compass may be operated electrically or manually, but not by both simultaneously, from the remote control boxes, Figures 146 and 148. For electrical control depress the button marked "Control" (8) in the lower right corner. When control is established, a green indicating light (10) will be illuminated on the face of the remote control panel.

The equipment is turned "ON" and "OFF" with a four position switch (11) on the face of the remote control units. This switch (11) is marked "OFF"—"COMPASS"—"ANT." — "LOOP." In the compass position, both the loop and the fixed antenna are connected. In the antenna position, the fixed antenna only is used. In the loop position, only the loop is used. Band selection is accomplished by rotating the selector switch (5) to the frequency band desired as indicated on the dial (2) then tuning to desired frequency by operation of tuning control (9). Brilliancy of dial illumination is controlled by the rheostat (3) on the face of the control box. **Always tune for maximum swing of the carrier meter (4)** located in the upper right corner of the control box, Figure 148.

ADJUSTMENTS AFTER INSTALLATION—After the radio compass has been installed in the aircraft, the following tests and adjustments should be made before placing the equipment in service:

Initial Checks

1. Before turning on the radio compass, check the battery voltage and polarity from terminal (61) on the Relay BK-22-A terminal panel to ground (See Figure 149). The inverters should be checked to see that their supply of input voltage is up to rated requirement. If the supply voltage is 24-28 volts, the link between terminals (59) and (60) on the relay terminal panel should be removed.
2. Check the vacuum tubes to ascertain that they are securely seated in their sockets, and that the grid clips and grid shields are making positive contact and are not shorting. (See Figure 157.)

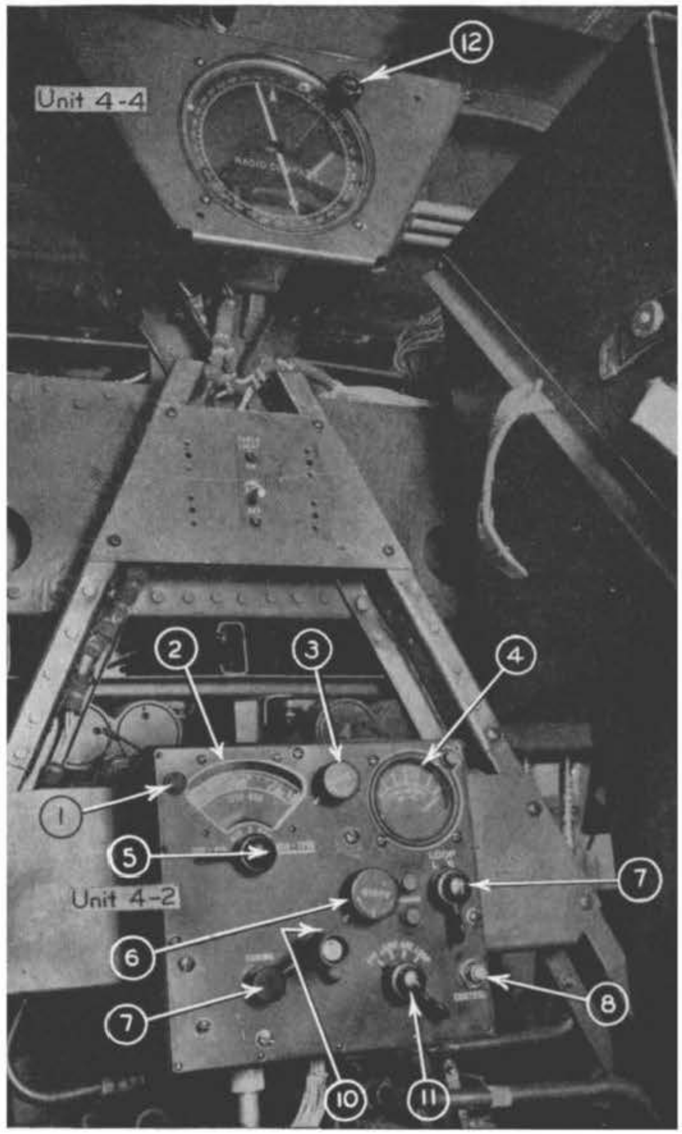


Figure 146. Navigator's Radio Compass Control and Indicator

Unit 4-2—Radio Compass Remote Control Box (BC 434-A)

(1)—Dial Light
(2)—Dial—Tuning
(3)—Dial Light Rheostat
(4)—Tuning Indicator
(5)—Band Change Switch
(6)—Volume Control
(7)—Loop Control Switch
(8)—Control Switch
(9)—Tuning Control
(10)—Control Indicator Light
(11)—Power & Antenna Switch

Unit 4-4—Radio Compass Indicator 1-82-A

(12)—Compass Indicator Variation Control

3. Inspect the loop to see that it is securely and properly mounted. The mounting screws must be properly locked and waterproofed with Permatex No. 1 sealing compound, or equal. Check the loop housing and base casting for damage or cracks which may weaken it or admit moisture and thus impair compass operation. Be sure that index lines on the fore and aft edges of the mounting plate are exactly in line with the fore-and-aft axis of the aircraft.

4. Test the operation of tuning shaft and Coupling MC203 or MC203-A and the connections at both radio control boxes. When properly connected, the "ALIGN" mark on both radio control boxes should coincide and be aligned with the dial index when the stop is reached.

5. Check the Mounting FT-213-A base screws, and the Dzus fasteners which hold the Radio Compass Unit, BC-433-C, to the mounting. Be sure the ground strap is securely clamped under the wing nut of the "GROUND" post (19) Figure 147.

6. Check the Radio Control Boxes BC-434-A Figures 146 and 148 for tightness of mounting to aircraft structure, and check mounting screws on panel for tightness.

7. Check the non-directional antenna, and see that the connections are properly made. In installations where no lead-in shield is employed, the "SHIELD" post is to be securely and directly connected to the "GROUND" with the ground strap provided. When a lead-in shield is employed, this shield is to be connected to the "SHIELD" post. In the latter type of installation, it is also recommended that the "SHIELD" post

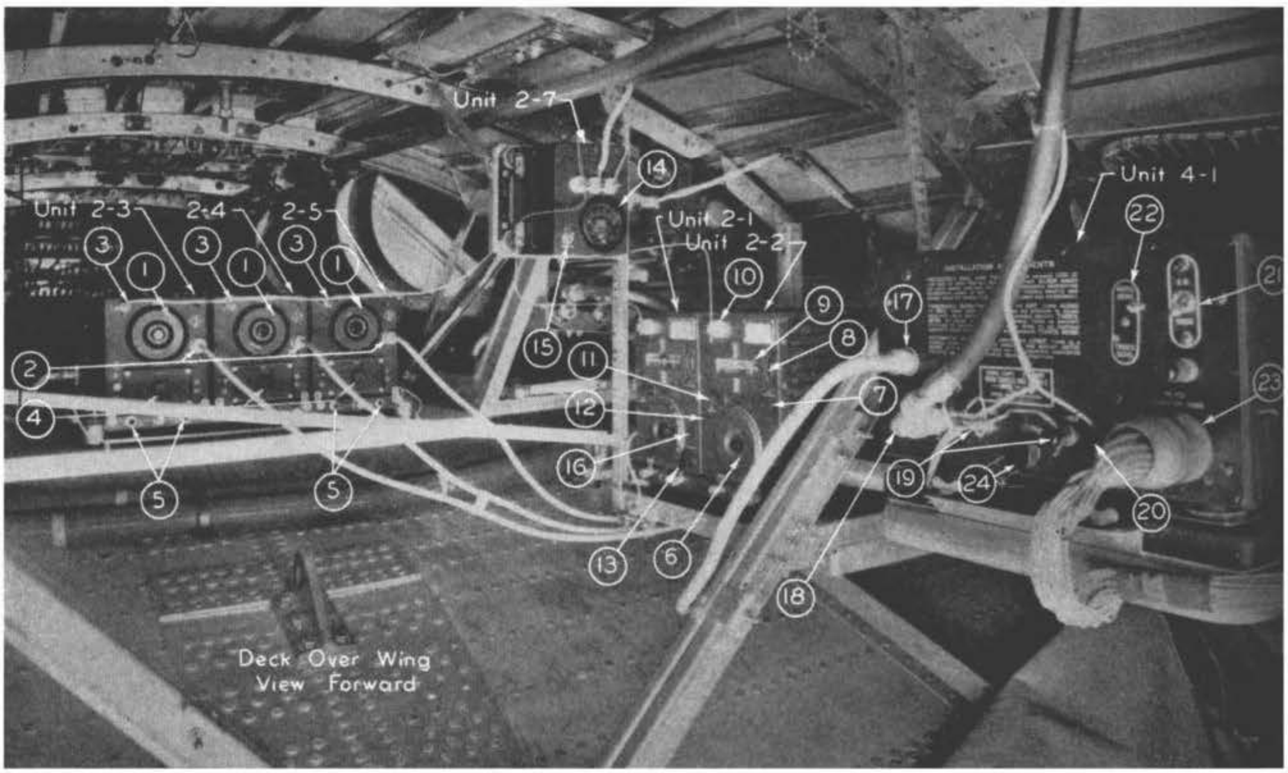


Figure 147. Radio Equipment Over Wing Center Section Showing Compass Receiver

Unit 2-3 (BC 453-A), 2-4 (BC 454-A) and 2-5 (BC455-A)—Command Receivers
(1)—Receiver Tuning Dials
(2)—Flexible Tuning Shafts & Connectors
(3)—Antenna Connection for Receivers
(4)—Covers
(5)—Phone Jacks
Unit 2-1 (BC 458-A), and 2-2 (BC 459-A) —Command Transmitters
(6)—Transmitter Tuning Dial
(7)—Antenna Inductance Tuning Lock
(8)—Antenna Inductance Tuning Control
(9)—Antenna Inductance Tuning Dial
(10)—Antenna Connection for Transmitters
(11)—Antenna Coupling Control
(12)—Lock
(13)—Tuning Control
(16)—Lock
Unit 2-7 (BC 442-A)—Command Antenna Switching Relay
(14)—Antenna Ammeter
(15)—Ammeter Selector Switch
Unit 4-1 (BC 433-C)—Compass Receiver
(17)—Compass Receiver Flexible Tuning Shaft
(18)—Loop Connector Cable
(19)—Ground Connection
(20)—Sense Antenna Connection
(21)—CW—Voice Selector Switch
(22)—Sensitivity Adjustments
(23)—Connector Plug
(24)—Release

be connected to the "GROUND" post, except in those installations where lower noise level is secured by the omission of this connection. (See (19) Figure 147.)

8. Be sure that Cord CD-365 or CD-365-A (18) Figure 147, is secured and that ground braids at each end of the cord are bonded to the structure of the aircraft. Check the tightness of the Plugs PL-108 and the ferrule couplings on the plugs.

9. Check for presence and operation of instrument lights. Also check light controls.

10. Using Headset HS-18, check loop and antenna operation on all three bands, then check compass operation and indicator response. Jar the Radio Compass Unit, BC-433-C, Unit 4-1 Figure 147, to check for possible sources of noise.

11. Switch the complete equipment on and off, and note whether or not the magnetic compass is affected.

12. Check for effects of other radio equipment in the aircraft upon the communicational and navigational performance of the radio compass. Also determine the extent of any interference produced by the radio compass in the other radio equipment.

13. Tune the Radio Compass to a transmitting station and operate on the "COMP." "ANT.," and "LOOP" positions (11) Figures 146 and 148. Observe the tuning meters (4) Figures 146 and 148, and indicators Unit 4-4 Figure 146 and 4-3 Figure 24, to be sure that they are functioning properly.

14. Switch (11) to "LOOP" and tune to several transmitting stations, to see that the sensitivity is satisfactory. Operate "AUDIO" control (6) to see that it controls the headset volume properly. Operate the "LOOP L-R" switch (7) to see that it is operating properly. When it is turned to "R," the bearing indicator pointers should rotate clockwise at a speed of approximately 1 degree per second; and when it is turned to "L," the bearing indicator pointers should rotate counter clockwise at a speed of approximately 1 degree per second. Similarly, if this switch is first pushed inward toward the panel and then turned to "R" and "L" the indicator pointers should rotate clockwise and counter clockwise, respectively, at a rate of 30-40 degrees per second. When checking reception of transmitting stations, rotate the loop by means of the "LOOP L-R" switch, for maximum headset volume. On a clear day, and at a location from electrical disturbances, it should be possible to clearly receive radio range signals 50 to 100 miles distant and broadcast signals 100 to 250 miles distant, depending upon the station power and external interference.

15. Switch (11) to "COMP." and head the aircraft directly toward a transmitting station. (Very accurate means should be used for determining this heading.) Tune the radio compass to this transmitting station. The indicator pointer should immediately swing to the zero index within ±2 degrees. The accuracy of this zero heading bearing will depend upon: (a) accuracy with which fore-and-aft line of the aircraft was aligned with the line of direction of the transmitting station; (b) accuracy with which the loop mounting base was aligned with the fore-and-aft line of the aircraft; (3) amount of distortion in direction of arrival of the radio waves caused by the unsymmetrical location of the loop with respect to the metal mass of the aircraft and location of other unsymmetrical antennae or masts; and (d) error in radio compass equipment, which does not exceed ± 1 degree under normal conditions at zero heading. An error in in-

dicated zero heading of not over ± 3 to ± 5 degrees will not be serious if the cause of this error can be definitely shown to be caused by (c) above, since this error is a function of the particular aircraft installation and can be corrected when the radio compass deviation correction is applied to the compensator. If the bearing indicator pointer should swing to 180 degrees instead of 0 degrees, it indicates that the sensing is not correct. This is a result of faulty interconnection of the components, in accordance with instructions in circuit diagram in Figure 152.

16. Swing the heading of the aircraft approximately 15 degrees to the right of the line of direction of the transmitting station. The bearing indicator pointer should swing immediately to an approximate azimuth reading of 345 degrees. If the pointer should swing to 15 degrees, instead of 345 degrees, it indicates improper interconnection of the components for the location of the loop in this installation.

17. Swing the heading of the aircraft toward the transmitting station again. Switch to "LOOP," and rotate loop for an azimuth reading of 175 degrees, as indicated by the bearing indicator pointer. Switch to "COMP.," and the pointer should return to the zero reading at a rate of 35 to 40 degrees per second if the AC-supply voltage is 115 volts. When the pointer arrives at zero, the overshoot should not exceed 2 degrees under any condition and will usually be less than 1 degree. The amount of hunting of the indicator needle may be controlled by means of the screwdriver adjustment which is marked "AUTO. SENS." (22) Figure 147, on the panel of the radio compass unit. Adjust this automatic sensitivity control to obtain the desired amount of hunting, but maintain sufficient sensitivity so that, if the loop is rotated one degree from its bearing position the automatic control will return to within 0.5 degree of its bearing position. This sensitivity can be checked as follows: (a) Switch to "COMP." with radio compass still tuned to the radio transmitting station; (b) note azimuth reading of bearing indicator pointer Unit 4-3 Figure 24, or Unit 4-4 Figure 146; (c) switch to "LOOP," and rotate loop so that indicator pointer is 1 degree from reading taken in (b) above; (d) switch to "COMP." and again note azimuth reading of bearing indicator pointer. The reading taken in (b) and (d) must be within 0.5 degree.

18. With the "AUDIO" control fully clockwise, tune through each band with the engine stopped, and note the noise level.

    Repeat the test with the engines running at various speeds. If any appreciable increase in noise is noted with the engines running at any speed, the aircraft shielding and bonding and the battery circuit filtering must be improved.

19. Switch "CW-VOICE" control (21), Figure 147, to "CW" and tune in several stations. Each station should give a strong 800-cycle audio signal when tuned in; if not, the operation of relay RE12, Figure 152, should be checked.

Threshold Sensitivity Adjustment—The purpose of the "THRES. SENS." control (22), Figure 147, is to reduce the noise output of the Radio Compass Unit BC-433-C when tuning between stations. The control is located on the front of the radio compass unit, access is through a hole in the front panel. Adjustment should not be undertaken until the interference from the aircraft ignition, generating, and electrical systems has been reduced to the lowest possible level. The adjustment procedure is as follows:

1. Set the function switch (11), Figure 148, to the "ANT." position, and the "AUDIO" control (6), Figure 148, fully clockwise.
2. Turn the "THRES. SENS." control to its maximum clockwise position.
3. Set the band selector switch (5) on the center band, and tune the radio compass unit to a point near the middle of the band where no station is being received.
4. With the aircraft motors operating at normal cruising speed, **reduce** the "THRES. SENS." control (22), Figure 147, until the noise level received in the headset is appreciable, but not objectionable.
5. Tune the radio compass unit throughout its frequency range to make sure that the sensitivity is satisfactory at **all points** on **all bands.** It may be necessary to tolerate a somewhat higher noise level on the lower frequencies in order to obtain proper sensitivity on the higher frequencies.

OPERATION—General

1. Set the radio control box switch (11), Figures 146 and 148, to "COMP." or "ANT." position.
2. Push "CONTROL" switch (8) to operate green light (10). The green light indicates when the radio control box is in control.

NOTE: When the system employs an inverter controlled by the On-Off relay in the Relay BK-22-A BK-22-E assembly, it will be necessary to hold down the "CONTROL" button until the inverter builds up to rated output voltage when taking control away from a radio control box whose function switch is in the "OFF" position.

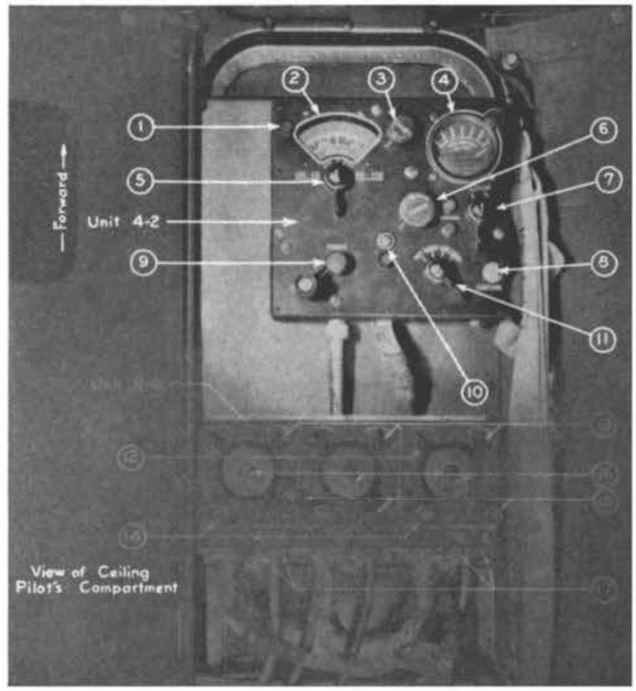


Figure 148. Pilot's Radio Compass Control

Unit 4-2—Compass Receiver Control Box

(1)—Dial Light
(2)—Tuning Dial
(3)—Dial Light Rheostat
(4)—Tuning Meter
(5)—Band Change Switch
(6)—Volume Control
(7)—Electric Loop Direction Control Switch
(8)—Control Transfer Switch
(9)—Tuning Control
(10)—Control Indicating Light
(11)—Power & Antenna Selector Switch

Unit 2-9—Command Receiver Control Box

(12)—Output Selector Switches
(13)—Power & CW or MCW Selector Switches
(14)—Volume Controls
(15)—Tuning Controls
(16)—Tuning Dials
(17)—Phone Jacks
(18)—Phone Jack
(19)—Compass Receiver Flexible Drive
(20)—Compass Receiver Flexible Drives

3. Rotate the band switch (5) to the frequency band desired.
4. Turn "TUNING" crank (9) to the desired station frequency, and rotate back and forth through resonance to determine the exact setting of the dial (2) for maximum clockwise deflection of the tuning meter (4). Listen for station identification to be sure the correct station is being received.

5. Radio Compass SCR-269-C provides for aural identification of keyed CW stations by means of internal modulation controlled by the "CW-VOICE" switch. Switch (21), Figure 147, to "CW" when this type of operation is desired.

HOMING COMPASS OPERATION—For homing operation perform the operations of paragraphs 1, 2, 3 and 4 above, and proceed as follows:

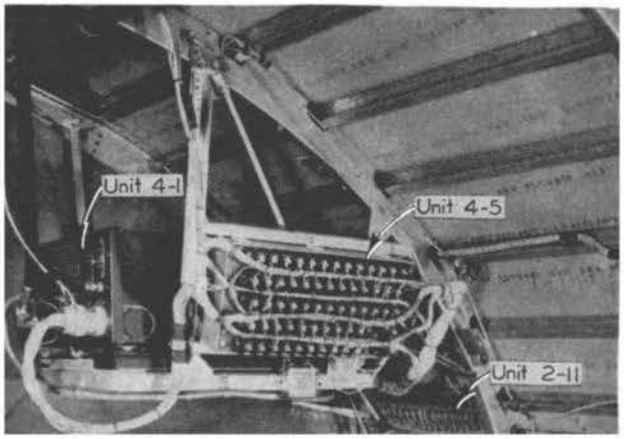


Figure 149. Compass Receiver, Relay Box and Junction Panel

Unit 2-11 Q 6202-16 Terminal Strip
Unit 4-1—Radio Compass Receiver
Unit 4-5—Relay Terminal Panel

1. Turn the "VAR" knob (12), Figure 146, on the Indicator I-82-A (Navigator's) until the azimuth zero is at the index. Indicator I-81-A (Pilot's) is effectively in this position at all times.
2. Switch (11), Figure 148, to "COMP."
3. Apply rudder in the direction shown by the indicator pointer. When the indicator pointer is at zero, the aircraft is headed toward the radio station. The indicator pointer always points toward the radio station. If the pointer is to the right of zero, the station is to the right of the aircraft's heading.
4. Adjust "AUDIO" (6), Figure 149, or Interphone volume control (6), (Figure 24), for satisfactory headset level.
5. Since in "COMP." operation, the equipment has an excellent automatic volume control action, it is not practical to home on a radio range course and fly it aurally at the same time.
6. Radio compass homing operation is such that the aircraft will ultimately arrive over the radio station antenna regardless of probable drift due to cross wind. However, the flight path will be a curved line, and coordination with ground fixes or landing fields along the route will be either difficult or impossible. Consequently, it is often expedient to fly a straight-line course by off-setting the aircraft's heading to compensate for wind drift. To do this, determine the wind drift, either with the drift sight or by noting the change in magnetic compass reading over a period of time, while homing with the radio compass. A **decreasing** magnetic bearing indicates a wind from the **left** while an **increasing** magnetic bearing indicates a wind from the **right.** By trial and error find the correct up-wind radio compass angle, as shown by the indicator pointer providing the minimum rate of change of magnetic compass reading. The scale on the indicator shows the deviation of the aircraft's heading from the direction of the radio station, directly in degrees.

DIRECTION FINDING—Visual Method—For operation as an automatic visual indicating direction finder, perform the operations of paragraphs 1, 2, 3 and 4 on General

Operation, and proceed as follows, using Indicator I-82-A (Navigator's) or Indicator I-81-A (Pilot's).

1. Switch (11 Figure 129) to "COMP."
2. Prior to making "fix" determinations, the stations to be used should be located on the map, tuned in, identified, and the dial reading logged. This avoids delay and error at the time of obtaining the "fix."

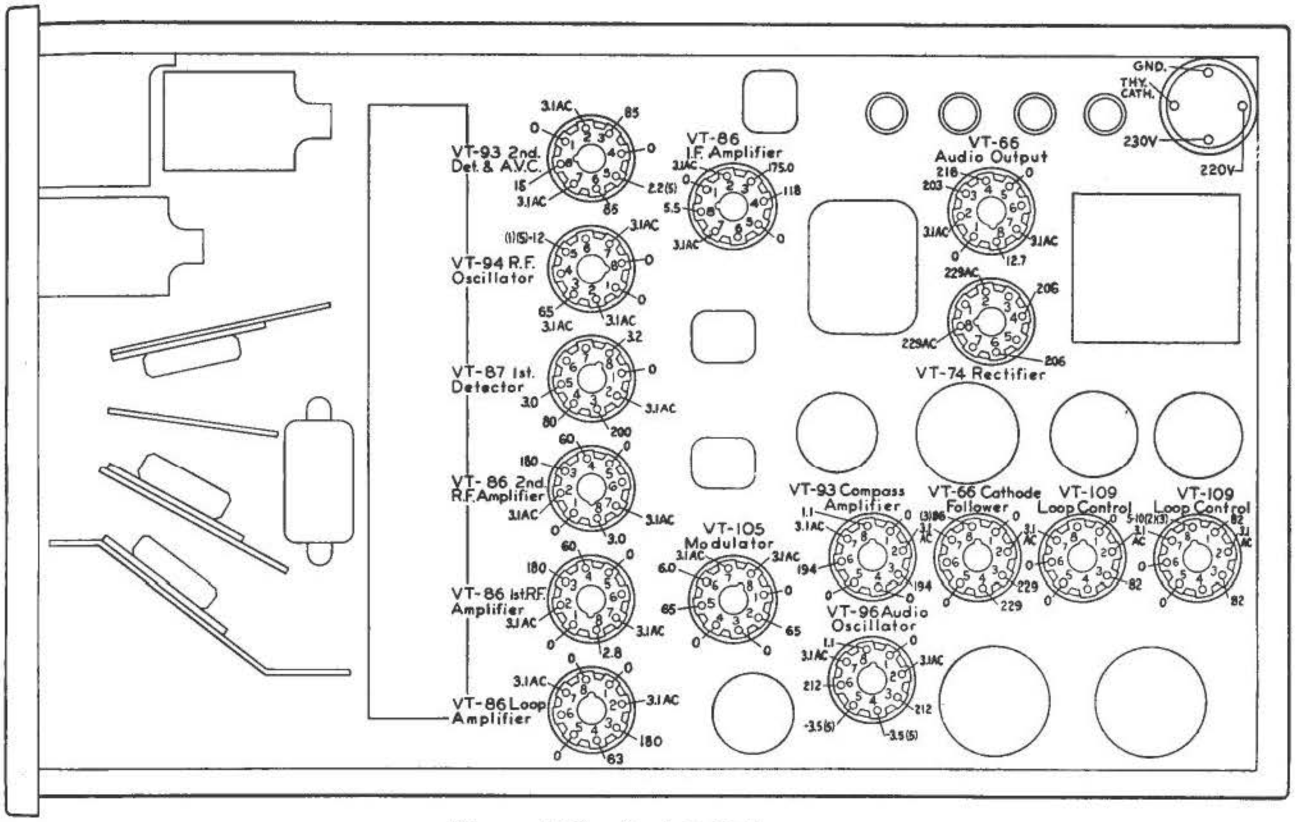
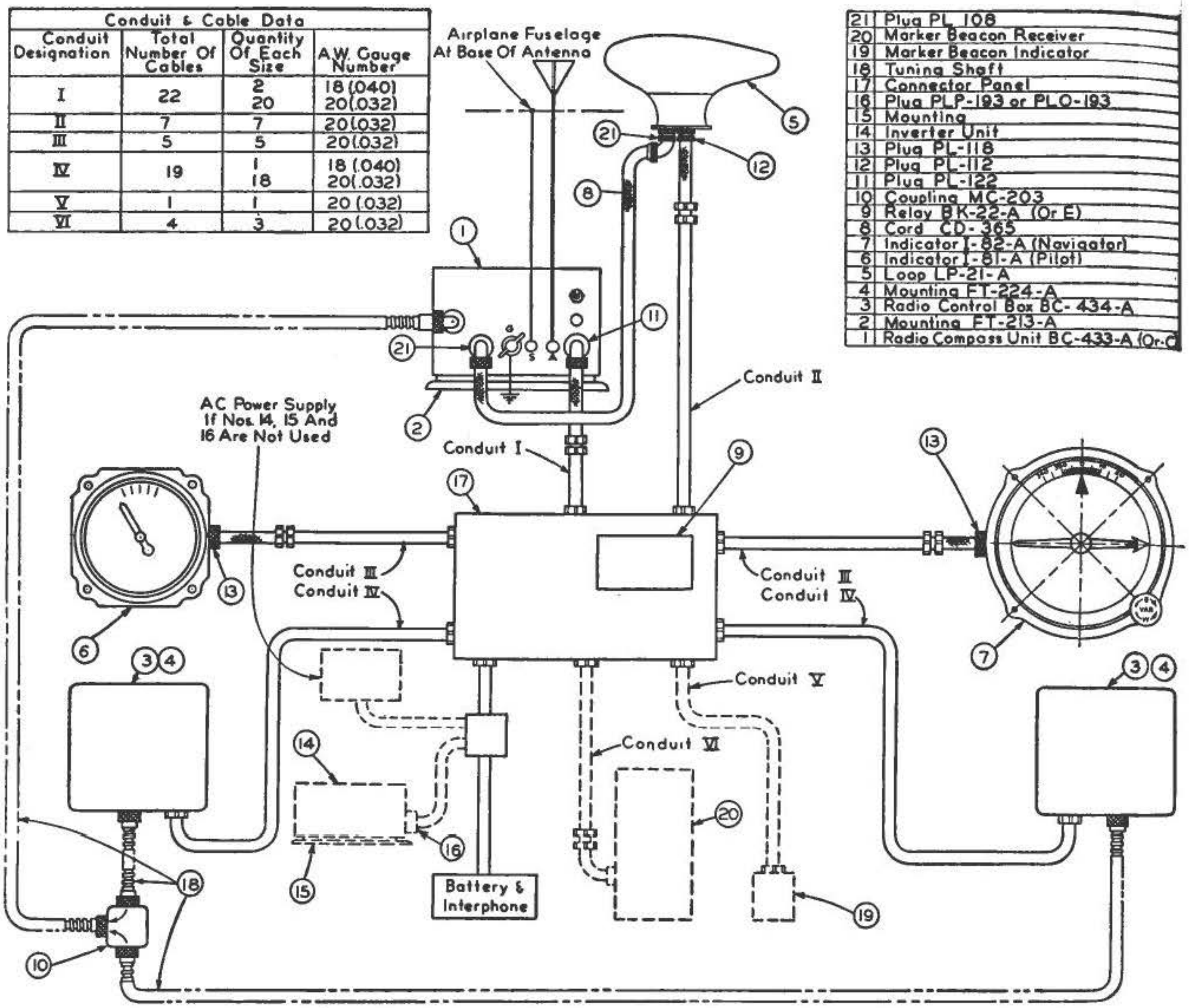


Figure 150. Socket Voltages

[1]—Subject to considerable variation from this value.
[2]—Fluctuates rapidly between these limits.
[3]—When equipment is tuned to signal of 1000 μV/m field strength, and these values measured while the loop is returning to zero bearing from either 175° or 185° the DC cathode voltage of the VT-66 cathode follower stage drops to 66 volts; the DC cathode and screen voltages on the VT-109 loop control tubes are 12.5 volts and the DC plate voltage has steady values at either 20 or 62 volts depending on which tube has control. Plate voltage on the tube in control is 20 volts.
[4]—The heater voltage, when measured between terminals 2 and 8, is 5 volts AC.
[5]—Use 100V DC scale.
[6]—CW modulation voltage with "CW-Voice" set on "CW" 18 volts AC.
All voltages measured to ground. DC unless otherwise indicated.

3. For best accuracy, several bearings should be taken in rapid succession thereby eliminating error caused by the distance traveled between bearing observations. Bearings cannot be accurate unless the aircraft is held on a steady heading.
4. Adjust "AUDIO" (6) or interphone control for desired headset level.
5. With the "VAR" knob (12 Figure 146) on Indicator I-82-A (Navigator's), set the azimuth scale so that the numerical value of the aircraft's magnetic heading is at the index.



NOTES: [A] This Drawing Is Not Intended To Show Mechanical Layout Or Point Of Connection Of Conduits To The Various Units

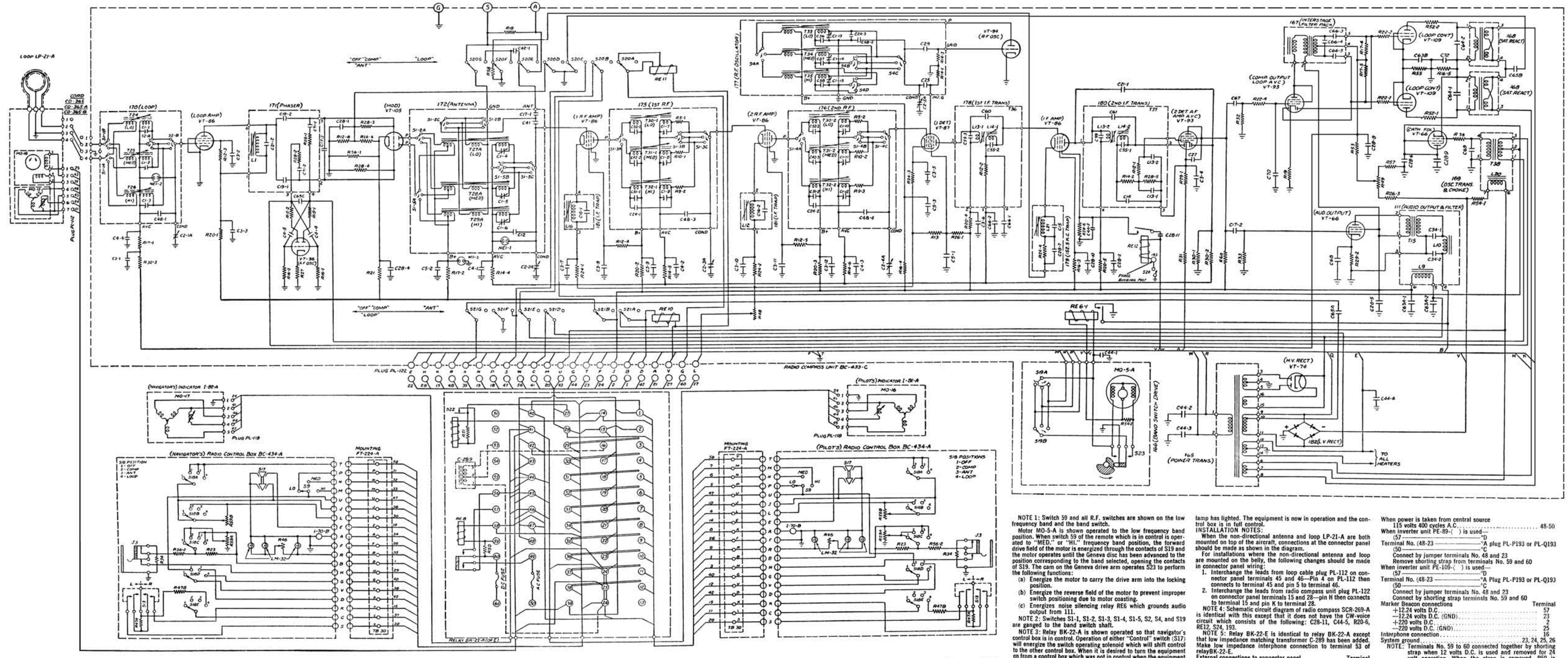
[B] Only Nos. 1 To 13 Inclusive. And No. 18 Are Components Of Radio Compass Scr-269-A (Or-C) No. 9 Controls Battery Circuit to No. 14. Nos. 14, 15, and 16 Comprise Power Inverter Equipment PE-89-() Or PE-109-() Which Is Installed In Airplanes Where Sufficient AC Power is Not Available At 115 Volts 400 Cycles. In This Case No. 9 Also Controls Battery Circuit To No. 14.

Figure 151. Typical Cording Diagram for Dual Control, Radio Compass SCR-269-C

6. Determine the magnetic variation for the locality over which the aircraft is passing, and rotate the "VAR" knob in the direction indicated by the arrows for the required correction. The knob is marked with arrows to show the proper direction of rotation to compensate for East or West variation.

7. Record the bearings shown by the tail end of the bearing indicator pointer. (This will be station-to-aircraft bearing from north.)

8. To obtain a fix, take bearings on three or more stations 30 degrees or more from the line of direction from any one station, and plot them on a map. The intersection of the plotted lines is the position of the aircraft at the time of observation.



NOTE 1: Switch 59 and all R.F. switches are shown on the low frequency band and the band switch.

Motor MO-5-A is shown operated to the low frequency band position. When switch 59 of the remote which is in control is operated to "MED." or "HI." frequency band position, the forward drive field of the motor is energized through the contacts of S19 and the motor operates until the Geneva disc has been advanced to the position corresponding to the band selected, opening the contacts of S19. The cam on the Geneva drive arm operates S23 to perform the following functions:

(a) Energize the motor to carry the drive arm into the locking position.

(b) Energize the reverse field of the motor to prevent improper switch positioning due to motor coasting.

(c) Energizes noise silencing relay RE6 which grounds audio output from 111.

NOTE 2: Switches S1-1, S1-2, S1-3, S1-4, S1-5, S2, S4, and S19 are ganged to the band switch shaft.

NOTE 3: Relay BK-22-A is shown operated so that navigator's control box is in control. Operation of either "Control" switch (S17) will energize the switch operating solenoid which will shift control to the other control box. When it is desired to turn the equipment on from a control box which was not in control when the equipment was last in operation, select the desired function, depress the control switch and hold for approximately 3 seconds or until the green lamp has lighted. The equipment is now in operation and the control box is in full control.

INSTALLATION NOTES:

When the non-directional antenna and loop LP-21-A are both mounted on top of the aircraft, connections at the connector panel should be made as shown in the diagram.

For installations where the non-directional antenna and loop are mounted on the belly, the following changes should be made in connector panel wiring:

1. Interchange the leads from loop cable plug PL-112 on connector panel terminals 45 and 46—Pin 4 on PL-112 then connects to terminal 45 and pin 5 to terminal 46.
2. Interchange the leads from radio compass unit plug PL-122 on connector panel terminals 15 and 28—pin H then connects to terminal 15 and pin K to terminal 28.

NOTE 4: Schematic circuit diagram of radio compass SCR-269-A is identical with this except that it does not have the CW-voice circuit which consists of the following: C28-11, C44-5, R20-6, RE12, S24, 193.

NOTE 5: Relay BK-22-E is identical to relay BK-22-A except that low impedance matching transformer C-289 has been added. Make low impedance interphone connection to terminal 53 of relayBK-22-E.

External connections to connector panel	Terminal
+12.24 volts D.C.	61
—12.24 volts D.C.	23

When power is taken from central source
115 volts 400 cycles A.C. 48-50

When inverter unit PE-89-( ) is used—
(57 —————— °D
Terminal No. (48-23 —————— °A plug PL-P193 or PL-Q193
(50 —————— °C
Connect by jumper terminals No. 48 and 23
Remove shorting strap from terminals No. 59 and 60

When inverter unit PE-109-( ) is used—
(57 —————— °D
Terminal No. (48-23 —————— °A Plug PL-P193 or PL-Q193
(50 —————— °C
Connect by jumper terminals No. 48 and 23
Connect by shorting strap terminals No. 59 and 60

Marker Beacon connections	Terminal
+12.24 volts D.C.	57
—12.24 volts D.C. (GND)	23
+220 volts D.C.	2
—220 volts D.C. (GND)	25
Interphone connection	16
System ground	23, 24, 25, 26

NOTE: Terminals No. 59 to 60 connected together by shorting strap when 12 volts D.C. is used and removed for 24 volt operation. When the strap is removed, R50 is inserted in series with RE8 relay coil in order that the coil will not be overloaded when operated from 24 volts.

Figure 152. Complete Schematic Circuit Diagram, Radio Compass SCR-269-C

9. The Radio Compass Deviation is compensated before delivery of the airplane and hence correction is made automatically and need not be considered when taking bearings.

Aural-Null Method

1. Switch (11) to "LOOP," push "CONTROL" switch (8) to obtain green light, and tune in desired station with band switch (5) and tuning control (9). When listening for station identification, it may be necessary to rotate the loop to a maximum signal position to obtain a good intelligible signal. The aural width of the loop null may be decreased somewhat by using "CW" operation. "CW" operation is also necessary to identify keyed CW stations.
2. Adjust "AUDIO" (6) Figure 146 or 148, or interphone control for desired headset level.
3. Using the "VAR" (12) Figure 146, knob or Indicator I-82-A (Navigator's), set the bearing scale so that the numerical value of the aircraft's magnetic heading is at the index mark.
4. Determine the magnetic variation for the locality, and rotate the "VAR" knob in the direction indicated by the arrows for the required correction. The knob is marked with arrows to show the proper direction of rotation to compensate for East or West variation.
5. Using the "LOOP L-R" switch, rotate the loop for minimum headset volume, and read the bearing indicator. If the signal null exists over too wide an angle, greater accuracy may be obtained by placing the "AUDIO" knob (6) fully clockwise and locating the null by either listening for the disappearance of the audio signal or noting the dip in tuning meter (4) deflection. (See Figure 146 or 148.)
6. Record the bearings shown by the tail end of the bearing indicator pointer. Bearings are subject to 180-degree ambiguity.
7. Fixes may be obtained as by the visual method, except that the 180-degree ambiguity must be resolved by a different method. Roughly, draw lines from the positions of the radio stations at the approximate angles indicated by the bearings obtained, using arrows to show the directions the lines are drawn from the stations. Extend the lines until they meet. If all arrows point to the intersection, the position is correct, and bearings may be plotted accurately; if not, bearings whose arrows point away from the intersection should first be retaken, rotating the bearing pointer to approximately 180 degrees from its original position.

ANTENNA AND LOOP RECEIVER OPERATION—Perform the operation described in paragraph on "General Operation" and proceed as follows:

Antenna Reception

1. Set function switch (11) to "ANT." and adjust the interphone knob or the "AUDIO" knob (6) of the radio control box for satisfactory headset volume.
2. For the best definition of radio range signals (between 200 and 420 KC), set the interphone control fully clockwise and adjust the "AUDIO" knob for the lowest usable headset volume.

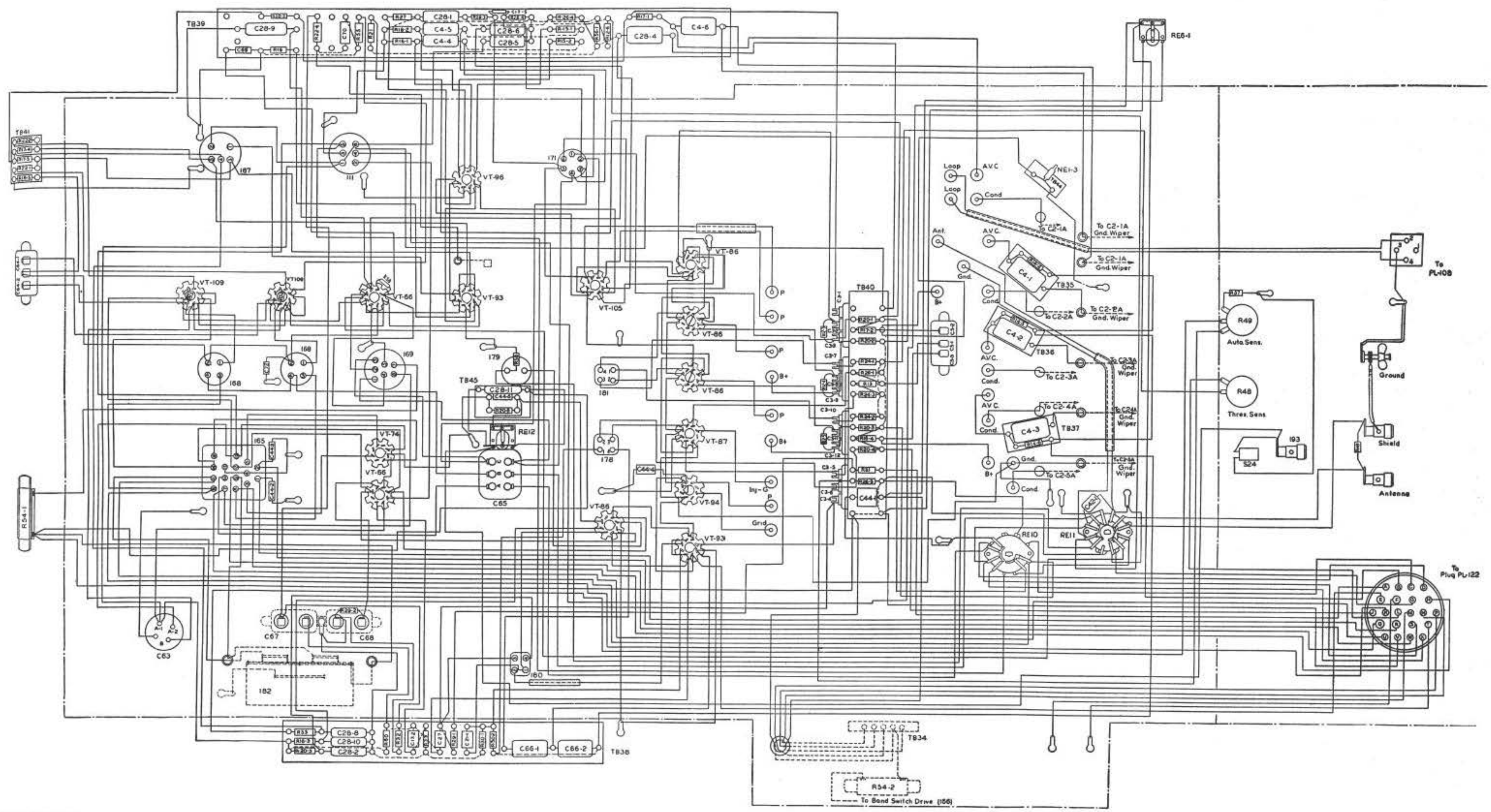


Figure 153. Wiring Diagram, Radio Compass Unit BC-433-C

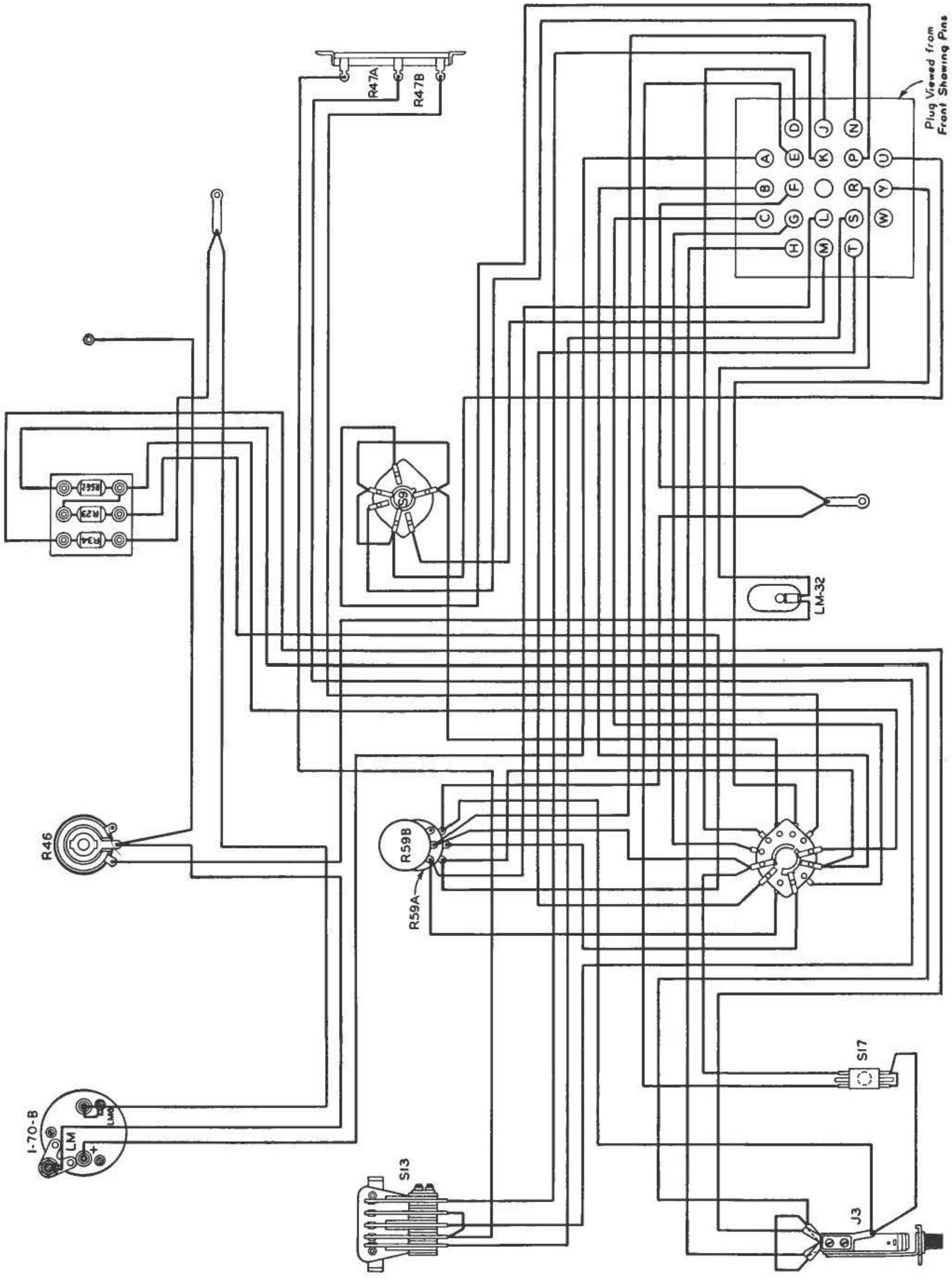


Figure 154. Wiring Diagram, Radio Control Box BC-434-A

Loop Reception

1. If reception on antenna is noisy because of precipitation static, commonly known as rain or snow static, loop reception may possibly be employed for better results. Turn function switch to "LOOP" position. Depress "LOOPL-R" knob and turn to "L" or "R," holding until maximum signal strength is obtained. Adjust the "AUDIO" knob (6) for desired headset volume. To rotate loop at slow speed do not depress "LOOP L-R" knob (7) when turning it to "L" or "R."
2. For the best definition of radio range signals on "LOOP," it is necessary to maintain the loop near the 90- or 270-degree position, set the interphone control fully clockwise and adjust the "AUDIO" knot (6) for the lowest usable headset volume.

NOTE: Cone of silence indications with "LOOP" receiver operation depend on the particular type of range transmitting antenna and the mounting of the loop on the aircraft and therefore are not always reliable. In some cases, an increase instead of a decrease in signal strength will be noted.

PRECAUTIONS DURING OPERATION

1. For aural reception of A-N signals, operate the equipment with control switch (11) on "ANT." or "LOOP" instead of "COMP." since the action of the AVC in the "COMP." position will cause broad course indications.

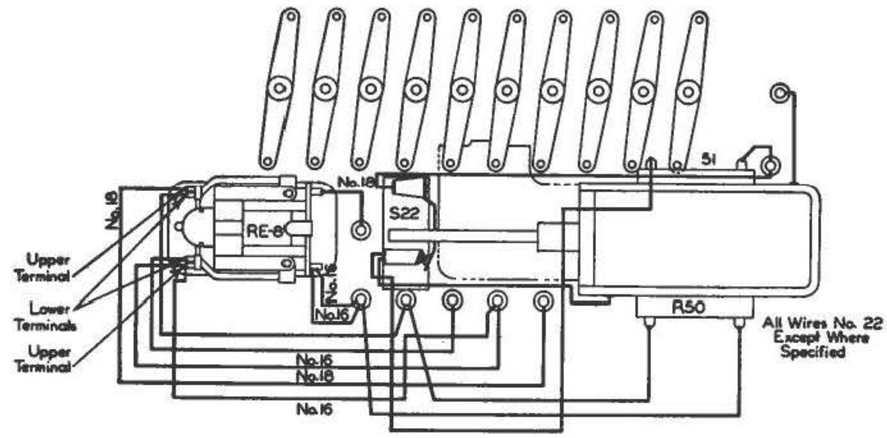


Figure 155. Wiring Diagram, Relay BK-22-A

2. For best definitions of A-N signals on "ANT." or "LOOP," the "AUDIO" control (6) must be set to the **lowest usable audio level** and must be reduced as A-N signals increase.
3. During period of precipitation static, operate on "LOOP," and for best reception, rotate the loop until a maximum signal is obtained.
4. For aural reception of A-N signals on interphone, the interphone volume control must be set fully clockwise and the "AUDIO" control (6) on the radio control box used to reduce headset volume. This is essential to obtain proper course definition.
5. To disconnect the radio compass from the interphone, plug the headset Cord CD-307 directly into the jack (18) on the radio control box having control. This allows the compass to be operated independently of the interphone system, this operation being especially desirable in those installations which have the compass and another receiver on the same interphone switch position.
6. When determining direction on "LOOP" by aural-null method, there is a 180-degree ambiguity and the direction of the station may be 180 degrees from the null obtained. The broadness of the null with aural-null direction finding depends on the strength

of the signal. Strong fields produce very sharp nulls, sometimes as small as one tenth (0.1) degree. Vary "AUDIO" control (6) until null is of satisfactory width. The tuning meter (4) may be used as a visual null indicator.

7. **Loop Operation—If the loop should be in the null position when flying on a radio range course, the signal may fade in and out and possibly be mistaken for a cone of silence.**

   Cone of silence indications are not reliable on loop type radio range stations, when the radio compass is operating on "LOOP." The signal may increase in volume to a strong surge when directly over the station instead of indicating a silent zone.

8. Select radio stations providing stable bearing. Tune equipment carefully. If an interfering signal is heard in the headset, it is probably causing an error in bearing. To check, tune a few kilocycles either side of resonance. A change in bearing with tuning indicates an interfering signal. If station interference exists, select another station or proceed by other means of navigation until closer to the desired station. Care must be exercised when taking bearings on stations broadcasting the same program, as they may be mistaken for each other. Avoid taking bearings on synchronized stations, except close to the desired station. If the radio station stops transmitting or fades, especially code stations operating in a network, bearings might be taken on other stations of the same frequency, thus causing errors. Do not use a station for bearings unless it can be identified by the headset signal on "COMP." operation.

9. Check dial calibrations against actual station frequencies. If the calibration is wrong, report the defect.

10. When homing, fly the aircraft with the indicator pointer at zero or fluctuating slightly, equally left and right.

11. **Do not depend on the tuning meter as a distance meter.**

12. Do not disturb any internal adjustments.

13. **Night effect, or reflection of the radio wave from the sky, is always present.** It may be recognized by a fluctuation in bearings. The remedy is, (a) increase altitude, thereby increasing the strength of the direct wave; (b) take an average of the fluctuations; or (c) select a lower frequency station. **Night effect is worst at sunrise and sunset.** Night effect may be present on Stations at 1750 KC at distances greater than 20 miles; as the frequency decreases, the distance increases, until, at 200 KC the distance will be about 200 miles. Satisfactory bearings, however, will often be obtained at much greater distances than stated above, and sometimes, unsatisfactory bearings may be obtained at shorter distances.

14. **When close to a station, accurate bearings cannot be taken with the aircraft in a steep bank.** This is especially applicable to reception of signals from instrument landing trucks.

15. **Only head-on bearings are entirely dependable. If side bearings are taken, keep the wings horizontal.**

16. **Do not depend on two stations for a fix of location; at least three station bearings should be used.** In general, a set of stations with bearings spaced at approximately equal intervals throughout 360° will give best accuracy.

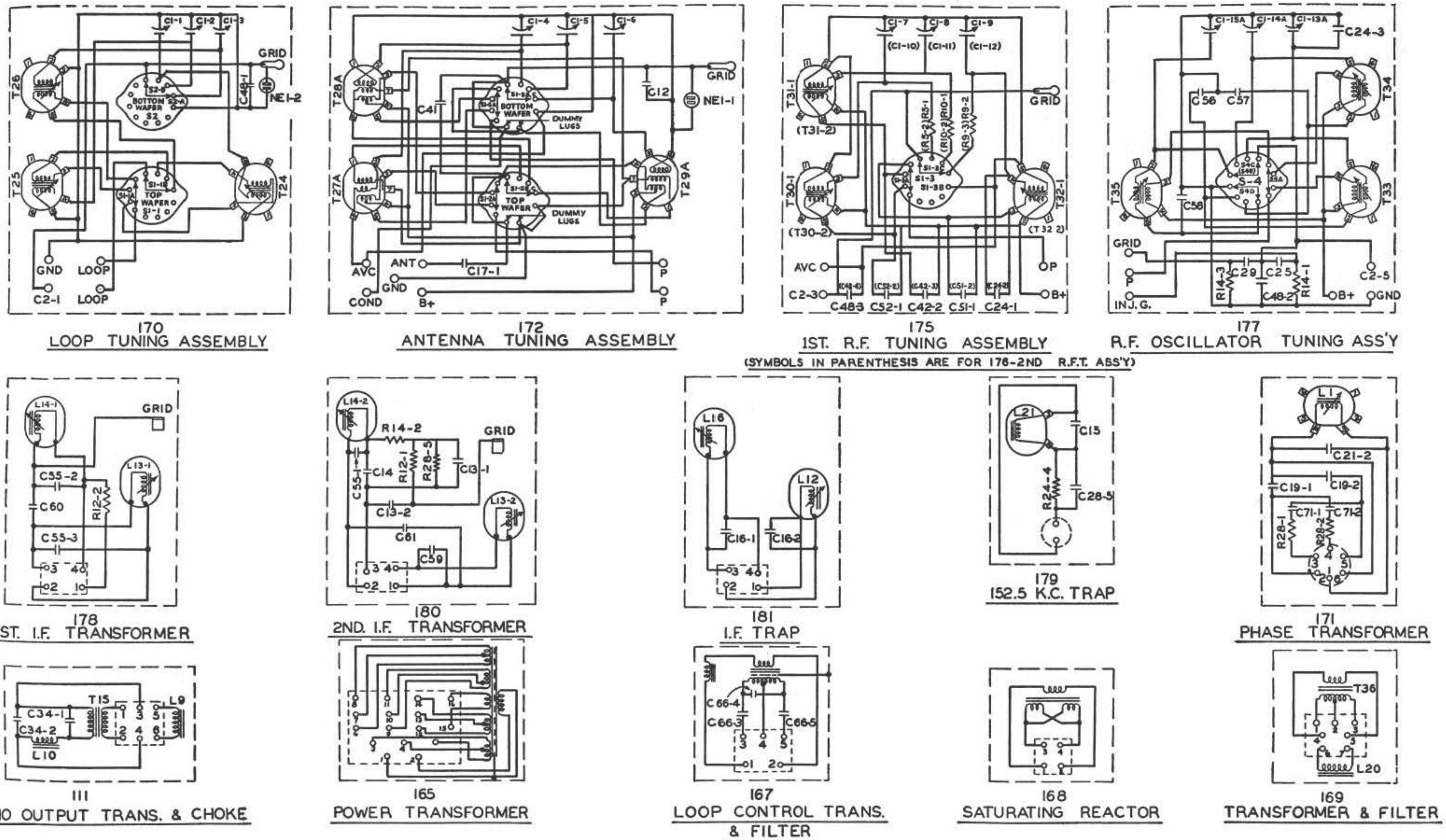


Figure 156. Schematic Wiring Diagram, Major Sub-Assemblies

17. This equipment should provide compass bearings during conditions of moderate precipitation static which interrupt normal reception. On occasions where severe precipitation static is present, especially when discharges occur from parts of the aircraft surfaces, it will be necessary to operate on "LOOP" position. In this position, satisfactory reception and aural-null direction finding will be possible most of the time. The type of precipitation static existing in air mass fronts at different temperatures can be avoided by crossing the air mass front at right angles and then proceeding on the desired course instead of flying along the air mass front.

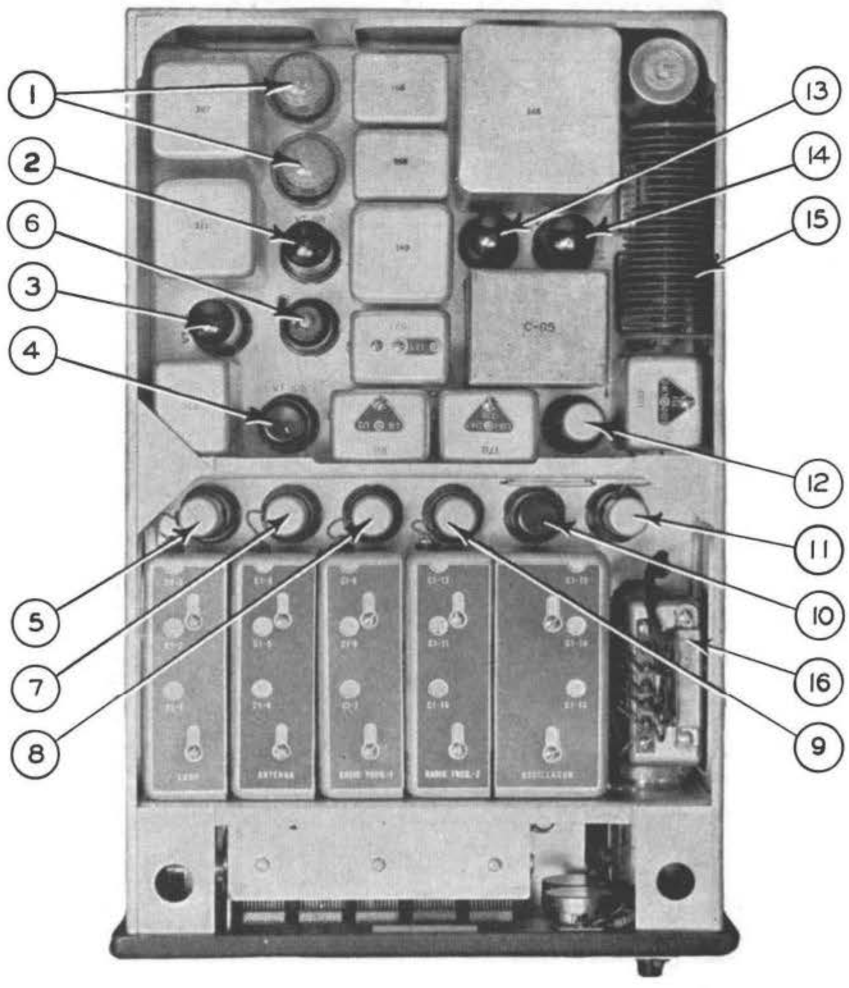


Figure 157. Unit 4-1—Compass Receiver Top View Case Removed

(1)—VT109's Loop Control Tubes
(2)—VT66 Cathode Follower
(3)—VT96 Beat Oscillator (Audio)
(4)—VT105 Modulator
(5)—VT86 Loop Amplifier
(6)—VT93 Compass Amplifier
(7)—VT86 1st R.F. Amplifier
(8)—VT86 2nd R.F. Amplifier
(9)—VT87 1st Detector
(10)—VT94 RF Oscillator
(11)—VT93 2nd Detector & AVC
(12)—VT86 IF Amplifier
(13)—VT74 Rectifier
(14)—VT66 Audio Output
(15)—Selenium Rectifier
(16)—Band Change Relay

18. When receiving modulated signals, intelligibility is greatly reduced if the "CW-VOICE" switch is set to "CW" Operation of the equipment when the function switch is set to "COMP." is not affected by the position of the "CW-VOICE" switch.

19. Erroneous or fluctuating bearings, in some instances, are produced by reflection of radio waves from the mountains. This phenomenon is called "Mountain Effect," and is known to exist under certain conditions in the vicinity of Pittsburgh and Salt Lake City. Because of this effect, bearings taken when flying over mountainous terrain should not be relied upon implicitly.

20. An additional effect, not unlike that of "Mountain Effect" has been observed to a limited extent when the radio wave travels through a "cold front."

TYPICAL VOLTAGES—DC-supply voltage, 14 or 28 volts, AC-supply voltage, 115 volts, 400 cycles. Equipment operating on "COMP." positions. "THRES. SENS.," "AUTO. SENS.," and "AUDIO" controls are fully clockwise. Band switch on Band 3. All voltages measured to chassis unless otherwise indicated (See Figure 150). Measurements made with Weston Selective Analyzer, Model 665, Type 2. Except where indicated, the series capacitor is not used for AC checks. Allowable tolerance on all voltages, ± 10%. Socket terminal number 1 is zero volts on all tube sockets except Loop Control tubes: 1 to ground 82 volts on loop control tubes.

When not given a Signal Corps type number, the number following the letter indicates the electrical characteristics and size of component or parts. All parts with the same letter and number are interchangeable. Following the letter and number is a dash and an additional number which serves to show the exact (1), physical and electrical position, (2) use in equipment, and (3) location on drawings or diagrams. In all cases, when replacing a defective component or part, the marking, including the part number, must agree exactly with that of the replaced part. This means that the radio repairman must place the dash number on all new replacement parts. Parts designated by a letter and an adjacent number (e.g. C5, C19-2, etc.) are assigned by the manufacturer for reference purposes in a particular equipment and are not to be confused with Signal Corps type numbers, which may be recognized by a dash number after the letter, e.g. I-81-A, LM-32, VT-86. Where parts assigned a Signal Corps type number have been used in this equipment, the type number assigned is used as the reference number. It should be noted in other than Signal Corps type numbers that the largest number following a specific letter and number indicates the total number of these identical parts which are contained in the radio compass, except when the part is a multiple unit. Hence C4-6 indicates that there are six C4 capacitors used, since capacitor C4 is a single unit. C3-12 indicates there are four C3 capacitors used, since C3 is a triple section unit. Interchangeable multiple section units with different values per section are identified as follows: C63A1, C63A-2, C63B, or R47A, R47B, R36B. Some switch sections have two or more groups of contacts which are indicated as follows: S1-1A, S1-1B. In all such cases the first letter and number completely describes the unit and indicates its interchangeability with units of like markings.

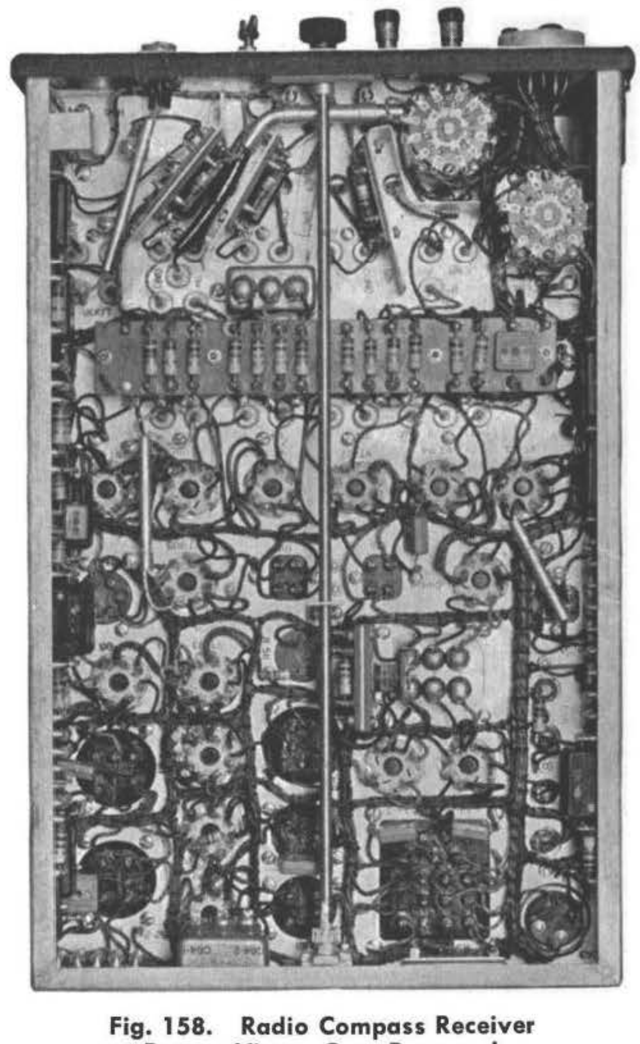


Fig. 158. Radio Compass Receiver Bottom View—Case Removed

Ref. No.	Name or Function	Description	Mfg.	Mfg. No.	Bendix No.
C1-1	Loop Stage Trimmer Capacitor, Band 1	6 to 25 mmf. ± 10%, 500 volts, variable capacitor, Part of Ref. No. 170			AL72443-1, -2
C1-2	Loop Stage Trimmer Capacitor, Band 2	Same as C1-1, Part of Ref. No. 170	Hammarlund R.C.C. or G.I.	Special	QB7751-25
C1-3	Loop Stage Trimmer Capacitor, Band 3	Same as C1-1, Part of Ref. No 170	Hammarlund R.C.C. or G.I.	Special	QB7751-25
C1-4	Ant. Stage Trimmer Capacitor, Band 1	Same as C1-1, Part of Ref. No. 172	Hammarlund R.C.C. or G.I.	Special	QB7751-25
C1-5	Ant. Stage Trimmer Capacitor, Band 2	Same as C1-1, Part of Ref. No. 172	Hammarlund R.C.C. or G.I.	Special	QB7751-25
C1-6	Ant. Stage Trimmer Capacitor, Band 3	Same as C1-1, Part of Ref. No. 172	Hammarlund R.C.C. or G.I.	Special	QB7751-25
C1-7	1st R.F. Stage Trimmer Capacitor, Band 1	Same as C1-1, Part of Ref. No. 175	Hammarlund R.C.C. or G.I.	Special	QB7751-25
C1-8	1st R.F. Stage Trimmer Capacitor, Band 2	Same as C1-1, Part of Ref. No. 175	Hammarlund R.C.C. or G.I.	Special	QB7751-25
C1-9	1st R.F. Stage Trimmer Capacitor, Band 3	Same as C1-1, Part of Ref. No. 175	Hammarlund R.C.C. or G.I.	Special	QB7751-25
C1-10	2nd R.F. Stage Trimmer Capacitor, Band 1	Same as C1-1, Part of Ref. No. 176	Hammarlund R.C.C. or G.I.	Special	QB7751-25
C1-11	2nd R.F. Stage Trimmer Capacitor, Band 2	Same as C1-1, Part of Ref. No. 176	Hammarlund R.C.C. or G.I.	Special	QB7751-25
C1-12	2nd R.F. Stage Trimmer Capacitor, Band 3	Same as C1-1, Part of Ref. No. 176	Hammarlund R.C.C. or G.I.	Special	QB7751-25
C1-13	R.F. Osc. Trimmer Capacitor, Band 1	6 to 25 mmf. ± 10%, 500 volt, variable capacitor Ref. No. 177	G.I. Hammarlund or R.C.C.	Special	QB7783-25
C1-14	R.F. Osc. Trimmer Capacitor, Band 2	Same as C1-13, Part of Ref. No. 177	G.I. Hammarlund or R.C.C.	Special	QB7783-25
C1-15	R.F. Osc. Trimmer Capacitor, Band 3	Same as C1-13, Part of Ref. No. 177	G.I. Hammarlund or R.C.C.	Special	QB7783-25
C2-1A	Loop Stage Gang Tuning Capacitor	5-section, variable, 400 mmf. per section max., 20 mmf. per section min., tolerance per section ± 0.5% or .5 mmf. (whichever is larger)	R.C.C.	Special	L72361
C2-2A	Ant. Stage Gang Tuning Capacitor	5-section, variable, 400 mmf. per section max., 20 mmf. per section min., tolerance per section ± 0.5% or .5 mmf. (whichever is larger)	R.C.C.	Special	L72361
C2-3A	1st R.F. Stage Gang Tuning Capacitor	5-section, variable, 400 mmf. per section max., 20 mmf. per section min., tolerance per section ± 0.5% or .5 mmf. (whichever is larger)	R.C.C.	Special	L72361
C2-4A	2nd R.F. Stage Gang Tuning Capacitor	5-section, variable, 400 mmf. per section max., 20 mmf. per section min., tolerance per section ± 0.5% or .5 mmf. (whichever is larger)	R.C.C.	Special	L72361

Ref. No.	Name or Function	Description	Mfg.	Mfg. No.	Bendix No.
C2-5A	R.F. Osc. Stage Gang Tuning Capacitor	3-section, oil, paper, with side terminals 0.1 mfd. ±10%, 400 volts per section	Aerovox	Special	A25097
C3-1	Loop A.V.C. Filter Capacitor				
C3-2	Loop Amp. Screen By-pass Capacitor				
C3-3	Loop Amp. Plate By-pass Capacitor				
C3-4	2nd Det. Cathode By-pass Capacitor	Same as C3-1, C3-2, and C3-3	Aerovox	Special	A25097
C3-5	1st Det. Cathode By-pass Capacitor				
C3-6	1st Det. Plate By-pass Capacitor				
C3-7	1st R.F. Cathode By-pass Capacitor	Same as C3-1, C3-2, and C3-3	Aerovox	Special	A25097
C3-8	1st R.F. Screen By-pass Capacitor				
C3-9	1st R.F. Plate By-pass Capacitor				
C3-10	2nd R.F. Cathode By-pass Capacitor	Same as C3-1, C3-2, and C3-3	Aerovox	Special	A25097
C3-11	2nd R.F. Screen By-pass Capacitor				
C3-12	2nd R.F. Plate By-pass Capacitor				
C4-1	1st R.F. A.V.C. Filter Capacitor	.05 mfd. ± 10%, 400 volt, fixed, paper	Micamold	345-8	A18015-503
C4-2	2nd R.F. A.V.C. Filter Capacitor	Same as C4-1			
C4-3	1st Det. A.V.C. Filter Capacitor	Same as C4-1			
C4-4	R.F. Oscillator Grid Coupling Capacitor	Same as C4-1			
C4-5	48-cycle Oscillator Grid Coupling Capacitor	Same as C4-1			
C4-6	Loop A.V.C. Filter Capacitor	Same as C4-1			

Ref. No.	Name or Function	Description	Mfg.	Mfg. No.	Bendix No.
C5-1	1st Det. Screen By-pass Capacitor	3-Section, oil, paper .1 mfd. ± 10%, 400 volt per section, top terminals	Yaxley Aerovox Elec. Utilities or Solar	Special	A25096
C5-2	Mod. Plate By-pass Capacitor				
C5-3	R.F. Oscillator Plate By-pass Capacitor				
C12	Ant. Stage Parallel Padder Capacitor	35 mmf. ± 2%, 400 volt, ceramic	Erie	N-680-K	A25715-5
C13-1	1st Audio Grid R.F. Filter Capacitor	50 mmf. ± 2%, 400 volt, ceramic	Erie	N-680-K	A25715-6
C13-2	1st Audio Amp. Grid By-pass Capacitor	Same as C13-1			
C14	2nd Det. R.F. By-pass Capacitor	100 mmf. ± 2%, 400 volt, ceramic	Erie	N-680-L	A25715-7
C15	152.5 Kcs. Trap Resonator Capacitor	Two Capacitors total capacitance .02 mfd. ± 2%, 400 volt, mica, XM262 case	Aerovox	1567	A25716-1
C16-1	1st R.F. Amp. I.F. Trap Resonator Capacitor	.005 mfd. ± 2%, 400 volts, mica, XM262 case	Aerovox	1467	A25714-2
C16-2	2nd R.F. Amp. I.F. Trap Resonator Capacitor	Same as C16-1			
C17-1	Ant. Coupling Capacitor	.001 mfd. ± 10%, 400 volt, mica, XM262 case	Aerovox	1468	A25713-102
C17-2	Aud. Output Grid Coupling Capacitor	Same as C17-1			
C17-3	Modulator Grid Coupling Capacitor	Same as C17-1			
C19-1	Mod. Grid R.F. Grid Coupling Capacitor	250 mmf. ± 5%, 400 volt, mica, XM262 case	Aerovox	1468	A25713-251
C19-2	Mod. Grid R.F. Grid Coupling Capacitor	Same as C19-1			
C21-1	2nd Det. A.V.C. Diode Coupling Capacitor	100 mmf. ± 5%, 400 volt, mica, XM262 case	Aerovox	1468	A25713-101
C21-2	Phaser Resonator Capacitor	Same as C21-1			
C24-1	Coupling Capacitor on T32-1	5 mmf. ± 10%, 400 volt, ceramic	Erie	P-120-K	A25715-1
C24-2	Coupling Capacitor on T32-2	Same as C24-1			
C24-3	Trimmer Shunt Capacitor R.F. Oscillator Band 1	Same as C24-1			

RADIO COMPASS UNIT—BC-433-C—Continued

Ref. No.	Name or Function	Description	Mfg.	Mfg. No.	Bendix No.
C25	1st Det. Injector Grid Coupling Capacitor	15 mmf. ± 10%, 400 volt, mica, XM262 case	Aerovox	1468	A25713-150
C27	1st Audio Plate R.F. By-pass Capacitor	500 mmf. ± 10%, 400 volt, mica, XM262 case	Aerovox	1468	A25713-501
C28-1	Mod. Cathode Filter Capacitor	.1 mfd. ± 10%, 400 volt, fixed, paper	Micamold	345	A18015-104
C28-2	I.F. Plate By-pass Capacitor	Same as C28-1			
C28-4	Mod. Cathode By-pass Capacitor	Same as C28-1			
C28-5	High Voltage R.F. By-pass Capacitor	Same as C28-1			
C28-6	High Voltage R.F. By-pass Capacitor	Same as C28-1			
C28-7	I.F. Cathode By-pass Capacitor	Same as C28-1			
C28-8	Loop Control Tube Grid Return By-pass Capacitor	Same as C28-1			
C28-9	High Voltage R.F. By-pass	Same as C28-1			
C28-10	I.F. Screen By-pass Capacitor	Same as C28-1			
C28-11	C.W. Coupling Capacitor	Same as C28-1			
C29	R.F. Osc. Grid Coupling Capacitor	25 mmf. ± 10%, 400 volt, mica, XM262 case	Aerovox	1468	A25713-250
C34-1	Low Pass Audio Filter Capacitor	.02 mfd. ± 10%, 400 volt, Part of Ref. No. 111	Micamold	342-12	A18015-203
C34-2	Low Pass Audio Filter Capacitor	Same as C34-1			
C41	Ant. Coupling Capacitor to 1st R.F. Grid	15 mmf. ± 2%, 400 volt, ceramic	Erie	N-680-K	A25715-3
C42-1	Ant. Compensating Capacitor	50 mmf. ± 5%, 400 volt, mica, XM262 case	Aerovox	1468	A25713-500
C42-2	1st R.F. Plate Resonator Capacitor, Band 2	Same as C42-1			
C42-3	2nd R.F. Plate Resonator Capacitor, Band 2	Same as C42-1			
C44-1	MO-5-A Filter Capacitor	.01 mfd. ± 10%, 400 volt, mica, XM262 case	Aerovox	1467	A25713-500
C44-2	R.F. Filter Capacitors	Same as C44-1			

Ref. No.	Name or Function	Description	Mfg.	Mfg. No.	Bendix No.
C44-3	R.F. Filter Capacitors	Same as C44-1	Aerovox	1467	A25714-3
C44-4	Heater R.F. By-pass Capacitor	Same as C44-1			
C44-5	I.F. Amp. Suppressor By-pass Capacitor	Same as C44-1			
C48-1	Loop Stage Parallel Padder Capacitor	45 mmf. ± 2%, 400 volt, ceramic	Erie	N-680-K	A25715-9
C48-2	R.F. Osc. Parallel Padder Capacitor	Same as C48-1			
C48-3	1st R.F. Stage Parallel Padder Capacitor	Same as C48-1			
C48-4	2nd R.F. Stage Parallel Padder Capacitor	Same as C48-1			
C51-1	1st R.F. Plate Resonator Capacitor, Band 3	45 mmf. ± 5%, 400 volt, mica, XM262 case	Aerovox	1468	A25713-450
C51-2	2nd R.F. Plate Resonator Capacitor, Band 3	Same as C51-1			
C52-1	1st R.F. Plate Resonator Capacitor, Band 1	175 mmf. ± 2%, 400 volt, mica, XM262 case	Aerovox	1468	A25713-1750
C52-2	2nd R.F. Plate Resonator Capacitor, Band 1	Same as C52-1			
C55-1	2nd Det. Diode Circuit Resonator Capacitor	270 mmf. ± 2%, 400 volts, mica, XM262 case	Aerovox	1468	A25713-271
C55-2	I.F. Grid Circuit Resonator Capacitor	Same as C55-1			
C55-3	1st Det. Plate Resonator Capacitor	Same as C55-1			
C56	R.F. Oscillator Series Padder Capacitor, Band 1	2 capacitors mounted as a single unit, total capacitance 662 mmf. ± 0.5%, 400 volt, XM262 case	Aerovox	Special	A25716-5
C57	R.F. Oscillators Series Padder Capacitor, Band 2	2 capacitors mounted as a single unit, total capacitance 1237 mmf. ± 0.5%, 400 volt, mica, XM262 case	Aerovox	Special	A25716-6
C58	R.F. Oscillator Series Padder capacitor, Band 3	2 capacitors mounted as a single unit, total capacitance 2225 mmf. ± 0.5%, 400 volt, mica, XM262 case	Aerovox	1468	A25716-7
C59	I.F. Plate Circuit Resonator Capacitor	260 mmf. ± 2%, 400 volt, mica, XM262 case	Aerovox	1468	A25713-261

RADIO COMPASS UNIT—BC-433-C—Continued

Ref. No.	Name or Function	Description	Mfg.	Mfg. No.	Bendix No.
C60	1st I.F. Transformer Coupling Capacitor	7.5 mmf. ± 10%, 400 volt, ceramic	Erie	P-120-K	A25715-10
C61	2nd I.F. Transformer Coupling Capacitor	3 mmf. ± 10%, 400 volt, ceramic	Erie	P-120-K	A25715-11
C63A-1	High Voltage Filter Capacitor	30 mfd., 350-volt section, Electrolytic	Aerovox	Special	L72499
C63A-2	High Voltage Filter Capacitor	30 mfd., 350-volt section, Electrolytic			
C63B	Loop Control Tube Cathode By-pass Capacitor	50 mfd., 50-volt DC section, Electrolytic			
C64-1	Loop Control Tube Plate Circuit Tuning Capacitor	2 x .5 mfd. ± 10%, 3 top terminals, oil, paper, 1000 volt	Yaxley Aerovox Elec. Utilities Solar	Special	A100169
C64-2	Loop Control Tube Plate Circuit Tuning Capacitor	Same as C64-1			
C65-A	Phase Shifting Capacitor Loop Motor Circuit	5 mfd. ± 10%, 50 volts, R.M.S., 400 cycles, oil, paper	Cornell-Dubilier Elec. Utilities Solar	Special	L72498
C65B	Phase Correcting Capacitor Loop Motor Circuit	2 mfd. ± 10%, 80 volts, R.M.S., 400 cycles, oil, paper			
C65C	48-cycle Oscillator Tuning Capacitor	.5 mfd. ± 5%, 400 volt, oil, paper			
C66-1	I.F. A.V.C. Filter Capacitor	.025 mfd. ± 10%, 400 volt	Micamold	342-30	A18015-253
C66-2	I.F. A.V.C. Filter Capacitor	Same as C66-1			
C66-4	Loop Control Tube Grid Circuit Coupling Capacitor	Same as C66-1			
C66-5	Loop Control Tube Grid Circuit Filter Capacitor	Same as C66-1	Micamold	342-30	A18015-253
C66-6	Loop Control Tube Grid Circuit Coupling Capacitor				
C67	Grid Coupling Capacitor Compass Output Tube	.5 mfd. ± 10%, 400 volt, oil, paper	Aerovox Yaxley Elec. Utilities Solar	Special	A100159-1
C68	Audio Output Tube Cathode By-pass Capacitor	.5 mfd. ± 10%, 50 volt, Electrolytic	Aerovox Yaxley Elec. Utilities Solar	Special	A100159-2

RADIO COMPASS UNIT—BC-433-C—Continued

Ref. No.	Name or Function	Description	Mfg.	Mfg. No.	Bendix No.
C69	Cathode Follower Grid Filter	.006 mfd. ± 10%, 400 volt, mica, XM262 case	Aerovox	1467	A25714-5
C70	Grid Filter Capacitor Compass Output Tube	.004 mfd. ± 10%, 400 volt, mica, XM262 case	Aerovox	1467	A25714-4
C71-1	Loop Phasing Circuit Capacitor	.002 mfd. ± 10%, 400 volt, Part of Ref. No. 171	Micamold	340-11	A18015-202
C71-2	Loop Phasing Circuit Capacitor	Same as C71-1			
C72	Plate Return By-pass Capacitor, Loop Control Tube Circuit	.005 mfd. ± 10%, 400 volt, mica, XM262 case	Aerovox	1467	A25714-6
L1	Loop Phaser Inductor	Part of Ref. No. 171	Bendix	Special	AL71687-16
L9	H.V. Filter Choke				
L10	Low Pass Audio Choke	Part of Ref. No. 111	Bendix	Special	AA19713-1
L12	I.F. Trap Inductor 2nd R.F. Cathode	Part of Ref. No. 181	Bendix	Special	AC56549-6
L13-1	1st I.F. Transformer Primary	Part of Ref. No. 178	Bendix	Special	AC56549-4
L13-2	2nd I.F. Transformer Primary	Part of Ref. No. 180	Bendix	Special	AC56549-5
L14-1	1st I.F. Transformer Secondary	Part of Ref. No. 178	Bendix	Special	AC56550-4
L14-2	2nd I.F. Transformer Secondary	Part of Ref. No. 180	Bendix	Special	AC56550-5
L16	I.F. Trap Inductor (1st R.F. Cathode)	Part of Ref. No. 181	Bendix	Special	AC56550-6
L20	Loop Motor Drive Circuit Choke	Part of Ref. No. 169	Bendix	Special	A27056
L21	152.5-Kcs. Trap Inductor I.F. Cathode	Part of Ref. No. 179	Bendix	Special	AL72172-21
MC-202	Grid Shield Caps	For V.T. Grids	Alden	Special	A25186-2
MO-5-()	Motor	Band Change Motor Part of Ref. No. 166	Eicor Bendix P. Gen.	Special	C58599 C58519 AC57588-1
NE1-1	Neon Lamp, Antenna	1/25 watt, 60 volt, unbased, Part of Ref. No. 172	G. E.	T2-CD 1010-CL	B15347
NE1-2	Neon Lamp, Loop	1/25 watt, 60 volt, unbased, Part of Ref. No. 170	G. E. G. E.	T2-CD 1010-CL	B15347
NE1-3	Neon Lamp	1/25 watt, 60 volt, unbased, Part of TB44	G. E.	T2-CD 1010-CL	B15347

RADIO COMPASS UNIT—BC-433-C—Continued

Ref. No.	Name or Function	Description	Mfg.	Mfg. No.	Bendix No.
R5-1	1st R.F. Compensator Resistor Band 1	25 ohms ± 10%, ½ watt	I. R. C.	BW-½	B1754-127-F
R5-2	2nd R.F. Compensator Resistor Band 1	Same as R5-1	I. R. C.	BW-½	B1754-127-F
R9-2	1st R.F. Stage Band 3 Compensator Resistor	3 ohms ± 10%, ½ watt	I. R. C.	BW-½	B1754-112-F
R9-3	2nd R.F. Stage Band 3 Compensator Resistor	Same as R9-2			
R10-1	1st R.F. Stage Band 2 Compensator Resistor	10 ohms ± 10%, ½ watt	I. R. C.	BW-½	B1754-103-F
R10-2	2nd R.F. Stage Band 2 Compensator Resistor	Same as R10-1			
R12-1	1st Audio Grid Resistor	100,000 ohms ± 5%, ¼ watt			
R12-2	I.F. A.V.C. Filter Resistor	Same as R12-1			
R12-3	Loop Amp. Screen Resistor	Same as R12-1			
R12-4	1st R.F. Amp. Screen Resistor	Same as R12-1	Erie	Special	A18001-104
R12-5	2nd R.F. Amp. Screen Resistor	Same as R12-1			
R12-6	Modulator Cathode Resistor	Same as R12-1			
R13	1st Det. Screen Dropping Resistor	150,000 ohms ± 5%, ½ watt	Erie	Special	A18004-154
R14-1	1st Det. Inj. Grid Leak Resistor	50,000 ohms ± 5%, ¼ watt	Erie	Special	A18001-503
R14-2	1st Audio R.F. Filter Resistor	Same as R14-1			
R14-3	R.F. Oscillator Grid Leak Resistor	Same as R14-1			
R14-4	1st R.F. A.V.C. Filter Resistor	Same as R14-1			
R14-5	2nd R.F. A.V.C. Filter Resistor	Same as R14-1			
R14-6	1st Det. A.V.C Filter Resistor	Same as R14-1			
R15-1	48-cycle Oscillator Plate Load Resistor	2000 ohms ±5, ½ watt	Erie	Special	A18004-202
R15-2	48-cycle Oscillator Plate Load Resistor	Same as R15-1			

RADIO COMPASS UNIT—BC-433-C—Continued

Ref. No.	Name or Function	Description	Mfg.	Mfg. No.	Bendix No.
R16-1	48-cycle Oscillator Grid Leak Resistor	50,000 ohms ± 5%, ½ watt	Erie	Special	A18004-503
R16-2	48-cycle Oscillator Grid Leak Resistor	Same as R16-1			
R16-3	I.F. Amp. Screen Dropping Resistor	Same as R16-1			
R16-4	R.F. Oscillator Plate Dropping Resistor	Same as R16-1			
R16-5	Cathode Follower Bias Resistor	Same as R16-1			
R17-1	Loop Amp. A.V.C. Filter Resistor	100,000 ohms ± 5%, ½ watt			
R17-2	Modulator Plate Dropping Resistor	Same as R17-1	Erie	Special	A18004-104
R17-4	Loop Control Tube Grid Circuit Resistor	Same as R17-1			
R17-5	Loop Control Tube Grid Circuit Resistor	Same as R17-1			
R18	Anti-Static Leak Resistor	1 megohm ± 5%, ¼ watt	Erie	Special	A18001-105
R19	Compass Output Tube Cathode Resistor	1000 ohm ±5%, ½ watt	Erie	Special	A18004-102
R20-1	Loop Amp. Plate Dropping Resistor	5000 ohms ± 5%, ½ watt	Erie	Special	A18004-502
R20-2	1st R.F. Amp. Plate Dropping Resistor	Same as R20-1			
R20-3	2nd R.F. Amp. Plate Dropping Resistor	Same as R20-1			
R20-4	1st Det. Plate Dropping Resistor	Same as R20-1			
R20-5	I.F. Amp. Plate Dropping Resistor	Same as R20-1			
R20-6	I.F. Amp. Suppressor Load Resistor	Same as R20-1			
R21	Modulator Cathode Bleeder Resistor	200,000 ohms ± 5%, ½ watt	Erie	Special	A18004-204
R22-1	Loop Control Tube Grid Resistor	500,000 ohms ± 5%, ½ watt	Erie	Special	A18004-504
R22-2	Loop Control Tube Grid Resistor	Same as R22-1			
R22-4	Compass Output Grid Resistor	Same as R22-1			

RADIO COMPASS UNIT—BC-433-C—Continued

Ref. No.	Name or Function	Description	Mfg.	Mfg. No.	Bendix No.
R24-1	1st R.F. Amp. Cathode Resistor	600 ohms ± 5%, ½ watt	Erie	Special	A18004-601
R24-2	2nd R.F. Amp. Cathode Resistor	Same as R24-1			
R24-3	1st Det. Cathode Resistor	Same as R24-1			
R24-4	I.F. Cathode Resistor	Same as R24-1			
R26-1	1st Det. Screen Voltage Divider Resistor	25,000 ohms ± 5%, ½ watt	Erie	Special	A18004-253
R26-3	Loop Control Tube Bias Circuit Resistor	Same as R26-1			
R26-4	Modulator Cathode Resistor	Same as R26-1			
R27	48-cycle Oscillator Cathode Bias Resistor	100 ohms ± 5%, ½ watt	Erie	Special	A18004-101
R28-1	Phaser Network Resistor	250,000 ohms ± 5%, ¼ watt	Erie	Special	A18001-254
R28-2	Phaser Network Resistor	Same as R28-1			
R28-3	Mod. Grid Resistor	Same as R28-1			
R28-4	Mod. Grid Resistor	Same as R28-1			
R28-5	1st Audio Grid Load Resistor	Same as R28-1			
R29-1	2nd Det. Cathode Bias Resistor	500 ohms ± 5%, ½ watt	Erie	Special	A18004-501
R29-2	Audio Output Cathode Bias Resistor	Same as R29-1			
R30-1	2nd Det. Diode Load Resistor	1 megohm ± 5%, ½ watt	Erie	Special	A18004-105
R30-2	A.V.C. Filter Resistor	Same as R30-1			
R30-3	Loop Amp. A.V.C. Filter Resistor	Same as R30-1			
R31	2nd Det. Cathode Bias Resistor	3000 ohms ± 5%, ½ watt	Erie	Special	A18004-302
R32	Compass Output Tube Grid Resistor	300,000 ohms ± 5%, ½ watt	Erie	Special	A18004-304
R33	Aud. Output Tube Grid Resistor	350,000 ohms ± 5%, ½ watt	Erie	Special	A18004-354
R38	Cathode Follower Grid Resistor	500,000 ohms ± 5%, ¼ watt	Erie	Special	A18001-504

RADIO COMPASS UNIT—BC-433-C—Continued

Ref. No.	Name or Function	Description	Mfg.	Mfg. No.	Bendix No.
R48	Threshold Sensitivity Control Resistor	500 ohms ± 5%, variable resistor	I. R. C.	CS Curve D	A100016
R49	Automatic Sensitivity Control Potentiometer	5000 ohms ± 5%, potentiometer	I. R. C.	CS Curve A	A100017
R52-1	Loop Control Tube Plate Series Resistor	200 ohms ± 5%, ¼ watt	Erie	Special	A18001-201
R52-2	Loop Control Tube Plate Series Resistor	Same as R52-1	Erie	Special	A18001-201
R53	Loop Control Tube Grid Circuit Filter Resistor	250,000 ohms ± 5%, ½ watt	Erie	Special	A18004-254
R54-1	Current Limiting Resistor Low Voltage Rectifier Circuit	50 ohms ± 10%, 5 watt	I. R. C.	MW-2	A29748-3
R54-2	Band Switch Motor Reverse Field Resistor	Same as R54-1	I. R. C.	MW-2	A29748-3
R55	Loop Control Tube Cathode Resistor	1500 ohms ± 5%, ½ watt	Erie	Special	A18004-152
R56	Modulator Cathode Resistor	3000 ohms ± 5%, ¼ watt	Erie	Special	A18001-302
R57	Loop Control Tube Bias Resistor	2500 ohms ± 5%, ¼ watt	Erie	Special	A18001-252
R58	I.F. Amp. Cathode Resistor	1500 ohms ± 5%, ¼ watt	Erie	Special	A18001-152
R60	2nd Det. Plate Resistor.	35,000 ohms ± 5%, ½ watt	Erie	Special	A18004-353
RE6	Noise Silencing Relay	S.P.D.T. contacts, 320 ohms	Leach	R-3	A30190
RE10	Ant. Relay	275 ohms, includes S21	Price	Special	A100352-1
RE11	Loop Relay	275 ohms, includes S20	Price	Special	A100351-1
RE12	C.W.-VOICE Switching Relay	S.P.D.T. contacts, 1280 ohms	Leach		A102680
S1-1A S1-1B	Loop Stage Band Selector Switch (Pri.)	Bakelite wafer	Oak	Special	QB9589-2
S1-2A S1-2B S1-2C	Antenna Stage Band Selector Switch	Same as S1-1	Oak	Special	QB9589-2
S1-3A S1-3B S1-3C	1st R.F. Stage Band Selector Switch (Pri. & Sec.)	Same as S1-1	Oak	Special	QB9589-2
S1-4A S1-4B S1-4C	2nd R.F. Stage Band Selector Switch (Pri. & Sec.)	Same as S1-1	Oak	Special	QB9589-2

RADIO COMPASS UNIT—BC-433-C—Continued

Ref. No.	Name or Function	Description	Mfg.	Mfg. No.	Bendix No.
S1-5A S1-5B S1-5C	Antenna Stage Band Selector Switch	Same as S1-1			
S2-A S2-B	Loop Stage Band Selector Switch (Secondary)	Bakelite wafer	Oak	Special	QB9589-1
S4 (A, B) (C, D)	R.F. Osc. Band Selector Switch	Bakelite wafer	Oak	Special	QB9589-3
S19 (A, B)	Motor Positioning Switch	Bakelite wafer	Oak	Special	A100064
S20	Loop Relay Switch	Bakelite wafer	Oak	Special	A104942 A104943
S21	Ant. Relay Switch	Bakelite wafer	Oak	Special	A104940 A104941
S23	Motor Control Switch	Cam operated	Kellogg	Special	C57496
S24	C.W.-VOICE Switch	SPST toggle	H & H		A10676-2
T15	Aud. Output Transformer	Part of Ref. No. 111	Bendix	Special	AA19713-1
T24	Loop Transformer, Band 1	Part of Ref. No. 170	Bendix	Special	AL72172-1
T25	Loop Transformer, Band 2	Part of Ref. No. 170	Bendix	Special	AL72172-2
T26	Loop Transformer, Band 3	Part of Ref. No. 170	Bendix	Special	AL72172-3
T27A	Ant. Stage Transformer, Band 1	Part of Ref. No. 172	Bendix	Special	AL72172-18
T28A	Ant. Stage Transformer, Band 2	Part of Ref. No. 172	Bendix	Special	AL72172-19
T29A	Ant. Stage Transformer, Band 3	Part of Ref. No. 172	Bendix	Special	AL72172-20
T30-1	1st R.F. Transformer, Band 1	Part of Ref. No. 175	Bendix	Special	AL72172-7
T30-2	2nd R.F. Transformer, Band 1	Part of Ref. No. 176	Bendix	Special	AL72172-8
T31-1	1st R.F. Transformer, Band 2	Part of Ref. No. 175	Bendix	Special	AL72172-9
T31-2	2nd R.F. Transformer, Band 2	Part of Ref. No. 176	Bendix	Special	AL72172-10
T32-1	1st R.F. Transformer, Band 3	Part of Ref. No. 175	Bendix	Special	AL72172-11
T32-2	2nd R.F. Transformer, Band 3	Part of Ref. No. 176	Bendix	Special	AL72172-12
T33	R.F. Osc. Transformer, Band 1	Part of Ref. No. 177	Bendix	Special	AL72172-13

Ref. No.	Name or Function	Description	Mfg.	Mfg. No.	Bendix No.
T34	R.F. Osc. Transformer, Band 2	Part of Ref. No. 177	Bendix	Special	AL72172-14
T35	R.F. Osc. Transformer, Band 3	Part of Ref. No. 177	Bendix	Special	AL72172-15
T38	48-cycle Osc. Transformer	Part of Ref. No. 169	Bendix	Special	A27056
TB15	Terminal Board	Part of Ref. No. 181	Bendix	Special	AA26047-1
TB18	Terminal Board	Part of Ref. No. 180	Bendix	Special	AA26046-1
TB20-1	Terminal Board	Part of Ref. No. 175	Bendix	Special	AA27846-1
TB20-2	Terminal Board	Part of Ref. No. 176	Bendix	Special	AA27846-2
TB21	Terminal Board	Part of Ref. No. 177	Bendix	Special	AA25957-2
TB22	Terminal Board	Part of Ref. No. 177	Bendix	Special	AA25959-2
TB23	Terminal Board	Part of Ref. No. 177	Bendix	Special	AA25960-2
TB24	Terminal Board	Part of Ref. No. 178	Bendix	Special	AA27843-1
TB29	Terminal Board	Part of Ref. No. 180	Bendix	Special	AA27843-2
TB32	Terminal Board	Part of Ref. No. 179	Bendix	Special	AA29929-1
TB33	Terminal Board	Part of Ref. No. 171	Bendix	Special	AA26015-2
TB34	Terminal Board	Part of Ref. No. 166	Bendix	Special	AA100011-1
TB35	Terminal Board	Includes C4-1, R14-4	Bendix	Special	AA29526-1
TB36	Terminal Board	Includes C4-2, R14-5	Bendix	Special	AA29526-2
TB37	Terminal Board	Includes C4-3, R14-6	Bendix	Special	AA100175-1
TB38	Terminal Board	Under chassis, 30 lugs, short side	Bendix	Special	AC57396-1
TB39	Terminal Board	Under chassis, 52 lugs, long side	Bendix	Special	AC57389-1
TB40	Terminal Board	Under chassis, 32 lugs, crosswise	Bendix	Special	AC57400-1
TB41	Terminal Board	Under chassis, 10 lugs, rear	Bendix	Special	AA100125-1
TB43	Terminal Board	Part of Ref. No. 171	Bendix	Special	AA26016-1
TB44	Terminal Board	Includes NE1-3	Bendix	Special	AA102489-1
TB45	Terminal Board	Includes C28-11, C44-5, R20-6	Bendix		AA102695-1
TB46	Terminal Board	Includes RE12	Bendix		AA102856-1

RADIO COMPASS UNIT—BC-433-C—Continued

Ref. No.	Name or Function	Description	Mfg.	Mfg. No.	Bendix No.
VT-66	Aud. Output Vacuum Tube	Metal	Kenrad	6F6	A30295 (Sig. Corps Spec. No. 71-766)
VT-66	Cathode Follower Tube	Metal			
VT-74	High Voltage Rectifier Tube	Metal	Kenrad	5Z4	A31526
VT-86	1st R.F. Amp. Vacuum Tube	Metal	Kenrad	6K7	A30300 (Sig. Corps Spec. No. 71-786)
VT-86	2nd R.F. Amp. Vacuum Tube	Metal			
VT-86	I.F. Amp. Vacuum Tube	Metal			
VT-86	Loop Stage Amp. Vacuum Tube	Metal			
VT-87	1st Detector Vacuum Tube	Metal	Kenrad	6L7	A30299 (Sig. Corps Spec. No. 71-787)
VT-93	2nd Detector A.F. Amp. A.V.C.	Metal	Kenrad	6B8	A30298 (Sig. Corps Spec. No. 71-793
VT-93	Compass Output Loop A.V.C. Vacuum Tube	Metal			
VT-94	R.F. Oscillator Vacuum Tube	Metal	Kenrad	6J5	A32097 (Sig. Corps Spec. No. 71-794)
VT-96	A.F. Oscillator Vacuum Tube	Metal	Kenrad	6N7	A30301 (Sig. Corps Spec. No. 71-796)
VT-105	Modulator Vacuum Tube	Metal	Kenrad	6SC7	A30296 (Spec. No. 71-1205)
VT-109	Loop Control Vacuum Tube	Glass	Kenrad	2051	A30974
VT-109	Loop Control Vacuum Tube	Glass	Kenrad	2051	A30974
111	Aud. Output Transformer Assembly	Includes L9, L10, T15, C34-1, C34-2, Potted	Bendix	Special	A19713-1
117	Geneva Disc. and Hub Assembly	Part of Ref. No. 166	Bendix	Special	AB10346
118	Worm Gear Shaft Assembly	Part of Ref. No. 166	Bendix	Special	AB10344
119	Right Side Housing	Part of Ref. No. 166	Bendix	Special	F11130

RADIO COMPASS UNIT—BC-433-C—Continued

Ref. No.	Name or Function	Description	Mfg.	Mfg. No.	Bendix No.
120	Left Side Housing	Part of Ref. No. 166	Bendix	Special	F11131
121	Band Switch Drive Shaft	Assembly	Bendix	Special	AB11502
122	Retaining Spring	For band switch drive shaft	Bendix	Special	B11010
132	Screw	For band switch drive assembly (3 required)	Bendix	Special	A111-42
136	Ant. Post Assembly	2 Assemblies required	Bendix	Special	AA26075-1
137	Ant. Post Insulator Bushing	For Antenna Posts (6 required)	Bendix	Special	A18155
138	Ground Post Assembly		Bendix	Special	AA26076-1
142	Plug Socket Base	22 contact, for plug PL-122	Bendix	Special	AA25719-1
143	Plug Socket Shell	For 22 socket plug socket	Bendix	Special	B9746-1
144	Plug Socket Base	4 contact for plug PL-108	Bendix	Special	AA25741-2
145	Plug Socket Shell	For 4 contact plug socket	Bendix	Special	B9681
146	Lock Screw Shaft	Steel	Bendix	Special	A26062
147	Lock Screw Knob	Aluminum, Anodized	Bendix	Special	B10721-1
148	Receiver Case Assy.	Incl. Ref. No. 149, 150, 151	Bendix	Special	AC56553-1
149	Upper Mounting Base	Part of Ref. No. 148	Bendix	Special	L71633
150	Mounting	Shock Absorbing	Lord	150-P8	A16330-7
151	Case Assembly	Part of Ref. No. 148	Bendix	Special	AL71690-1
152	Cover Plate Assembly	For socket hole in case	Bendix	Special	AB12131
154	Setscrew Wrench	For No. 6 Allen Setscrews	Allen	Special	A18190-6
158	Ratchet Gear	For lock screw shaft	Bendix	Special	A26061
159	Collar	For lock screw shaft	Bendix	Special	B9319
163	Large Bearing	For motor MO-5-()	P. Gen.	Special	A100408
164	Small Bearing	For motor MO-5-()	P. Gen.	Special	A100412
165	Power Transformer	400-cycle, 115-volt input, for fil. and plate supply	Bendix	Special	A27058
166	Band Switch Assembly	Includes MO-5-(), R54-2, S23, S19A, S19B, 117, 118, 119, 12O, 121, 122, 132, TB34	Bendix	Special	AC57481
167	Interstage Filter Pack	Includes C66-3, C66-4, C66-5, inductor, and transformer	Bendix	Special	A27062

RADIO COMPASS UNIT—BC-433-C—Continued

Ref. No.	Name or Function	Description	Mfg.	Mfg. No.	Bendix No.
168	Reactors, Loop Control Tube Plate Circuit	Saturable core reactors (Matched)	Bendix	Special	A19776-1
169	48-cycle Oscillator Pack	48-cycle Oscillator Transformer and Loop Motor Drive Circuit Choke	Bendix	Special	A27056
170	Loop Tuning Assembly	Includes C1-1, C1-2, C1-3, C48-1, S1-1, S2, T24, T25, T26, NE1-2	Bendix	Special	AL71665-3
171	Loop Phasing Assembly	Includes: C19-1, C19-2, C21-2, C71-1, C71-2, L1, R28-1, R28-2, TB33, TB43	Bendix	Special	AC56541-2
172	Antenna Tuning Assembly	Includes: C1-4, C1-5, C1-6, C12, C17-1, C41, NE1-1, S1-2, S1-5, T27A, T28A, T29A	Bendix	Special	AL72419-1
175	First R.F. Tuning	Includes: C1-7, C1-8, C1-9, C24-1, C42-2, C48-3, C51-1, C52-1, R5-1, R9-2, R10-1, S1-3, T30-1, T31-1, T32-1, TB20-1	Bendix	Special	AL71663-3
176	2nd R.F. Tuning Assembly	Includes: C1-10, C1-11, C1-12, C24-2, C42-3, C48-4, C51-2, C52-2, R5-2, R9-3, R10-2, S1-4, T30-2, T31-2, T32-2, TB20-2	Bendix	Special	AL71663-4
177	R.F. Oscillator Tuning Assembly	Includes: C1-13, C1-14, C1-15, C24-3, C25, C29, C48-2, C56, C57, C58, R14-1, R14-3, S4, T33, T34, T35, TB21, TB22, TB23	Bendix	Special	AL71662-2
178	1st I.F. Transformer Tuning Assembly	Includes: C55-2, C55-3, C60, L13-1, L14-1, R12-2, TB24, T36	Bendix	Special	AC56848-1
179	152.5-Kcs. Trap	Includes: C15, C28-7, L21, R24-4, TB32	Bendix	Special	AC57459-1
180	2nd I.F. Transformer Tuning Assembly	Includes: C13-1, C13-2, C-14, C55-1, C59, C61, L13-2, L14-2, R12-1, R14-2, R28-5, TB18, TB29	Bendix	Special	AC56848-2
181	I.F. Trap	Includes: C16-1, C16-2, L12, L16, TB15	Bendix	Special	AC56555-2
182	Rectifier	Dry Selenium rectifier, 24 volt, bridge type	Int. Tel. Develop.	Special	C57381-1

RADIO COMPASS UNIT—BC-433-C—Continued

Ref. No.	Name or Function	Description	Mfg.	Mfg. No.	Bendix No.
185	Band Switch Motor, with Worm Assembly	Part of Ref. No. 166 Includes MO-5-()	Bendix	Special	AB11496-6 or AB11496-7
188	Armature (complete with bearings)	For MO-5() Motor	P. Gen.	Special	A100411
189	Condenser and Drive Assembly (Final)	Includes C2	Bendix	Special	AC57455-1
190	Split Gear Assembly	For capacitor drive assembly	Bendix	Special	A28769
191	Tube Socket	Isolantite (15 required)	Ampehnol	Special	A29858
193	C.W.-Voice Post Assembly	1 required	Bendix	Special	AA26075-1
195	Positive Brush	For MO-5-()	P. Gen.	Special	A100409
	Negative Brush	For MO-5-()	P. Gen.	Special	A100410
197	Relay Coil	28 volts, 275 ohms, part of RB10, RE11	Price	Special	A28196

RADIO CONTROL BOX—BC-434-A

1-70-B	Tuning Meter	2 MA zero right reading, 5 MA full scale left reading, DC Res. 5 ohms	Weston	Special	A100414
J3	Jack	For Headset, 2 break circuits	Yaxley	X40	A25577
LM-32	Lamp	Instrument dial illuminating 3 volts, 0.18 ± 0.02 amps	P. Inst.	Special	A18881-2
R23	Impedance Limiting Resistor	10,000 ohms ± 5%, ¼ watt	Erie	Special	A18001-103
R34	Audio Load Compensating Resistor	8000 ohms ± 5%, ¼ watt	Erie	Special	A18001-802
R46	Lamp Rheostat	15 ohms, 25 watt	Ohmite	Special	A29842
R47A	Loop Motor Circuit Limiting Resistor	Wire wound, 2000 ohms ± 5%, 5 watt	I. R. C.	MW3	A100005
R47B	Loop Motor Current Limiting Resistor	Wire wound, 100 ohms ± 5%, 5 watt			
R56-2	Impedance Limiting Resistor	3000 ohms ± 5%, ¼ watt	Erie	Special	A18001-302
R59A	Audio Volume Control Potentiometer	25,000 ohms, dual action	A. Bradley	Special	L72473
R59B	Manual Sensitivity Control Resistor	20,000 ohms, dual action			
S9	Band Selector Switch	Bakelite wafer	Oak	H	AB6707

RADIO CONTROL BOX—BC-434-A—Continued

Ref. No.	Name or Function	Description	Mfg.	Mfg. No.	Bendix No.
S13	Switch	Manual control for loop drive motor	Bendix	Special	AC56949-1
S17	Control Push Button	D.P.S.T. push button switch	H & H	3594D	A29843
S18 (A, B, C, D, E)	Function Switch	Bakelite wafer complete with shaft and detent	Oak	Special	A29422
TB31	Terminal Board	Includes R23, R34, R56-2	Bendix	Special	AA29546-1
202	Cable Pinion Housing Assembly	Part of Ref. No. 227	Bendix	Special	AB8950-1
205	Dial Gear Assembly	Part of Ref. No. 227	Bendix	Special	AB11956
206	Setscrew Wrench	For No. 6 Allen setscrews, same as Ref. No. 154 and 431	Allen	Special	A18190-6
207	Crank Assembly	For tuning drive	Bendix	Special	AB8917-2
210 211	Knob (Lights) Switch Lever	For R46 For S9, S13, S18	Bendix Bendix	Special Special	AA25754-2 AA104948-3
214	Detent Arm Assembly	Used on band switch mechanism	Bendix	Special	AB11447-1
215	Band Switch Control Shaft	Assembly	Bendix	Special	AB11669
216	Mounting Screw	Panel	Bendix	Special	B10251-2
217	Plug Release Screw	For releasing Ref. No. 225	Bendix	Special	B10251-1
225	Plug Assembly	20 contact for socket assembly Ref. No. 224	Bendix	Special	AA92595-1
227	Dial Drive Assembly	Includes Ref. No. 202, 205, 228, 229	Bendix	Special	A L72368-1
228	Dial Mask Assembly	Part of Ref. No. 227	Bendix	Special	AA100733-2
229	Dial Assembly	Part of Ref. No. 227	Bendix	Special	AA25751-2
230	Knob (Audio)	For R59A and R59B	Bendix	Special	AA25756-2
231	Glass	Tuning Meter I-70-B	Weston	Special	A106120

MC-203 COUPLING

MC-203	Coupling	For coupling two BC-434-A to BC-433-C	Bendix	Special	AC56453-1
400	Housing	Machined casting	Bendix	Special	C55964
401	Fitting and Shaft Assembly	Includes spline fitting and bevel gear (2 required)	Bendix	Special	AA25639-1
402	Fitting and Shaft Assembly	Includes spline fitting and bevel gear (1 required)	Bendix	Special	AA25638-1

MC-203 COUPLING—Continued

Ref. No.	Name or Function	Description	Mfg.	Mfg. No.	Bendix No.
403	Nameplate Gasket	Fits under nameplate	Bendix	Special	A26083
432	Nameplate		E. C. A.	Special	A25652

MC-203-A COUPLING

Ref. No.	Name or Function	Description	Mfg.	Mfg. No.	Bendix No.
MC-203-A	Coupling	For coupling two BC-434-A to BC-433-C	Bendix	Special	AC58256-1
465	Housing	Machined casting	Bendix	Special	AC58139-1
466	Fitting and Shaft Assembly	Includes spline fitting and bevel gear (2 required)			
467	Fitting and Shaft Assembly	Includes spline fitting and bevel gear (1 required)	Bendix	Special	AA103960-1
403	Nameplate Gasket	Fits under nameplate	Bendix	Special	A26083
468	Nameplate		E. C. A.	Special	A103988

INDICATOR I-81-A (PILOT'S)

Ref. No.	Name or Function	Description	Mfg.	Mfg. No.	Bendix No.
I-81-A	Indicator	For Pilot	P. Inst.	Special	AL72336-2-3
MO-16	Motor for Autosyn		P. Inst.	Special	C57250
429	Socket Base	For Plug PL-118	Bendix	Special	AA25744-1
430	Socket Housing	For Ref. No. 429	Bendix	Special	B9604
435	Glass	Indicator Face	P. Inst.	Special	A106119
436	Armature	For MO-16	P. Inst.	Special	A100396
437	Bearing	For MO-16	P. Inst.	Special	A100397
438	Brush	For MO-16	P. Inst.	Special	A100392

INDICATOR I-82-A (NAVIGATOR'S)

Ref. No.	Name or Function	Description	Mfg.	Mfg. No.	Bendix No.
I-82-A	Indicator	For Navigator	P. Inst.	Special	AL72332-2-3
MO-17	Motor for Autosyn		P. Inst.		AC57342-1
413	Glass	Indicator Face	Kearfott	Special	A30267
429	Socket Base	For PL-118	Bendix	Special	AA25744-1
430	Socket Housing	For PL-118	Bendix	Special	B9604
436	Armature	For MO-17	P. Inst.		A100396
437	Bearing	For MO-17	P. Inst.		A100397
438	Brush	For MO-17	P. Inst.		A100392
408	Knob	For "E-W Variation" Adjustment	Kearfott	AS-920-1	A28743

LOOP LP-21-A

Ref. No.	Name or Function	Description	Mfg.	Mfg. No.	Bendix No.
LP-21-A	Automatic Loop	Complete with Compensator MC-217	Kearfott	Special	AL72302-1
MC-217	Compensator	Indicator compensator	Kearfott	Special	L73384
MO-15	Motor	Autosyn transmitter	P. Inst.	Special	C57225
TB42	Terminal Board		Kearfott	U-167	A100478
MO-18	Motor for Loop Drive	Low inertia type	P. Inst.	Special	C57349
430	Socket Housing	For Ref. No. 446	Bendix	Special	B9604
431	Allen Wrench	Part of MC-217	Allen	Special	A18190-6
437	Bearing	For Ref. Nos. 444, 445	P. Inst.	Special	A100397
438	Brush	For MO-15	P. Inst.	Special	A100392
444	Armature	Cup assembly for Motor MO-18	P. Inst.	Special	A103924
445	Armature	For Autosyn Transmitter MO-15	P. Inst.	Special	A100390
446	Socket Base	For PL-112, 9 pin	Bendix	Special	B9603
448	Socket Base	For PL-108, 4 pin	Kearfott	V-166	A28745
449	Socket Housing	For Ref. No. 448	Kearfott	AS-564-1-B	A100395
451	Allen Wrench	¼" for 8 cap screw	Allen	Special	A100683
454	Loop Housing	Zeppelin Type	Kearfott	Y-350	R95780
455	Loop & Shaft Assembly	8 turn loop with 3 contact rings	Kearfott	W-94	AL72398-1
456	Cam Strip	Part of MC-217	Kearfott	U-87	A102026
457	Loop Dehydrator	Includes Silica Gel and mounting clips	Multi-Products	Special	AC57763-1
458	Right Angle Fitting	For dehydrator connection	Bendix	Special	A100738
462	Cam Holder Assembly	For cam strip	Kearfott	Special	A29070
463	Cam Holder Assembly	For cam strip overlap	Kearfott	Special	A29071
464	Cam Holder Assembly	For cam strip 0° position	Kearfott	Special	A29075

CORD CD-365 AND CORD CD-365-A

Ref. No.	Name or Function	Description	Mfg.	Mfg. No.	Bendix No.
CD-365	Cord	72-inch cord, capacitance 140 mmf. ± 5%	Bendix	Special	AC56469-1
CD-365-A	Loop Cord	Like CD-365, with one elbow	Bendix	Special	AC56469-2

CORD CD-365 AND CORD CD-365-A—Continued

Ref. No.	Name or Function	Description	Mfg.	Mfg. No.	Bendix No.
FT-184	Conduit Elbow	90° Elbow	Bendix	Special	B10862
PL-108	Plug	4 pin	Bendix	Special	AA25745-1
426	Conduit	Flexible, metallic, neoprene covered, 72 inches	Am. Brass	Special	C56471-1
427	Bushing	Part of FT-184	Bendix	Special	A25775
428	Nut	Conduit	Bendix	Special	B15403

MOUNTING FT-213-A

Ref. No.	Name or Function	Description	Mfg.	Mfg. No.	Bendix No.
FT-213-A	Mounting	For Radio Compass Unit BC-433-C	Bendix	Special	AL71622

FT-224-A MOUNTING

Ref. No.	Name or Function	Description	Mfg.	Mfg. No.	Bendix No.
FT-224-A	Mounting Base Assembly	For Radio Control Box BC-434-A	Bendix	Special	AL72372-1
TB30	Terminal Board	20 lugs	Bendix	Special	AA29560-1
224	Socket Assembly	20-contact for Plug Ref. No. 225	Bendix	Special	A29563-1

RELAY BK-22-A

Ref. No.	Name or Function	Description	Mfg.	Mfg. No.	Bendix No.
R50	Voltage Dropping Resistor	65 ohm ± 10%, 5 watt	I.R.C.	MW-2	A29748-1
R51	Solenoid Holding Resistor	250 ohm ± 10%, 5 watt	I.R.C.	MW-2	A29748-2
RE8	Power On-Off Relay	DPST, 12-volt coil	Leach	1054-SN	A29543
S22	Current Limiting Switch	SPST, spring type	Bendix	Special	AA2950-1
558	Switch Contact Bar	With Bushing	Bendix	Special	AA25671-1
559	Switch Contact		Bendix	Special	A25703
560	Bearing Stud	For contact bar	Bendix	Special	A25660
564	Relay BK-22-A	Final Assembly	Bendix	Special	AN90731-1
565	Solenoid Assembly	Includes coil frame	Bendix	Special	AA29702-1
566	Core Assembly	With gear rack	Bendix	Special	AA29529-1
567	Ratchet Assembly	To operate cam shaft	Bendix	Special	AA25681-1
568	Cam Shaft		Bendix	Special	AA100331-1
570	Casting	Ratchet and cam support	Bendix	Special	C56493
571	Switch Operating Bar	Assembly with roller posts	Bendix	Special	AA29538-1
572	Terminal Strip	Moulded bakelite (3 per unit)	Bendix	Special	A29534
573	Terminal Strip	Moulded bakelite (2 per unit)	Bendix	Special	A29544

RELAY BK-22-A—Continued

Ref. No.	Name or Function	Description	Mfg.	Mfg. No.	Bendix No.
574	Cover Assembly	With mounting brackets	Bendix	Special	AA25677-4
575	Solenoid Coil	Part of Ref. No. 565, 28 volts, 12.5 ohms	Bendix	Special	AA29704-1
RELAY SW-172-A OR RELAY SW-182-A					
SW-172-A	Power ON-OFF Relay	DPST, 24-volt coil	Leach	Special	A29543-1
SW-182-A	Power ON-OFF Relay	DPST, 12-volt coil, type 1054-SN	Leach	Special	A29543
BK-22-E RELAY					
Relay BK-22-E is identical with Relay BK-22-A, with the following exceptions: Delete Ref. No. 574 and BK-22-A and add the following:					
BK-22-E	Transfer Relay BK-22E	Final Assembly	Bendix	Special	AN91154-1
579	Cover Assembly	With mtg. brackets	Bendix	Special	AA25677-6
C-289	Output Autotransformer	Part of Relay BK-22-E	Bendix	Special	A103068
PLUGS					
PL-108	Plug	4-contact. (For cord CD-365 and cord CD-365-A)	Bendix	Special	A27545-1
PL-112	Plug	9-contact. (For loop motor & autosyn connections)	Bendix	Special	AB9601
PL-118	Plug	5-contact. (For indicators I-81-A and I-82-A)	Bendix	Special	AB9730
PL-122	Plug	22-contact. (Compass Unit to Connector Panel)	Bendix	Special	AB10057
INSTRUCTOR CHART					
MC-238	Chart	Instruction	E.C.A.	Special	C58258
ALIGNMENT TOOL					
TL-138-B	Tool TL-138-B	Alignment	Bendix		AB12439
INTERCHANGEABLE PARTS					
175	1st R.F. Tuning Assembly	See Reference List	Bendix	Special	AL71663-3
176	2nd R.F. Tuning Assembly	Identical except for lettering and etching			AL71663-4
154 206 431	Setscrew Wrench	See Reference List	Allen	Special	A18190-6

NOTES: For identification purposes, all radio compass components are given Signal Corps type numbers. Parts of components are given Signal Corps type numbers or are marked by numbers or by letters and numbers. Generally, sub-assemblies and mechanical parts are marked by letters and numbers, the letters indicating the electrical nature of the part, viz.:

C—Capacitor
I—Meter
J—Jack
L—Inductor
LM—Lamp
NE—Neon Lamp
MO—Motor
R—Resistor
RE—Relay
S—Switch
T—Transformer
TB—Terminal Board
VT—Vacuum Tube

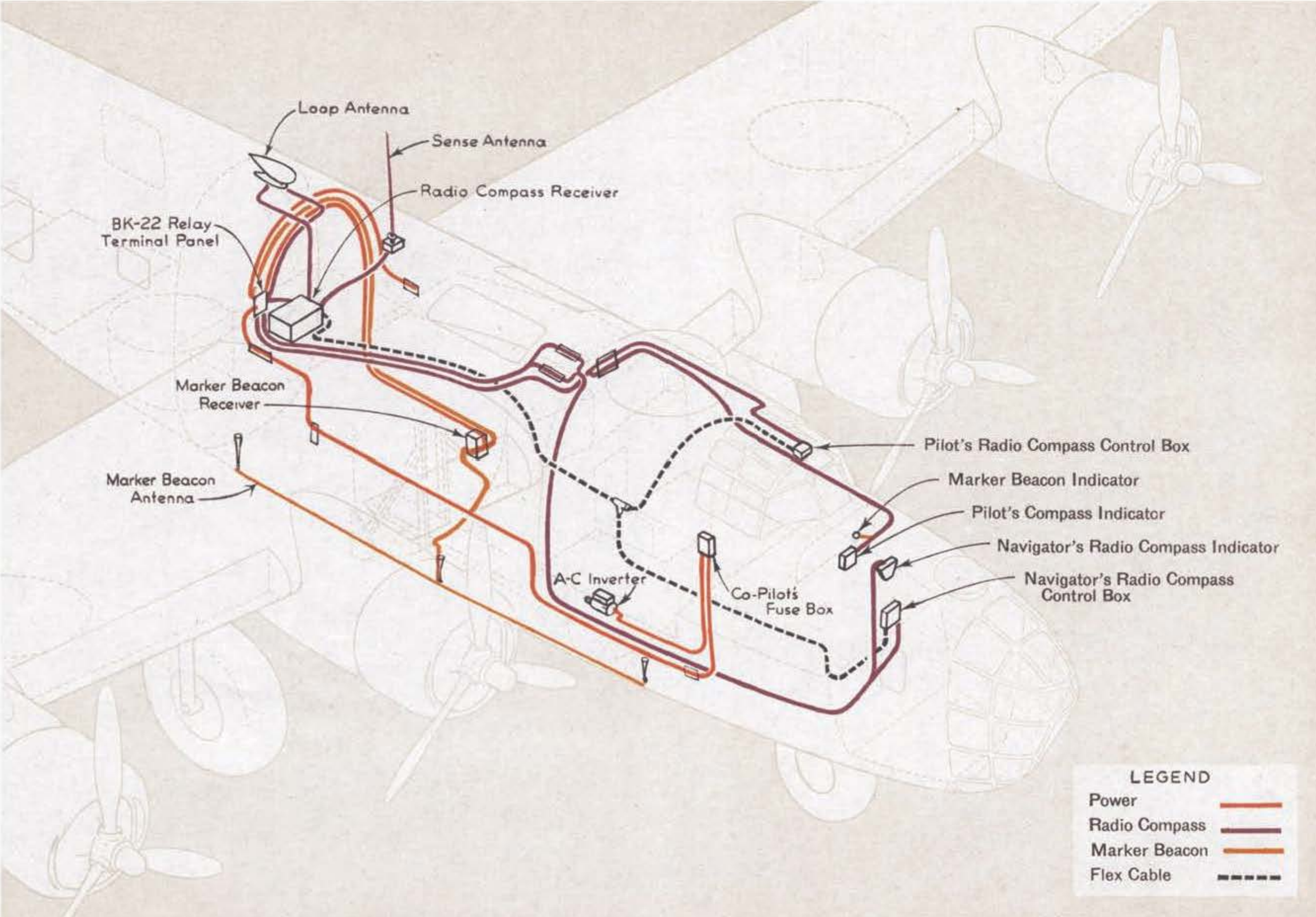
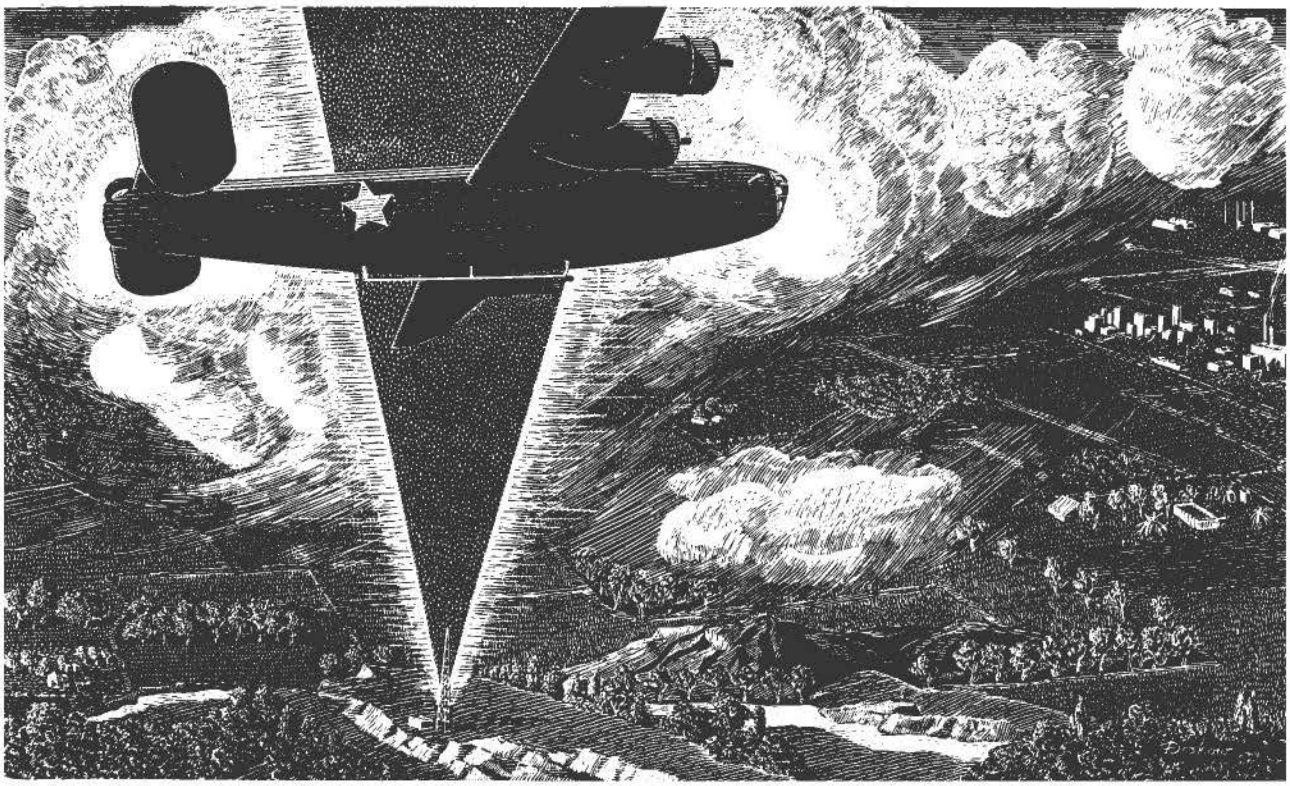


Figure 159. General Location of Compass and Marker Beacon Equipment and Main Cable Routing



Chapter VI

MARKER BEACON EQUIPMENT

MARKER BEACON EQUIPMENT—RC-43-A Unit 5—The Marker Beacon Equipment consists of the following:

Unit 5-1 One BC-357-B Marker Beacon Receiver—Located in the bomb bay at Station 5.0 left side. Figure 160.

5-2 One special antenna mounted underneath the ship on special stand-off insulators. Figure 166.

5-3 One WC-358 Antenna lead in from antenna to marker beacon receiver. Figure 161.

5-4 One indicator lamp with amber jewel cover, on the Pilot's Instrument Panel, using a 14V, .15 amp. miniature bayonet base type T 3¼ lamp. Figure 24.

The Marker Beacon equipment is designed to operate on 75 MC (ultra high-frequency). Its purpose is to receive signals transmitted from instrument landing systems, fan stations, cone of silence stations, and other stations employing 75 MC horizontally polarized wave patterns.

Marker Beacon Operation (Figure 160)—Since power is derived from the Compass Receiver, it is necessary that the Compass equipment be "ON" for marker beacon operation, which is then entirely automatic without further control.

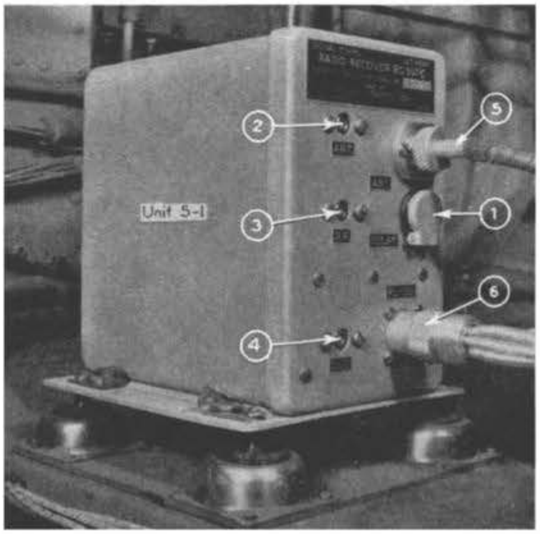


Figure 160. Marker Beacon Receiver
Unit 5-1—Marker Beacon Receiver (BC 357-B)
(1)—Phone Jack
(2)—Antenna Adjustment Screw
(3)—R. F. Adjustment Screw
(4)—Detector Adjustment Screw
(5)—Antenna Lead in and Connector
(6)—Power and Output Connector Cable and Plug

As the ship enters a fixed area or passes over a fixed point, depending on the type of transmitting station, the signal, picked up by the receiver, actuates a relay which completes the circuit to the indicator light on the Pilot's Instrument Panel. Since the signal is intermittent the lamp will flash, indicating to the Pilot that he is passing over a marker beacon station.

MARKER BEACON RECEIVING EQUIPMENT RC-39-A and RC-43-A

PREPARATION FOR USE—After the receiving equipment has been installed and all connections made, proceed as follows:

1. Turn on the radio compass equipment by moving switch (11), Figure 148, to Comp., Ant., or Loop positions. This supplies the power for Radio Receiver. Wait about 40 seconds for the tubes to warm up.

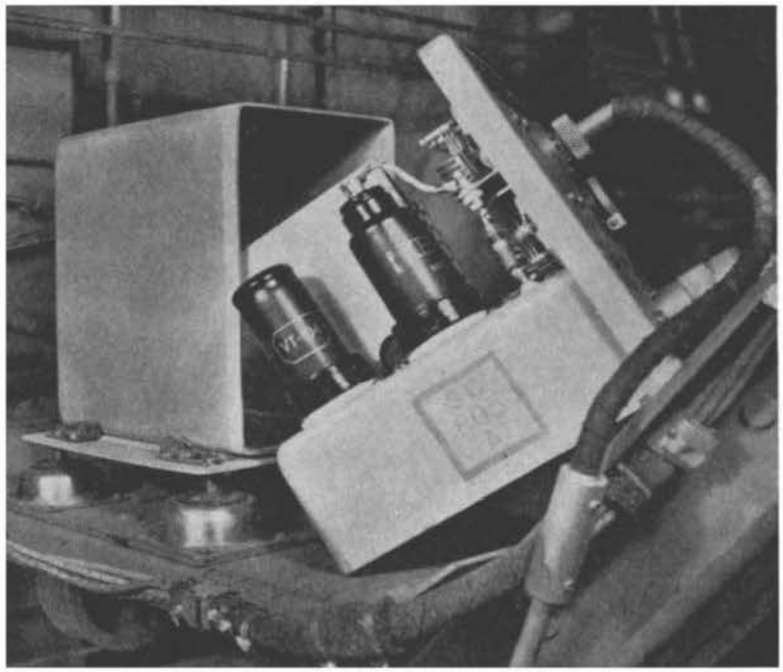
2. Apply a test signal to the receiver and check the tuning. This is done with Test Set I-76. (For a complete description of Test I-76 see the instruction book for that equipment.) Proceed as follows:

   a. Set Test Oscillator (BC-376-A or BC-376-B or equivalent) on the ground to the side of the aircraft about 10 to 20 feet from the marker beacon receiving antenna. The battery switch should be turned "ON" and the modulation set for 3,000 cycles.

   b. Connect Test Indicator BE-67, which is also part of Test Set I-76, to the output of the receiver by plugging one end of Cord CD-200, provided with Test Set I-76, into the jack on the front of the receiver marked "RELAY" and the other end of the cord into the jack of the test indicator. Set the switch on the test indicator to the "Tune Receiver" position, and the milliammeter will indicate the output current of the receiver when the latter is properly aligned and normal. If no indication be obtained, check the oscillator and refer to the instructions pertinent to adjustment of that instrument.

   c. Use a screwdriver with a 1/8" blade for tuning the "Ant." (2) "R.F." (3), and "Det." (4) tuning capacitors, Figure 160. Tune for maximum response on the test indicator. Tune in this order: "Det." (4) "R.F." (3), "Ant." (2), "R.F." (3), "Det." (4). If the "Ant." (2) and "R.F." (3), adjustments are very far off, it is desirable to check from one to the other a couple of times and then tune "Det." (4) last. It has been noted that there is a weak response point at minimum setting of the "Ant." (2) capacitor. In making tuning adjustments be sure that "Ant." capacitor (2), is tuned at **strongest** response point and is not left at minimum capacity. If the output exceeds .5 ma, at the maximum response, decrease the length of the antenna on the test oscillator by collapsing the sections or place the test oscillator at a more remote point. Rotation of the oscillator will also accomplish the same result. There should be no moving object in the vicinity of the test oscillator or the marked beacon antenna while the tuning adjustment is in progress. This tuning adjustment should always be made with the receiver chassis in its case.

3. Remove the test signal and check relay as follows:
   a. Hold the switch on Test Indicator BE-67 (part of Test Set Equipment) in the "Adjust Relay" position.
   b. Turn the control knob on the test indicator clockwise until the marker beacon indicator light goes "ON" and then turn the knob back until the light goes "OFF." The relay should close at 0.4 milliampere (± 10%), as read on the meter in the test indicator, and open at 0.2 milliampere (± 10%). The procedure outlined in paragraph on relay adjustment under Maintenance should be followed if the relay needs adjustment.



Temp. Figure 161. Marker Beacon Receiver Left Side—Removed From Case

   c. Disconnect Test Indicator BE-67. After Test Indicator BE-67 has been disconnected, the receiver is ready for operation.
   d. Turn the test oscillator "ON" and observe that the indicator lamp on the instrument panel lights after the test indicator has been removed. This is a check that the jack circuit closes properly after the plug has been removed.

OPERATION

1. The use of Marker Beacon Receiving Equipment RC-39-A enables the Pilot to determine when he is flying over a 75 megacycle marker transmitter. This transmitter may be an Army instrument landing type such as Radio Transmitter BC-302 or Marker Beacon Projector A-1. Along the airways the marker may be of the cone of silence or fan type. The receiver will respond to any 75 megacycle signal which is horizontally polarized and modulated at an audio rate, responding with increasing sensitivity as the modulation frequency increases up to 3000 cycles. A signal approximately 85 times

greater is required at 60 cycles modulation than at 3000 cycles modulation to give normal output. The receiver has been thus designed because the 60 cycle modulated transmitter used in the Army instrument landing system is too powerful for use with the sensitive receiver required for cone of silence operation.

2. The interval during which the marker beacon indicator lamp will light varies from a few seconds to as long as several minutes and depends upon the type of marker, altitude and speed of the airplane. Cone of silence markers utilize non-directional antenna arrays which cause equal indications for any direction of flight. Indications over cone of silence markers last about 1 minute at 10,000 feet altitude, when the speed of the airplane is 150 miles per hour.

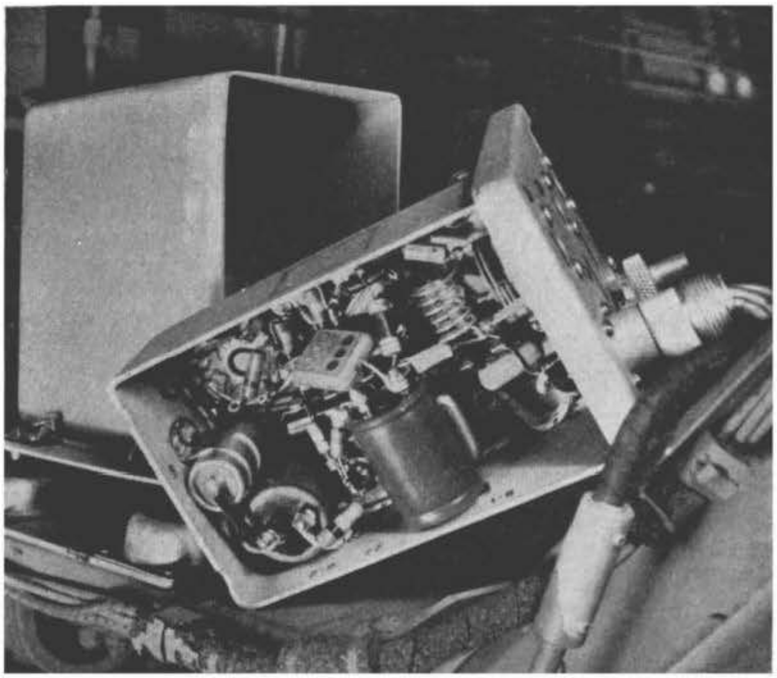


Figure 162. Marker Beacon Receiver—Bottom View—Case Removed

3. In order to eliminate false or confusing signals, the receiver is designed so that stray radiations, natural or man-made static, ignition interference or vibrations shall have a minimum effect.

4. The actual operation of the receiving equipment requires only that the compass switch be turned on. No other adjustments are required while the equipment is in use. The "Marker Beacon Test" switch which appeared on earlier marker beacon installations has been eliminated.

PRECAUTIONS DURING OPERATION

The following precautions should be observed during the operation of this equipment in order to avoid faulty use and misinterpretation of results:

1. The radio compass switch should be in the "ON" position.

2. When passing over a marker the indication should be steady or flash regularly, following the keying of the transmitter. Cone of silence markers and Army instrument landing markers are not keyed. Fan type markers and C.A.A. instrument landing markers are identified by keying. However, the radio receiver may not follow the keying of the 100 watt fan marker transmitters when the airplane is passing through the strongest part of the beam at low altitudes.

   Flickering of the indicator lamp may be caused by a defect in the antenna installation, microphonic tubes, or ignition interference.

DETAILED FUNCTION OF PARTS

ANTENNA ASSEMBLY—The antenna used with Marker Beacon Receiving Equipment RC-39-A is horizontal and parallel to the fuselage. See Figure 166. It is of suitable length for resonance at 75 megacycles, and is tapped off-center as shown in order to obtain a 75 ohm impedance match to the concentric transmission line lead-in. The length of the antenna is critical since it is operated at resonance. The concentric transmission line length is not critical. Bends should be as large as possible and of at least 3 inch radius. The transmission line is terminated at the receiver end in its characteristic impedance of about 75 ohms by means of the tap on primary of R.F. Input Transformer 5. The entire antenna assembly and details of the dimensions, connections, and installation are shown in Figures 20, 21, 22, and 23.

RADIO RECEIVER BC-341-B (MARKER BEACON)—Radio Receiver BC-341-B is a two tube ultra high frequency receiver having the following tube complement: duplex diode pentode Tube VT-153 and duplex diode triode Tube VT-104, see Figures 161 and 164. By means of a reflex circuit Tube VT-153 functions as a radio frequency amplifier, detector, and audio frequency amplifier. Tube VT-104 functions as an audio frequency amplifier and rectifier, which supplies the relay current.

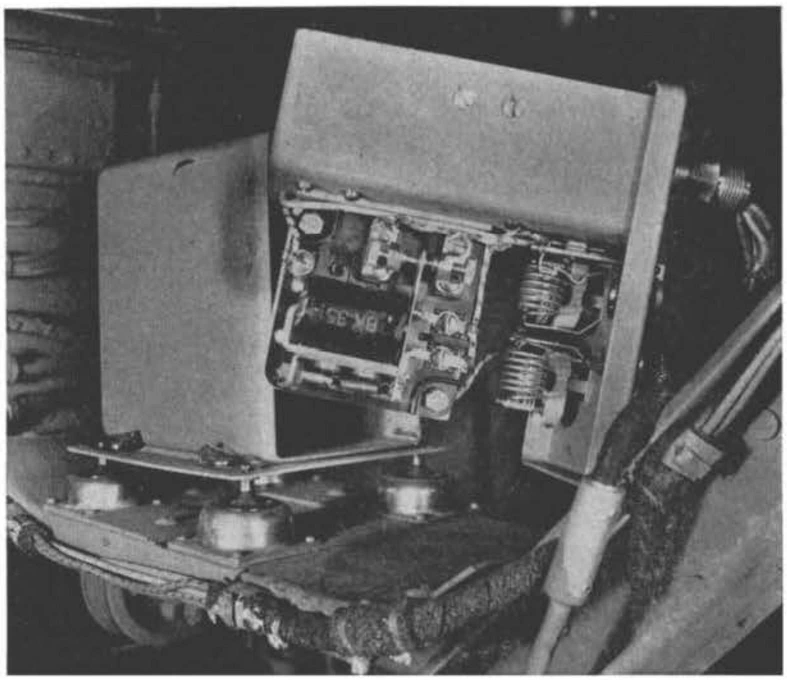


Figure 163. Marker Beacon Receiver—Right Side

Referring to the schematic diagram, Figure 164, the ultra high frequency signal (75 megacycles) picked up by the antenna is fed to the primary of the input radio frequency transformer (5) through a concentric transmission line. Both the primary and secondary of the radio frequency transformer are tuned. The ultra high frequency voltage induced in the secondary of the RF transformer is impressed on the control grid of Tube VT-153 (26-1) by means of the capacitor (10) and grid resistor (18-1) and grid resistor (18-2) is effectively by-passed at radio frequency by capacitor (11-3). The ultra high frequency variations of plate current of Tube VT-153 caused by the signal voltage impressed on the control grid produces a radio frequency voltage across RF Choke (7-1) which is impressed on the diode plate by means of coupling capacitors (11-1) and (11-2) and FR Choke (7-3). The main advantages of tuned circuit (6) and (9-3) is to give the receiver more selectivity. The radio frequency signal is rectified by the diode. The audio frequency voltage produced across the resistor (19) is coupled back to the grid of Tube VT-153 by means of capacitor (14) and resistor (18-2). Resistor (18-1) can be considered in series with the control grid when the tube functions as an audio frequency amplifier (decreasing the value of this resistor causes the receiver to become unstable). The audio frequency variations of plate current flowing through audio choke (8-1) and resistor (24) produce an audio frequency voltage which is impressed on the grid of Tube VT-104, (26-2) by means of coupling capacitor (13) and grid resistor (21). The audio frequency voltage produced across audio choke (8-2) is impressed on the diode plate of Tube VT-104 by means of capacitor (17), and the coil of relay (25), which functions as the diode load. The rectified audio frequency current flowing through the relay coil operates the relay, the contacts of which close the circuit of the marker beacon indicator lamp.

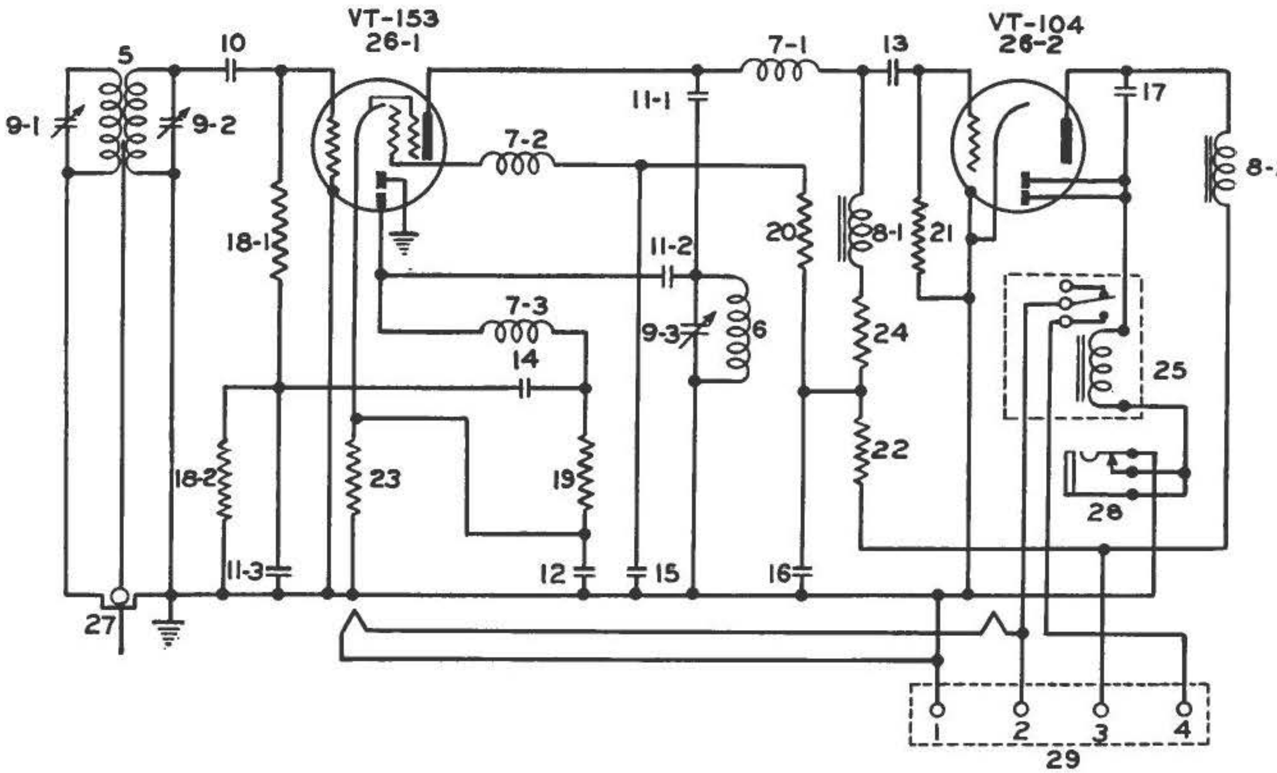


Figure 164. Marker Beacon Receiver—Schematic Circuit Diagram

(5)—R.F. Input Transformer
(6)—Detector Tuning Coil
(7)—R.F. Choke (3 Reqd.)
(8)—Audio Choke (2 Reqd.)
(9)—Tuning Capacitor, 18 MMF (3 Reqd.)
(10)—Capacitor, Ceramic, 500 VDC 25 MMF
(11)—Capacitor, Ceramic, 500 VDC 50 MMF (3 Reqd.)
(12)—Capacitor, Mica, 250 VDC 750 MMF
(13)—Capacitor, Mica, 250 VDC 750 MMF
(14)—Capacitor, Mica, 500 VDC .004 MFD
(15)—Capacitor, Mica, 500 VDC .01 MFD
(16)—Capacitor, Paper, 600 VDC 0.5 MFD
(17)—Capacitor, Paper, 600 VDC .03 MFD
(18)—Resistor, ½ Watt, 1.0 Megohm (2 Reqd.)
(19)—Resistor, ½ Watt, 0.5 Megohm
(20)—Resistor, ½ Watt, 0.15 Megohm
(21)—Resistor, ½ Watt, 2.0 Megohm
(22)—Resistor, ½ Watt, 20,000 Ohm
(23)—Resistor, ½ Watt, 200 Ohm
(24)—Resistor, ½ Watt, 10,000 Ohm
(25)—Relay BL-35
(26)—Tube Socket (2 Reqd.)
(27)—Antenna Jack
(28)—Relay Jack
(29)—Socket SO-88

At the ultra high frequencies it is necessary to regard the wiring of the ultra high frequency circuits as an appreciable part of the circuit constants. As an illustration, the lead from pin No. 1 of the Tube VT-153 socket to the chassis ground, although less than one inch in length, is an inductance and its actual length and position have considerable effect on the receiver sensitivity and stability. Due also to the reflex circuit connections there exists some feed-back which is regenerative. This feed-back tends to cancel out the "transit time effect," of Tube VT-153 when used as an ultra high frequency amplifier and results in improved sensitivity and selectivity. The amount of this feed-back depends on the exact length of wiring and by-passing associated with the first tube as well as the circuit constants themselves. For this reason, whenever parts are replaced, another receiver or the photographs of the instruction book must be used as reference and the exact lengths and positions of the leads duplicated. Design details which may seem unconventional are essential to the stability of

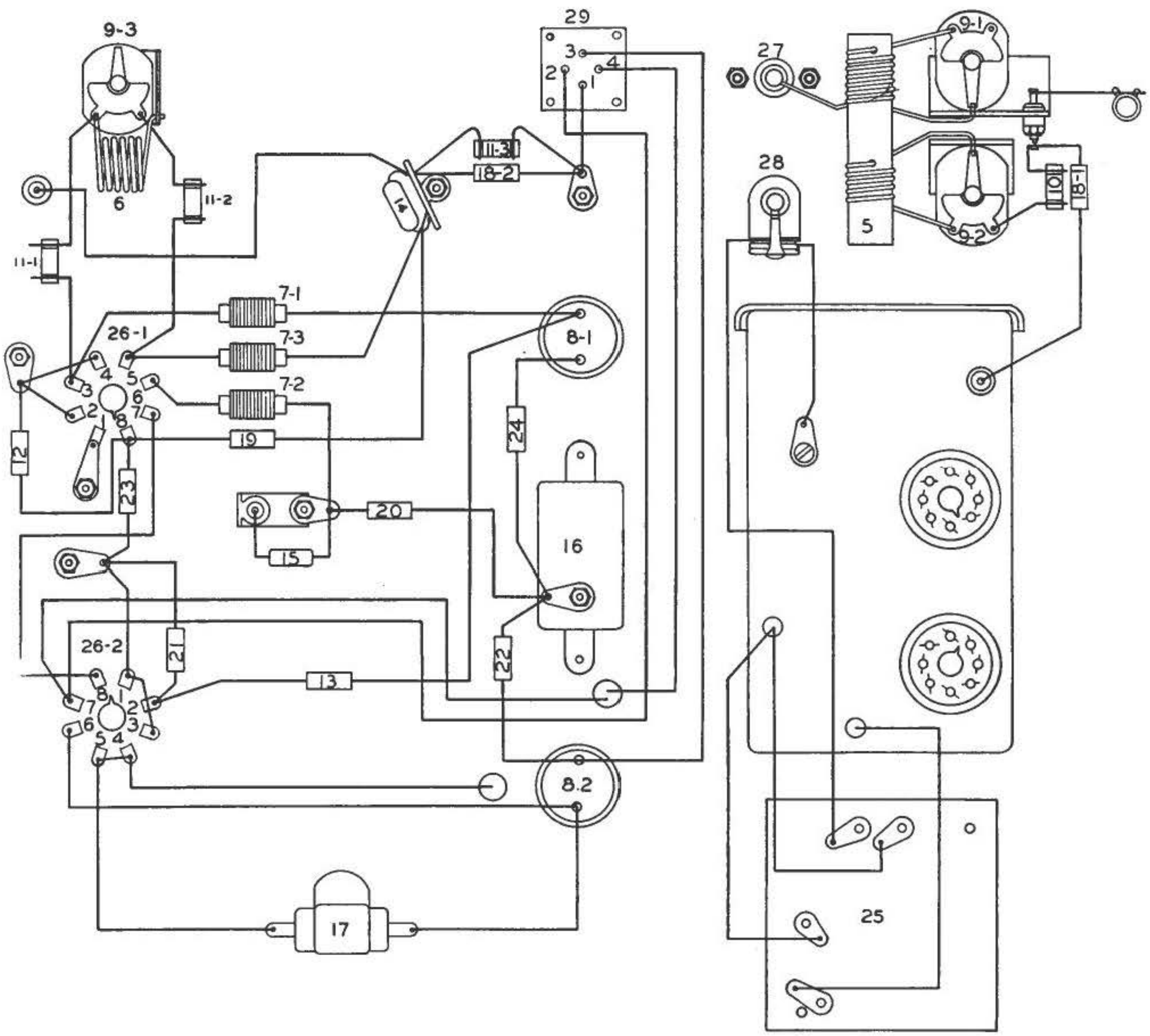


Figure 165. Radio Receiver BC-357-B Practical Wiring Diagram

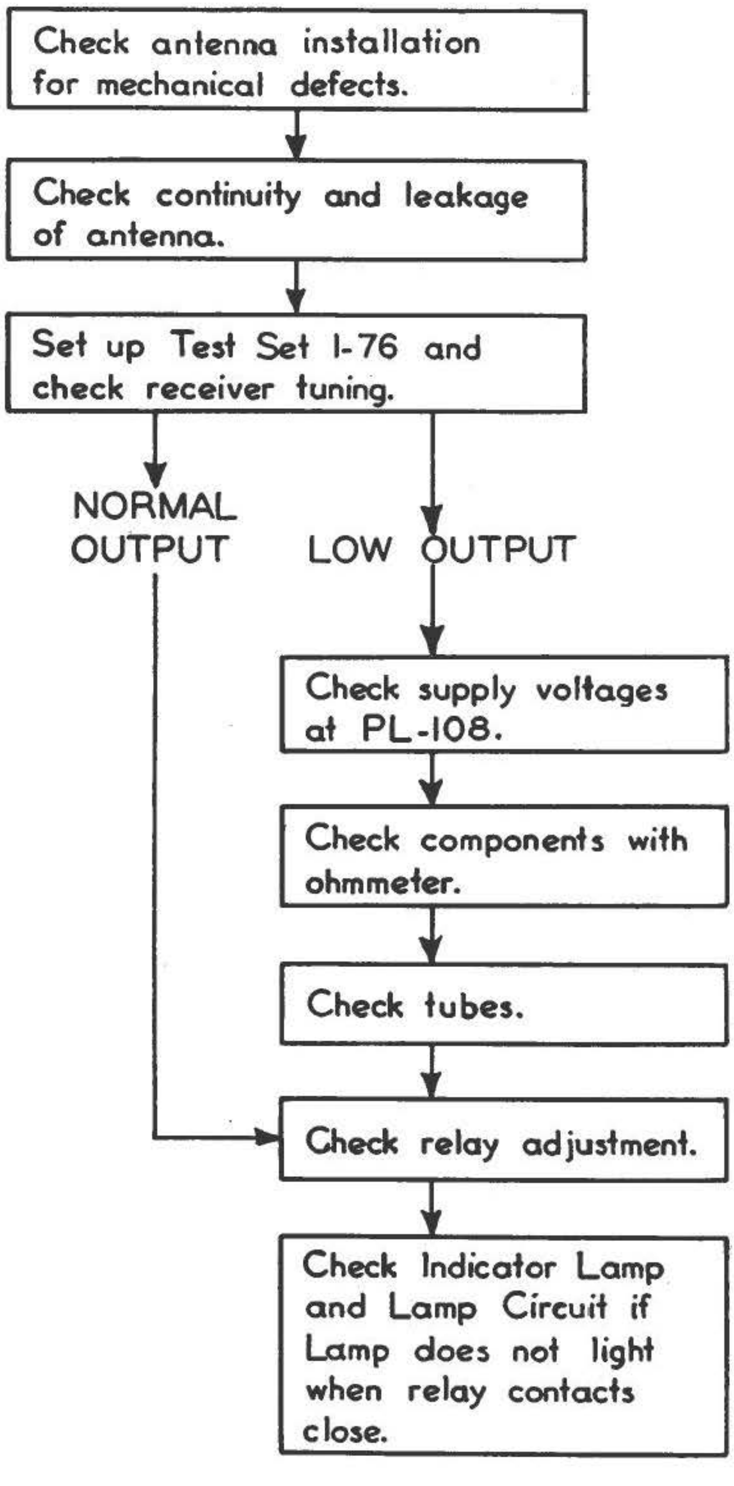
the receiver. The omission of the conventional RF by-pass capacitor between screen grid of Tube VT-153 and chassis ground is one of these details.

One of the requirements of this marker beacon receiver is that it must be relatively insensitive for use with the 20 watt, 60 cycle modulated marker beacon transmitter of the Army instrument landing system, yet provide maximum sensitivity for use with the 5 watt, 3,000 cycle modulated cone of silence markers on the civil airways. For this reason the constants of the audio frequency coupling circuits have been chosen to discriminate against the lower audio

TROUBLE LOCATION AND REMEDY CHART

SERVICE ROUTINE

EQUIPMENT NOT SATISFACTORY IN FLIGHT



frequencies and to provide maximum amplification at 3,000 cycles. Coupling capacitors (13) and (14) have a comparatively low value for this reason. Also, it will be noted that audio choke (8-1) has a very high impedance at 3,000 cycles which causes Tube VT-153 to be very efficient as an audio amplifier at 3,000 cycles. The impedance of audio choke (8-1) is, of course, comparatively low at 60 cycles. However, resistor (24) (10,000 ohms) is a part of the plate load, which does not discriminate against the low audio frequencies.

The space current (plate current plus screen grid current) of Tube VT-153 flowing through resistor (23) supplies the grid bias for the tube. By-pass capacitor (12) is of a comparatively low value. Thus resistor (23) has a slight degenerative effect at audio frequencies.

Resistor (22) and capacitor (16) act as a filter circuit in the high voltage supply to Tube VT-153. This filter serves to prevent "hash" or "ripple," which might be present in the high voltage supply from operating the relay. The characteristics of 3 volts of audio ripple in the band 40 c.p.s. to 3,000 c.p.s., in the high voltage supply. The audio frequency which appears in the plate circuit return of the radio compass may contain the modulation of the received signal as well as a component due to the modulator in the radio compass, the latter appearing when "OFF COURSE."

SUPPLY VOLTAGES

Plug PL-108 permits a check on the high and low voltage supply which is obtained from the radio compass. When the radio compass is in operation and Plug PL-108 is removed from the marker beacon receiver, the voltage measurements should be as follows:

Terminals 1 – 2 (Positive Terminal) + 12 volts

1 – 3 (Positive Terminal) + 220 volts

These are typical values and depend upon the battery voltage and type of compass. The high voltage will vary depending upon the regulation of the voltage supply circuit for the marker beacon receiver. The use of a 35,000 ohm resistor as a load will simulate the high voltage drain of the receiver. The correctness of voltage distribution in the receiver in operation is assured by the determination of the proper values of the component and tubes and supply voltage.

CONTINUITY TESTS ON ANTENNA INSTALLATION

Antenna continuity tests provide a check on the external wiring, transmission line, and fittings. Possibilities of failure are:

(1) Poorly soldered lead-in splice.

(2) Short or open circuit in Terminal TM-187-A.

(3) Short or excessive leakage in Cable WC-538.

(4) Short in Cable WC-537.

(5) Short or open circuit in Coupling MC-192.

Mechanical inspection and continuity tests with the ohmmeter will reveal defects in the antenna installation. Leakage due to moisture absorption by the transmission line, Cable WC-538, will not affect operation unless excessive because the antenna lead-in is a non-resonant low impedance circuit. Antenna leakage should be measured with Cable WC-537 removed from ANT. jack on receiver. The measured value of leakage resistance will vary with humidity conditions but be very high and on the order of megohms. Antenna continuity is measured with Cable WC-537 connected to the receiver. In this case the circuit is completed through the low resistance of the tapped section of Primary of RF transformer 5, and has a resistance on the order of a fraction of an ohm.

SUPPLEMENTARY DATA AND LIST OF REPLACEABLE PARTS
RADIO RECEIVERS BC-341-B and BC-357-B (MARKER BEACON)

Reference No.	Stock No.	Name of Part	Description	Function	Drawing No.
5		Coil	Air Communications, Special	Antenna and R.F. Tuning	D-734-6
6		Coil	Air Communications, Special	Detector Tuning	D-734-3
7		R.F. Choke	Air Communications, Special Ref. No. 7-1 Ref. No. 7-2 Ref. No. 7-3	 VT-153 Plate Choke VT-153 Screen Choke VT-153 Diode Choke	D-734-2
8		A.F. Choke	Air Communications, Special (Thordarson T-45535) 28 Henries, ± 15%, 3 M.A. Ref. No. 8-1 Ref. No. 8-2	 VT-153 Plate Choke VT-104 Plate Choke	D-888-1
9		Capacitor	Hammarlund, Special APC, or Millen 26,000 series, Variable type 18 Mmf., or Johnson type 18K8. Ref. No. 9-1 Ref. No. 9-2 Ref. No. 9-3	 Antenna Tuning R. F. Tuning Detector Tuning	 PD-733-1 PD-733-1 PD-733-6
10		Capacitor	Centralab, type 813, Ceramic 500 VDC, .000025 mfd. plus or minus 20%, 0° Temp. K.	R.F. Grid Coupling	PA-782-5
11		Capacitor	Centralab, type 813, Ceramic 500 VDC, .00005 mfd. plus or minus 20%, Neg. Temp. K of 7 x 10−4 Ref. No. 11-1 Ref. No. 11-2 Ref. No. 11-3	 R.F. Plate Coupling R.F. Diode Coupling R.F. By-Pass 1st Audio	PA-798-7
12		Capacitor	Aerovox, Mica, No. 1468, type SM Bakelite, 250 VDC, .00075 mfd. plus or minus 20%	R.F. Cathode By-Pass	PA-779-23A
13		Capacitor	Aerovox, Mica, No. 1468, type XM Bakelite, 250 VDC, .00075 mfd. ± 10%	2nd Audio Coupling	PA-779-23
14		Capacitor	Aerovox, Mica No. 1467, 500 VDC, .004 mfd. plus or minus 10%	1st Audio Coupling	PA-776-30
15		Capacitor	Aerovox, Mica, 1467, 500 VDC, .01 mfd. ± 20%	Screen By-Pass	PA-776-34
16		Capacitor	Electrical Utilities Co. No. 10604, 400 VDC, .5 mfd. minus 0%, plus 30%	Plate Supply By-Pass	D-733-5

RADIO RECEIVERS BC-341-B and BC-357-B (MARKER BEACON)—Continued

Reference No.	Stock No.	Name of Part	Description	Function	Drawing No.
17		Capacitor	Electrical Utilities Co. No. 10601 Paper 600 VDC, .034 mfd. ± 15%	3rd Audio Coupling	P10,095
18		Resistor	IRC type BT ½. 1.0 megohm plus or minus 20% Ref. No. 18-1 Ref. No. 18-2	 R.F. Grid 1st Audio Grid	
19		Resistor	IRC type BT ½, 0.5 megohm plus or minus 20%	VT-153 Diode Load	PA-760-69
20		Resistor	IRC type BT ½, 0.15 megohm plus or minus 10%	Screen Supply	PA-760-64
21		Resistor	IRC Type BT ½, 2.0 megohms plus or minus 10%	2nd Audio Grid	PA-760-74
22		Resistor	IRC Type BT ½, 20,000 ohms plus or minus 20%	VT-153 Plate Supply	PA-760-51
23		Resistor	IRC Type BT ½, 200 ohms plus or minus 20%	VT-153 Cathode	PA-760-20
24		Resistor	IRC Type BT ½, 10,000 ohms plus or minus 20%	VT-153 Plate Load	PA-760-45
25		Relay BK-35	Kurman Electric Co. Type No. 310 C 42A (NOTE: Relays BK-35 procured on Order No. 577-NY-41 were erroneously marked "BK-25").	Indicator Lamp Circuit	PD-758-2
26		Socket	American Phenolic Corp. Type SS8 Phosphor Bronze Contacts, Silver-plated, for .062 inch thick chassis Ref. No. 26-1 Ref. No. 26-2	 For tube VT-153 For tube VT-104	P10,000
27		Cable Connector	H. B. Jones No. 101-D, Special, Single Conductor	Antenna	D-888-2
28		Phone Jack	Mallory and Co., Circuit Closing Type A-2 with 1 hex nut No. 232, 1 extruded fibre washer No. 203, 1 flat bakelite washer No. 212	Relay test circuit	P10,003
29	2Z8788	Socket SO-88	4 Prong cable connector socket	For plug PL-108	SC-D-2419-A
30		Socket Ring	American Phenolic Corp. No. 4 Steel, nickel plated	Socket retaining ring	P10,001
31		Grip Cap	Sierick Mfg. Co. No. 223	For VT-153	

RADIO RECEIVERS BC-341-B and BC-357-B (MARKER BEACON)—Continued

Reference No.	Stock No.	Name of Part	Description	Function	Drawing No.
32		Jack Cover Assembly	Air Communications, Special	Relay Jack Cover	D-853-1
33		Capacitor Dust Shield	Air Communications, Special	For Capacitors 9-1, 9-2 and 9-3	D-853-6
34		Slide Fastener Latch	Air Communications, No. K-743	Snap slide, for FT-161	SC-D-2024-B (1)
35		Slide Fastener Rivets	Air Communications, No. K-745	Snap slide, for FT-161	SC-D-2024-B (7)
36		Slide Fastener Spring Washers	Air Communications, No. K-744	Snap slide, for FT-161	SC-D-2024-B (3)
37*		Circuit Label	Air Communications, Special		D-735
38**		Circuit Label	Air Communications, Special		D-755
39		Casing Assembly	Air Communications, Special	For Radio Receiver Chassis	D-737

*Used only in Radio Receiver No. BC-341-B **Used only in Radio Receiver No. BC-357-B.

ANTENNA ASSEMBLY

	2Z1585-537	Cable WC-537	Flexible Transmission Line	Connects WC-538 to Receiver	SC-C-3186
	2Z1585-538	Cable WC-538	Concentric Transmission Line Communication Products, Inc. Type 600	Transmission Line Lead-in	
	2Z3272	Coupling MC-192	Coupling for Flexible Concentric Transmission Line	Connects WC-538 to WC-537	SC-C-3185
	3G-588	Insulator IN-88	Strain Insulator	Antenna	SC-A-419
	2Z9299-187A	Terminal TM-187-A	Coupling Terminal	Connects W-106 and WC-538	SC-D-3339
	1A106	Wire W-106	Steel, Copper Clad, Bare No. 18 A.W.G.	Antenna	Spec. 71-526

MISCELLANEOUS

	2T153	Tube VT-153	Duplex-Diode Pentode	R.F. Amp. Det. A.F. Amp.	
	2T104	Tube VT-104	Duplex-Diode High-Mu Triode	2nd Audio-Diode Rectifier	Spec. 71-1204
	2Z7208	Plug PL-108	4 Connector Plug	To fit Socket SO-88	SC-D-2202
	2Z6701	Mounting FT-161	Shock Absorbing	For Receiver	SC-D-2138-C

APPENDIX


R.F. Duggan

APPENDIX

ANTENNA SYSTEM

The Antenna system used on B-24D airplanes consists of six separate antennae, each with a specific purpose.

The Command Antenna is a single wire which extends aft from alongside the top turret to the top of the left vertical stabilizer.

The Liaison Fixed Antenna is also a single wire which extends aft from alongside the top turret to the top of the right vertical stabilizer.

The Radio Compass "Sense" Antenna is a "vertical whip type," mounted on top of the airplane at Station 5.1 and accessible through a junction box mounted in the top compartment aft of the life raft area.

The Marker Beacon Antenna is mounted underneath the plane below the catwalk on stand-off insulators. The lead-in is at Station 5.0. (See Figure 166.)

The Radio Compass Loop is mounted topside at Station 5.3. to 5.4.

The Liaison "Trailing Antenna" is a single wire wound on an electrically operated reel located under the flight deck. (See Figure 158.)

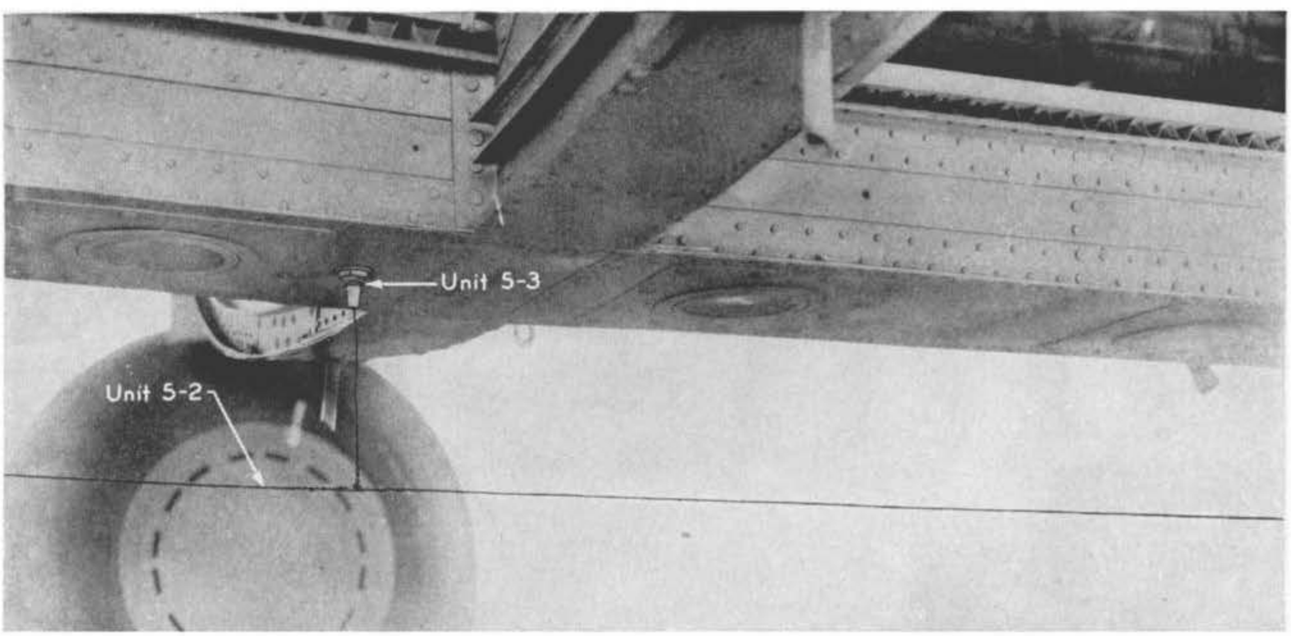


Figure 166. Marker Beacon Antenna

GENERAL PRECAUTIONS AND MAINTENANCE SUGGESTIONS

1. Check both tube sockets and connector plug sockets or receptacles for loose or broken connections.
2. Banana plugs used on radio connectors, loose spring tension and break easily.
3. On modulator unit—CAUTION: Remove plug PL-148 when replacing or removing fuses as fuse clips are hot to clips supply when plug attached.
4. All radio plugs normally installed with number "up."
5. If BC-456-A modulator ceases to function:
   a. Check relays next to modulator tubes. These should be closed.
   b. If relays are closed look for tube trouble.
6. NOTE: If imput voltage falls to 24V or less the relay inside the base may not operate.
7. If filter choke in modulator unit shorts to ground, cut leads to choke and tie all leads together leaving choke out of circuit. Unit may have some hum but it will be operatable.
8. Never force a plug—TO DO SO MAY CAUSE BREAKAGE.
9. Noise in command receivers common to all. Look for loose contacts on antennae relay.

   DO NOT ATTEMPT TO BEND relay contact springs. Loosen lock nut on spring shaft and rotate in such a direction that spring tension is increased (on receiver side).
10. Liaison receiver noisy and inoperative at times, look for plating of condenser plates scaling and shorting out.
11. Liaison transmitter blowing fuses:
    a. Most common cause is arcing over of plate feed line to final tube. This is exceptionally bad to wiring of voltmeter circuit. Bend wiring for clearance.
    b. If H.V. dynamotor fuse blows and there is flash of fire from relay contacts in transmitter when transmitter key is closed, look for blown condenser in end of liaison dynamotor. Do not continue to operate under this condition else spring tension and contacts of transfer relay will be damaged. Same holds true of high voltage fuse in transmitter.
12. NOTE: Liaison receiver will not operate with liaison transmitter power plugs removed. Relay in transmitter must function before receiver circuit is completed, (controls receiver screen voltage). If relay fails receiver is also inoperative.
13. Check condenser in asc plate circuit if command receiver goes dead. Plate tuning is used with high voltage on condenser. Check asc plate to ground for resistance. Should be 100,000 ohms.
14. Command receiver dead—Check condenser (C35 of Figure 39 in schematic drawings) from terminal No. 2 of plug J3, to ground. Resistance from No. 2 to ground should be about 300 ohms. If much less, cut condenser loose.

15. Erratic operation of compass receiver and no compass action is usually caused by:
    1. VT93 (without shielding), between UT105 and UT66 all in rear compartment, going bad.
    2. Next check or change VT105 just forward of VT93 above.
    3. Next possibility is VT96 alongside of UT93 or
    4. UT66 back of VT93.
16. Compass receiver dead—tubes—check or change VT87 **first.**
17. Compass receiver dead due to failure of selenium rectifier, cut leads to rectifier and remove elements. Use receiver on band in use when rectifier went out, if possible. Only aural indication for course charting is possible. Use in LOOP position. If necessary to change band pull set—pull band change shaft—reinsert from left side and turn manually to band desired. Pull shaft and leave out. Be **careful** in shaft removal or insertion else switch will get out of alignment. Line up band switches with notches all on same side.

ABBREVIATIONS COMMONLY USED IN RADIO

Alternating current	a.c.
Antenna	ant.
Audio frequency	a.f.
Automatic Volume Control	a.v.c.
Continuous waves	c.w.
Current	I
Cycles per second	~
Decibel	db.
Direct current	d.c.
Electromotive force	e.m.f.
Frequency	f.
Ground	gnd.
Henry	h.
Intermediate frequency	i.f.
Interrupted continuous waves	i.c.w.
Kilocycles (per second)	kc.
Kilowatt	kw.
Megohm	meg.Ω
Microfarad	μf.
Microhenry	μh.
Micromicrofarad	μμfd.
Microvolt	μv.
Microvolt per meter	μv/m.
Milliampere	ma.
Milliwatt	mw.
Modulated Continuous Waves	m.c.w.
Ohm	Ω
Power factor	p.f.
Radio frequency	r.f.
Volt	v. or E

COMMON RADIO RECEIVER TROUBLES
STAGE-BY-STAGE

R. F. STAGE

SYMPTOMS	CAUSE
Inoperative	Open or shorted R. F. coil
	Band Switch contacts dirty
	Shorted tuning or trimmer condenser
	Open plate decoupling resistor or choke
Intermittent Fading	Shorting trimmer condenser
	Loose connecting lugs on R.F. coil
	Leaky plate or screen by-pass condenser
	Band switch making poor contact
Oscillation or Noisy	Rotor contacts on tuning condenser dirty
	Open Cathode or screen by-pass condenser
	Shorted bias resistor
	Aligned too sharply
Distortion or Hum	Shorted filament by-pass condenser
	Antenna too long, causing overload
	Shielding making poor contact
	Shorted antenna coupling condenser

MIXER-OSCILLATOR STAGE

SYMPTONS	CAUSE
Inoperative	Oscillator plate resistor open
	First I. F. transformer primary open
	Shorting or open oscillator trimmer condenser
	Open plate choke coil

MIXER-OSCILLATOR STAGE—Continued

SYMPTOMS	CAUSE
Intermittent Fading	Poor insulation on oscillator trimmer condenser
	Open grid return resistor
	High resistance at lugs of oscillator coil
	Dirty band switch contacts
Oscillation or Noisy	Open grid coil
	Cathode by-pass condenser open or leaky
	Shield on grid leads corroded or open
	Decoupling resistor shorted
Distortion or Hum	Leaky plate by-pass condenser
	Shorted or leaky cathode by-pass condenser
	Open grid filter condenser
	Oscillator coil misaligned

I. F. STAGE

SYMPTOMS	CAUSE
Inoperative	Open I. F. coil
	Plate decoupling resistor open
	Shorted trimmer condenser
	Primary or secondary by-pass condenser shorted
Intermittent Fading	Open or shorting grid by-pass condenser
	Litz wire on lugs corroded
	Trimmer condenser shorting
	A.V.C network defective
Oscillation or Noisy	Screen by-pass condenser open
	I. F. transformer out of alignment
	Shorted cathode bias resistor
	Poor coil contacts at lugs

I. F. STAGE—Continued

SYMPTOMS	CAUSE
Distortion or Hum	Open cathode by-pass condenser
	Stage out of alignment
	Too sharply tuned oscillation
	High resistance between primary and secondary of I. F. transformer

2ND DETECTOR

SYMPTOMS	CAUSE
Inoperative	Plate load resistor open or shorted
	Shorted trimmer condenser
	Control grid lead shorting to shield
	Open plate filter choke
Intermittent Fading	Defective volume control
	Load resistor by-pass condenser shorting
	High resistance contact in I. F. transformer secondary
	R. F. by-pass condenser shorting
Oscillation or Noisy	Open plate or grid by-pass condenser
	Defective volume control
	Out of alignment
	Defective plate load resistor
Distortion or Hum	Defective volume control
	Leaky audio coupling resistor
	Plate load resistor too high
	Leaky plate by-pass condenser

1ST AUDIO STAGE

SYMPTOMS	CAUSE
Inoperative	Plate load resistor open
	Open audio coupling condenser
	Shorted plate by-pass condenser
	Open cathode resistor
Intermittent Fading	Defective audio transformer primary
	Open volume control
	Leaky grid or plate coupling condenser
	Defective plate load resistor
Oscillation or Noisy	Shorted cathode by-pass condenser
	Plate decoupling resistor shorted
	Open plate by-pass condenser
	Primary of coupling transformer opening
Distortion or Hum	Shorted grid or plate coupling condenser
	Cathode by-pass condenser shorted
	Audio transformer open or shorting
	High resistance from primary to secondary of audio transformer

POWER SUPPLY

SYMPTOMS	CAUSE
Inoperative	Shorted electrolytic condenser in power supply
	Power supply filter choke open
	Open voltage divider in power supply
	Shorted or open power transformer secondary
Intermittent Fading	Shorted or leaky filter condenser
	Loose contacts on voltage divider
	Defective line switch
	Filter choke shorting to ground

POWER SUPPLY—Continued

SYMPTOMS	CAUSE
Oscillation or Noisy	Open filter condenser
	Defective voltage divider
	Filter choke leaking to ground
	Leaky by-pass condenser from rectifier tube to ground
Distortion or Hum	Open or shorted primary by-pass condenser
	Center tap on filament windings open
	Open or leaky output filter condenser
	Grounded pilot light bracket

OUTPUT (POWER) STAGE

SYMPTOMS	CAUSE
Inoperative	Primary of output transformer open
	Open cathode bias resistor
	Shorted audio coupling condenser
	Secondary of output transformer shorted or open
Intermittent	Defective primary on output transformer
	Open cathode bias resistor
	Shorting audio coupling condenser
	Open secondary on input transformer
Oscillation or Noisy	Open cathode by-pass condenser
	Defective cathode resistor
	Leaky audio coupling condenser
	High resistance from primary to secondary
Distortion or Hum	Shorted cathode by-pass condenser
	Screen grid circuit open
	Shorted turns on output transformer
	I. F. push-pull tubes may be unbalanced

ARMY TYPE VACUUM TUBES AND RMA EQUIVALENTS

VT Type	RMA Equivalent	VT Type	RMA Equivalent	VT Type	RMA Equivalent
VT-1	None	VT-73	843	VT-130	250TL
VT-2	None	VT-74	5Z4	VT-131	12SK7
VT-4-B	211	VT-75	75	VT-132	12K8
VT-4-C	None	VT-76	76	VT-133	12SR7
VT-5	WE215-A	VT-77	77	VT-134	12A6
VT-7	WX-12	VT-78	78	VT-135	12J5GT
VT-17	860	VT-80	80	VT-136	1625
VT-19	861	VT-83	83	VT-137	1626
VT-22	204A	VT-84	84, 98, 6Z4	VT-138	1629
VT-24	884	VT-86	6K7	VT-139	VR-150-30
VT-25	10	VT-86A	6K7G	VT-140	R-1628
VT-26	22	VT-87	6L7	VT-141	531
VT-27	30	VT-87A	6L7G	VT-144	813
VT-28	24A, 24	VT-88	6R7	VT-145	5Z3
VT-29	27	VT-88A	6R7G	VT-146	IN5GT
VT-30	01A, 01	VT-89	89	VT-148	1D8GT
VT-31	31	VT-90	6H6	VT-149	3A8GT
VT-33	33	VT-91	6J7	VT-150	6SA7
VT-34	207	VT-91A	6J7GT	VT-151	6A8G
VT-35	35,51	VT-92	6Q7	VT-152	6K6GT
VT-36	36A, 36	VT-93	6B8	VT-153	12C8 Special
VT-37	37, 37A	VT-94	6J5	VT-154	GL814
VT-38	38, 38A	VT-94A	6J5G	VT-155	
VT-39A	869A	VT-96	6N7		Reserved for
VT-40	40	VT-97	5W4	to	Special
VT-41	851	VT-98	6U5, 6G5		Types
VT-42-A	872A	VT-99	6F8G	VT-160	
VT-43	845	VT-100	807	VT-161	12SA7
VT-44	32	VT-101	837	VT-162	12SJ7
VT-45	45	VT-103	6SQ7	VT-163	6C8G
VT-46A	866A, 866	VT-104	12SQ7	VT-164	1619
VT-47	47	VT-105	6SC7	VT-165	1624
VT-48	41	VT-106	803	VT-166	371A
VT-49	39, 44	VT-107A	6V6GT	VT-167	6K8
VT-50	50, 585, 586	VT-107	6V6	VT-168	—
VT-51	841	VT-108	Eimac 450TH	VT-169	1208
VT-52	45-Special	VT-109	2051	VT-170	1E5GP
VT-54	34	VT-111	5BP5	VT-171	1R5
VT-55	865	VT-112	6AC7	VT-172	1S5
VT-56	56	VT-114	5T4	VT-173	1T4
VT-57	57	VT-115	6L6	VT-174	3S4
VT-58	58	VT-116	6SJ7	VT-175	1613
VT-60	850	VT-117	6SK7	VT-177	1LH4
VT-62	801	VT-118	832	VT-178	1LC6
VT-63	46	VT-119	879	VT-179	1LN5
VT-64	800	VT-120	954	VT-180	3LE4
VT-65	6C5	VT-121	955	VT-181	7Z4
VT-66	6F6	VT-124	1A5GT	VT-182	1291
VT-67	Special-30	VT-125	1C5GT	VT-183	1294
VT-68	6B7	VT-126	6X5	VT-192	7A4
VT-69	6D6	VT-127	Eimac 100TS	VT-193	7C7
VT-70	6F7	VT-128	A5588	VT-208	7B8
VT-72	842	VT-129	304TL	VT-233	6SR7

FREQUENCY TOLERANCE TABLE FOR THE BC 348-H, J, K, & L LIAISON RECEIVERS

Frequency	Tolerance	Frequency	Tolerance
200 — 500 Kilocycle Band		6.0 — 9.5 Megacycle Band	
200 Kilocycles	1.5 KC	6800 Kilocycles	51 KC
300 Kilocycles	2.25	7500 Kilocycles	56.25
400 Kilocycles	3.00	8200 Kilocycles	61.50
500 Kilocycles	3.75 KC	8900 Kilocycles	66.75
		9500 Kilocycles	71.25
1.5 — 3.5 Megacycle Band		9.5 — 13.5 Megacycle Band	
1500 Kilocycles	11.25 KC	10,000 Kilocycles	75 KC
2000 Kilocycles	15. KC	11,000 Kilocycles	82.50
2500 Kilocycles	18.75	12,000 Kilocycles	90.
3000 Kilocycles	22.50	13,000 Kilocycles	97.50
3500 Kilocycles	26.25 KC		
3.5 — 6.0 Megacycle Band		13.5 — 18 Megacycle Band	
4000 Kilocycles	30.75 KC	13,500 Kilocycles	101.25 KC
4500 Kilocycles	33.75	14,600 Kilocycles	107.5
5000 Kilocycles	37.50	16,000 Kilocycles	120.
5500 Kilocycles	41.25	17,000 Kilocycles	127.5
6000 Kilocycles	47.00	18,000 Kilocycles	135.

Flight and Service Department of Consolidated Aircraft Corporation wishes to express its appreciation to the following concerns for their cooperation and for the use of drawings and material in the preparation of this manual:

Air Communications, Inc.
Belmont Radio Corporation
Bendix Radio
General Electric Company
Western Electric Company