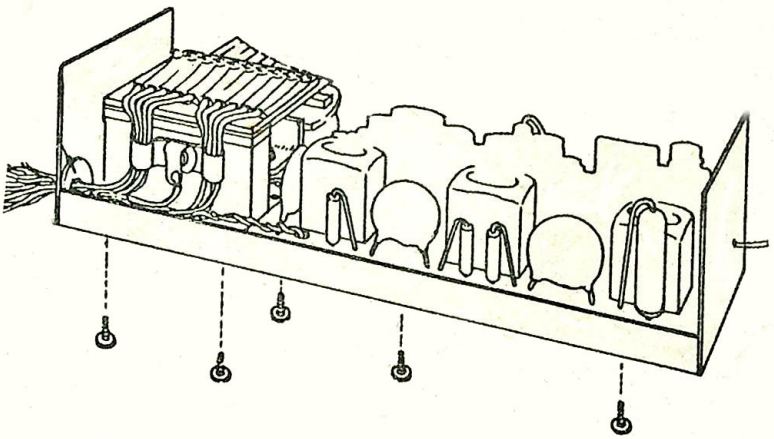
ASSEMBLY INSTRUCTIONS



CONTROLAIRE

10 Channel Superhetrodyne Receiver Kit

Parts Check and Price List

Hardware

[ ]	(1 ea.) Receiver Case, Top and Bottom	3.50
[ ]	(1 ea.) Controlaire Emblem	.25
[ ]	(1 ea.) Reed Bank Wire Clamp	.15
[ ]	(3 ea.) No. 2 x ¼ Flathead Screws	.01
[ ]	(4 ea.) No. 2 x 3/16 Sheetmetal Screws	.01
[ ]	(2 ea.) No. 2 x ¼ Sheetmetal Screws	.01
[ ]	(1 ea.) No. 4 Solder Lug	.01

Wiring

[ ]	1 ea.) 2" Length No. 26 Solid	.60
[ ]	(1 ea.) 24" Length No. 26 Red Flex	.60
[ ]	(1 ea.) 24" Length No. 26 Black Flex	.60
[ ]	(1 ea.) 36" Length No. 26 Flex Ant	.60
[ ]	(1 ea.) 12" Length No. 22 Red Flex	.60
[ ]	(8 ea.) 12" Lengths No. 26 Flex as foil white, blue, green, orange, purple, yellow, brown, silver	

Miscl. Parts

[ ]	(1 ea.) Etched Circuit Board	3.60
[ ]	(1 ea.) O.S. 10 Chan Reed Bank	16.95
[ ]	(1 ea.) Reed Bank Micarta Board	.35
[ ]	(1 ea.) Rubber Grommet ¼ x 5/16	.03
[ ]	(2 ea.) ½" Length 1/8 Tubing	.02
[ ]	(9 ea.) Paper Mounting Rings	.02
[ ]	(1 ea.) Operating Instructions	1.50
[ ]	(1.ea.) Assembly Instructions	2.50
[ ]	Kit Assem. Tips	.20
[ ]	(1 ea.) Inslator Paper	.10
[ ]	(1 ea.) 4' length Solder	.15

Transistors Diode

[ ]	(1 ea.) 2N-1745 Mixer I.F.	3.25
[ ]	(2 ea) 2N-1787 1st and 2nd I.F.	2.10
[ ]	(1 ea.) ~~T-1324~~ Local Oscilator	2.95
[ ]	(2 ea.) ~~2N-224~~ Audio Amplifier	1.95
[ ]	(1 ea.) IN-295 2nd Detector	70

Capacitors

[ ]	(1 ea.) 3.3 or 4mmfd Disc	.25
[ ]	(1 ea.) 10mmfd Disc	.25
[ ]	(2 ea.) 16mmfd Disc	.25
.01 [ ]	(1 ea.) ~~.005~~ mfd Disc	.25
[ ]	(4 ea.) .02 mfd Disc	.25
[ ]	(2 ea.) 1mfd, 6 volt Electrolytic	.85
[ ]	(1 ea.) 10mfd, 6 volt Electrolytic	.85
[ ]	(3 ea.) ~~50~~ 70 mfd, 6 volt P. C. Electrolytic	1.25

Resistors ¼ Watt

[ ]	(1 ea.) 100 Ohm (brown, black, brown)	.12
[ ]	(5 ea.) 470 Ohm (yellow, violet, brown)	.12
[ ]	(1 ea.) 1000 Ohm (brown, black, red)	.12
[ ]	(2 ea.) 3.3 K Ohm (orange, orange, red)	.12
[ ]	(2 ea.) 4.7 K Ohm (yellow, violet, red	.12
[ ]	(2 ea.) 10 K Ohm (brown, black, orange)	.12
[ ]	(2 ea.) 27 K Ohm (red, violet, orange)	.12
[ ]	(2 ea.) 47 K Ohm (yellow, violet, orange)	.12
[ ]	(1 ea.) 100 K Ohm (brown, black, yellow)	.12

Coil, Transformers, Choke

[ ]	(1 ea.) Antenna Coil Assembly	1.90
[ ]	(1 ea.) R.F. Choke 12 uhf	.35
[ ]	(1 ea.) OS-MI Interstage Transformer	1.20
[ ]	(1 ea.) Mixer I.F. Transformer	1.50
[ ]	(1 ea.) 1st I.F. Transformer	1.50
[ ]	(1 ea.) 2nd I.F. Transformer	1.50

Assembly Instructions

Introduction

The Controlaire Superhet has to its credit over two years of reliable operation in the field before being introduced as a kit for home construction. Hundreds of users have purchased the receiver in assembled form and their letters of satisfaction have prompted the production of a kit. This success, coupled with noncritical circuit features, make the receiver a natural for home construction. The kit and the factory assembled unit are one and the same receiver. The only difference being that the home builder supplies the labor in the assembly of the kit. The builder should not rush the project but rather should take the time to understand each operation before doing it to insure success. So — do not rush, and yours will be a rewarding experience of reliability and satisfaction.

The instructions are presented in two separate manuals and a small pamphlet titled "Kit Assembly Tips". One manual is the standard "Operating Instructions" as supplied with factory assembled units and the other manual is the "Assembly Instructions" which you are now reading. It is of primary importance that before any assembly work is started that you initially read all three of these items to gain a preliminary understanding of all information involved.

As you study the assembly manual you will notice the exacting care with which it was prepared. Work procedure is presented by the step by step method and, to illustrate the exact placement of every part, a large page of receiver pictorials have been included and made removable from the main manual for your convenience. It is intended that you place the pictorial page at a convenient spot on your workbench thus eliminating the confusion of turning pages to clarify a point of reference when accomplishing a step. Study all of the pictorials but especially take notice of Fig. 2. This is the main pictorial about which the assembly text is centered. Notice that this is a top view of the main receiver chassis and that all components are assigned specific hole numbers to insure their exact placement on the circuit board. The shaded area represents the etched copper circuit pattern and although on the underside of the board, the same pattern can be recognized from the small receiver board by holding it up to a light source where the pattern will show through. By using the light on the actual receiver board specific holes can be identified by association with the pattern or individual copper lands as shown in the pictorial.

Assembly of parts to the circuit board is quite conventional. Resistors and most other parts are mounted flush to the circuit board in an upright position with their bodies standing over the holes as shown. Some parts have special positioning but in all cases this is brought to your attention dur-

ing the step it is installed. As each part is installed, bend its leads over slightly, except I. F. transformers, to hold it in position for soldering. After soldering has been completed clip off the excess lead about 1/16" from the circuit copper.

Tuning procedure is the essence of simplicity. No special instruments are needed except your companion transmitter to furnish a signal and a simple 0-50 ma milliampmeter to measure total current flow in the receiver. Each of the four adjustments, one antenna coil and three I. F. transformers, are peaked in the same manner to obtain highest current reading on milliampmeter while using a very weak tone signal from your transmitter. Complete instructions follow in the text.

Preliminary Notes

After you have studied the pictorials and initially read all of the instructions, unpack your kit carefully and check each part as identified on the check list. By doing this you will become familiar with parts appearance that will help you during assembly. After the check has been made, group the parts, resistors, in one pile, condensers in another, until parts are generally separated for easy identification.

Occasionally we may have to substitute a part to allow an even production of kits when a specific part is not available. This is done to prevent a delay in filling your order and in no way will the substitution effect normal operation. If this has been done in your kit a note, "Parts Substitution", will be included for your identification.

The use of the "Unger soldering pencil" equipped with 37½ watt heat element and small chisel pointed tip is considered mandatory in the construction of this kit. Similar irons may be used, but none larger and of higher heat. The small close work on the etched circuit board is somewhat delicate so let a word to the wise be sufficient. "If you do not have the small iron, it should be purchased at your local radio or hardware store."

Common tools required are a small pair of dykes (wire snippers), long nose pliers, small screwdriver, penknife, file, and pad of steel wool. Other items are Goodyear Plio-Bond contact cement, available locally, and a 0-50 ma milliampmeter, moving coil type, available from either World Engines or Controlaire at a price of $4.95. Do not use cheap vane type meters of high internal resistance as improper readings will result. Solder is supplied in the kit.

Start construction by referring to the assembly steps. During each step refer to the pictorials for necessary parts location and solder the leads of each part as it is installed. Place a check mark in the space provided after completion of each step. Good luck and may your experience be a pleasant one.

ASSEMBLY INSTRUCTIONS

As components are installed to circuit board, clip excess leads about 1/16" from copper then solder unless otherwise noted.

Mandatory — Read the booklet KIT ASSEMBLY TIPS before you start to assemble this Receiver.

1. ( ) Try the circuit board for a proper fit into the bottom half of the receiver case. If it is very tight or will not fit into the space provided, use a small file and square up the edges of the board so a fit can be obtained.

   Clean circuit board with fine steel wool until copper is bright and shiny. Do so away from work area to prevent steel dust from being attracted to reed bank magnet and other parts.

2. ( ) The antenna coil form is cemented and sandwiched to the circuit board by use of two small paper rings and Plio-Bond Cement. (Do not use model cement.) Coat the outside bottom portion of the coil form with a light coat of Plio-Cement. Slip one ring on form and position it so that it is about flush with the lower solder terminal. Study Figs. 2, 4, 6, so that you can correctly position the coil form when it is inserted into the printed circuit board. Now, give the bottom portion of the coil form another coat of Plio-Bond and insert the coil form in the large hole on the printed circuit board. As the coil form enters the board it will be necessary to thread two wires into the printed circuit board at the same time. The center terminal (wire "A", Fig. 4A) inserts into hole No. 5. The twisted center tap wire (wire "B", Fig. 4A) inserts into hole No. 8. Push the form down lightly until the ring that you installed is flush with the circuit board.

   Note: The second paper ring that is installed on the underside of the chassis is installed in a later step.

3. (✓) Mount the OS-M1 transformer to circuit board with metal hold-down lugs in holes No. 72 and No. 73. Bend lugs over for tight fit before soldering. To prevent possible damage to the delicately attached leads they should be inserted into the proper holes without trimming or restripping. Excess length can be taken up by folding lead next to transformer body. Insert the white lead in hole No. 74, black in No. 71, red in No. 93, and green in No. 96.

4. ( ) Insert a 10K ohm resistor (brown, black, orange) in holes No. 1 and No. 3.

5. ( ) Insert a 1K ohm resistor (brown, black, red) in holes No. 10 and No. 15.

6. ( ) Insert a 3.3 mmfd disc condenser in holes No. 7 and No. 51. Refer to Fig. 2 and 3 and note how this condenser is positioned between the body and top lead of a 100K ohm resistor. To get proper installation of these two parts insert the 100K ohm resistor (brown, black, yellow) at this time in holes No. 14 and No. 6.

7. ( ) Insert the leads of the RF choke in holes No. 45 and No. 48.

8. ( ) Cut a piece of No. 24 solid insulated wire to a length of 1½". Strip 3/16" insulation from both ends. To install the wire properly, (AGC line), refer to Fig. 2 and note how it is routed to make room for other components. Insert ends in holes No. 39 and No. 112.

9. ( ) Insert a 47K ohm resistor (yellow, violet, orange) in holes No. 16 and No. 42.

10. ( ) Insert a 4.7K ohm resistor (yellow, violet, red) in holes 40 and 41.

11. ( ) Insert a 470 ohm resistor (yellow, violet, brown) in holes No. 44 and No. 47.

12. ( ) Insert a 27K ohm resistor (red, violet, orange) in holes No. 46 and No. 49.

13. ( ) Insert a 4.7K ohm resistor (yellow, violet, red) in holes 50 and 52.

14. ( ) Insert a 470 ohm resistor (yellow, violet, brown) in holes No. 53 and No. 67.

15. ( ) See Fig. 2 and 3 and notice the installation of the 47K (yellow, violet, orange) ohm resistor in holes No. 77 and No. 82. Notice that the top lead of this resistor is bent in a manner so that it comes down to surface of the PC board then over along surface of board to hole No. 82. Pre-form the top lead of this resistor as described above then install in holes No. 77 and No. 82.

16. ( ) Insert a 27K ohm resistor (red, violet, orange) in holes No. 92 and No. 111.

17. ( ) Insert a 100 ohm resistor (brown, black, brown) in holes No. 108 and No. 113.

18. ( ) Insert a 3.3K ohm resistor (orange, orange, red) in holes No. 106 and No. 107.

19. ( ) Insert a 470 ohm resistor (yellow, violet, brown) in holes 101 and No. 105.

20. ( ) Insert a 3.3K ohm resistor (orange, orange, red) in holes No. 102 and No. 104.

21. ( ) Insert a 10K ohm resistor (brown, black, orange) in holes No. 33 and No. 80.

22. ( ) Insert a 470 ohm resistor (yellow, violet, brown) in holes No. 31 and No. 32.

23. ( ) Insert a 470 ohm resistor (yellow, violet, brown) in holes No. 87 and No. 121.

24. ( ) Refer to Fig. 2 and Fig. 3 and note how the two 10mmfd disc conds are installed right next to, and at different heights from, one another. Insert one condenser in holes No. 56 and No. 58 and allow its body to stand ¼" above circuit board. The other condenser inserts in holes No. 59 and No. 60 with body flush with circuit board.
The close, staggered, installation of these two condensers is necessary to make room for later installation of the crystal and local oscillator transistor. After installation, inspect to insure no leads are shorting to one another.

25. A ( ) In this step four identical 02mf disc condensers are installed, one in holes No. 23 and No. 30, another in holes No. 81 and No. 86, another in holes No. 118 and No. 123, and the last in holes No. 95 and No. 97.

25. B. ( ) Insert the leads of a .005mf disc condenser in holes No. 2 and No. 9.

26. ( ) See Fig. 2 and note that the mixer I. F. Transformer with yellow slug installs in a total of seven holes. Five are for the terminal pins (17, 13, 19 20, 21) and two (25 and 26), are for the lugs of the I. F. Transformer cover. Before installation, inspect and straighten any bent terminal or lug to match alignment with holes in board then install

with base of transformer flush with top of circuit board. Along with soldering the respective terminals, solder also the I. F. Transformer lugs to circuit copper at their respective holes. Do not bend lugs over and use care not to overheat.

27. (✓) In same manner as described in step No. 26, install the first I. F. Transformer which is identified by a white slug. The terminals insert in holes 35, 36, 37, 78, 79 and the transformer lugs in holes 34 and 38.

28. (✓) Again, as described in step 26, install the second I. F. Transformer. This is identified by either a black or blue slug with terminals inserting into holes 88, 89, 90, 117, 119 and transformer lugs in holes 116 and 120.

29. (✓) Install the 10mf electrolytic condenser with positive lead in hole No. 24 and minus lead in hole No. 22. Polarity is identified by either a red mark or plus sign on condenser body nearest the positive lead. After installation, and to add support to the condenser, use a small amount of Plio-Bond to cement the condenser body to the side of the I. F. transformer. Inspect to insure the minus lead is not shorting to surface of I. F. transformer.

30. ( ) Note the color code markings on the glass body of the IN-295 diode. There are bands of Red, White, and Green. Insert the lead from the green band end in hole No. 115 and the other lead in hole No. 114. Use care when bending the one lead going into hole No. 114 as if bent too close or sharp at glass junction, the diode may break. Position the diode body about ¼" above surface of circuit board to lessen the transfer of heat during the soldering operation.

31. ( ) In this step three identical 50mf (plug-in) Electrolytic condensers are installed. Observe polarity on condenser body and insert one on holes (/) 94 and (-) 100, one in (/) hole 75 and (-) hole 76 and the last in holes (/) 68 and (-) 69. Press all condensers down so they are mounted firm against surface of circuit board.

32. ( ) In this step, two identical I MF electrolytic condensers are installed. Observe polarity on condenser body and insert one in holes (/) 109 and (-) 110. The other inserts in holes (/) 70 and (-) 63.

33. ( ) Insert the leads of the local oscillator crystal in holes No. 61 and No. 62. Allow the leads to protrude slightly less than 1/16" through copper, then solder. Do not prolong the soldering as an extreme amount of heat can damage crystal.

34. ( ) In this step the receiver power in-put wires are installed. Cut two pieces of No. 26 stranded insulated wire, one red to an 8" length and the other black to a 9" length. From both wires strip ⅛" insulation from one end and ½" from the other. Refer to Fig. 2 and note the copper land at hole position No. 92. This is the negative in-put land. To this land, at hole position No. 92 and from copper side of board, solder the small stripped end of the black wire. The small stripped end of the red wire solders to the positive ground land located at corner of board at hole position No. 123. After both wires have been attached, thread them through hole No. 122 then twist for the balance of their length.

35. ( ) For the anntena cut a piece of No. 26 stranded insulated wire to a length of 36". Strip 1/8" insulation from one end and solder to the bottom terminal of antenna coil. See Fig. 6 for orientation.

TRANSISTOR INSTALLATION

In the following steps the transistors are installed. They are not necessarily delicate but do not apply excess heat when soldering the leads. Excess heat can be transferred to the internal junction of the transistor through the leads and damage can result. To prevent this, the following soldering procedure is given. Apply the iron to the copper land where the lead is to be soldered. Apply solder, to the land and then flow it over to the lead. The leads will solder easily as they are gold plated. Refer to Figs. 2, 4, 5, and 11 for proper lead identification and exact transistor location. Position the bottom of the transistor 1/8" above the P. C. board. The extra wire length gives some heat protection to the transistor during the soldering operation.

36. ( ) To prepare for easier installation, clip all leads of all transistors to an initial length of 1" and straighten if bent.

37. ( ) Insert the leads of the 2N-1745 (Mixer) in holes 11, 12, and 13 with the collector lead in hole No. 13, base lead in hole No. 12 and emitter lead in hole No. 11.

38. ( ) Insert the leads of a 2N-1787 (I. F.) in holes 27, 28, and 29 with collector lead in hole No. 29, base lead in hole No. 27 and emitter lead in hole No. 28.

39. ( ) Insert the leads of the remaining 2N-1787 (I. F.) in holes 83, 84, and 85 with collector lead in hole No. 85, base lead in hole No. 84, and emitter lead in hole No. 83.

40. ( ) Insert the leads of the T-1324 (Local Osc) in holes 54, 55, and 57 with collector (red mark) lead in hole 54, base in hole 57, and emitter in hole 55.

41. ( ) Insert the leads of 2N-224 (Audio) in holes 64, 65, and 66 with collector (red mark) lead in hole 64, base in hole 66, and emitter in hole 65.

42. ( ) Insert the leads of the remaining 2N-224 (Audio) in holes 98, 99, and 103 with the collector (red mark) lead in hole 98, base in hole 103, and emitter in hole 99.

43. ( ) To complete the assembly of the superhet chassis board, cement the remaining paper ring to bottom of antenna coil.

OS REED BANK

The reed bank as supplied in this kit is not adjusted. There are some things that we have found out about these reed banks in installing them into our assembled equipment that we want to pass on to you. This is outlined in a step procedure as follows.

44. ( ) Notice that there are 10 small adjustment screws that contact the reeds when the bank is in operation. Past experience has revealed that when the threads were cut on the screws that sometimes little hairs or whiskers of metal still remained on the screw thread area and these have caused shorts. The point here is to remove each screw and inspect it individually for such a condition. If any hairs are evident remove them. Also inspect around and under the screw tension leaf springs on top of the bank as some of these metal hairs may have lodged between the springs and again could cause shorts.

45. ( ) Leaf spring tension is considered proper if the tip of each individual spring assumes a position of 1/8 inch above the micarta board with contact screws removed. If any measure less, adjust by bending spring carefully.

46. ( ) Before installing reed contact screws an initial adjustment is required to properly space the reeds above the coil pole piece. This clearance nomanily is 3/64 inch and is adjusted by use of a small screwdriver or probe to bend each reed at its base so it assumes this clearance, see Fig. 7. It should be noted that the above is only an initial adjustment to the bank that is very best accomplished at this time. Final adjustment is done later and can only be accomplished with completed receiver in operating condition. At this time and to acquaint you with overall reed bank adjustment refer to page 7 of the operating instructions and read paragraph 1 through 8 under maintenance notes. After you have completed the initial adjustment, replace the reed contact screws.

47. ( ) There are ten No. 28 flexible wires that are to be soldered to the spring terminals on top of the reed bank. Each is a different color and the color code is shown on Fig. 12. Cut each wire to a length of 10 inches and strip away 1/8 inch insulation from one end. Before soldering the wires to the contact springs it is best to pre-tin each wire and its respective spring then while reheating the spring joint insert the wire into the hole of the spring from back side of reed bank. Do not use excess solder and inspect for shorts between the springs after completion.

48. ( ) See Fig. 7 and note the installation of the strain relief clamp and wiring. Divide the ten coded function wires into two groups of five each. Install over each group a piece of special heat shrinkable insulating tubing and space this tubing for proper alignment when finally installed under the clamp. To shrink the tubing so it grips the wires firmly use the flame of a common match, but use care so as not to burn tubing or wires. Use a No. 2 x 3/16 long sheetmetal screw to attach the clamp and reed plate solder lug to back of reed bank. Tighten firmly.

49. ( ) Cut a piece of No. 22 flexible hook up wire to a length of 10 inches then strip away 1/8 inch insulation from one end. This wire serves as the reed plate common connection and solders to the solder lug installed on the back of reed bank.

50. ( ) Install the insulating micarta board to the bottom of the reed bank with three flathead screws as shown in Fig. 7. Use plastic electrical tape to insulate screwheads as these may protrude slightly and could short out to receiver case when the reed bank is installed in a later step.

Receiver Operating Test

At this point you have completed assembly of the basic receiver chassis and also inspected and prepared the reed bank. Before installing these units into the receiver case an initial operating test is to be accomplished The test is primarily intended to check operation of the superhet receiver and not one of final adjustment to both receiver and reed bank. It involves connecting the reed bank to the receiver chassis and in turn the receiver power wires to the batteries. Test results are viewed by the readings of a 0-50 milliampmeter which monitors the current used by the receiver. As a signal device to tune and operate the receiver a Controlaire multi transmitter is used. Be sure its R.F. output frequency matches the frequency printed on top of the receiver crystal. If it does not, no complete test can be performed. To acquaint you with receiver operation and the tuning procedures involved if you have not already read the standard Operating Instructions we strongly advise that you do so now. It will prepare you for a better overall understanding of the information to follow. The manual makes reference to a factory assembled receiver, yours is home built and not pre-tuned. The following steps describe an orderly procedure in which to accomplish this test.

51. ( ) Inspect the receiver chassis to insure all components are installed properly. If any doubt exists refer to Fig. 2 and with receiver in hand check each component for assembly into the proper circuit holes. If a magnifying glass is available use it to inspect the soldered side of circuit board. Inspect that all joints are secure and that no shorts exist between the copper lands.

52. ( ) To attach the reed bank coil wires to the receiver chassis, thread them first behind the coil assembly allowing them to come out the side of the bank with the shortest reed. From this side of the bank measure the wires to a length of 2½ inches then clip off the excess. Remove 1/8 inch insulation from the end of each wire, pre-tin the exposed ends, then solder to the following copper lands under the receiver chassis. Green wire to copper land containing hole No. 63 and red wire to copper land containing hole No. 92.

53. ( ) Procure a tuning tool and fabricate it to fit the slots in the slugs of both the antenna coil and I.F. cans. It should be at least 10 inches long and made from plastic, hard rubber or wood dowelrod. Do not use metal screwdrivers or metal tipped tools.

54. ( ) Clean off your workbench of wire clippings and solder splotches then lay down a clean sheet of paper over which you will lay receiver for testing. Antenna should be stretched out and in a clear area.

55. ( ) Refer to page 4 of the operating instructions and read the paragraph titled "Receiver Wiring". With the information contained therein and reference to Fig. 13, a pictorial on receiver hookup, connect the receiver, red and black, power wires to the batteries. If standard pencells are used connect three in series to obtain 4½ volts and if Ni-Cads are used connect four in series for 4.8 volts.

56 ( ) Turn the receiver on and observe the following readings on the milliampmeter. With no signal from the transmitter the idle current flow should be from 3½ to 6 ma. Also the meter needle should have a rather steady reading. If your receiver tests within these current limits, all is well, however if the idle current rises to 10ma or more or even pegs the meter needle immediately turn the receiver off and refer to the troubleshooting section of these instructions. If your idle readings are normal continue the test by observing operation of the receiver's local oscilator. Moisten the tip of one of your fingers and touch the top of the R.F. choke. Upon touch it should be noted that the meter current drops about .5 to 1ma from point of normal idle. The drop indicates the oscilator is operating and you are now ready to tune and adjust the receiver's antenna coil and three I.F. cans. This is done with transmitter turned on.

57. ( ) Receipt of a tone signal by the receiver will be noted by an increase in meter reading up to a saturation level of 20 to 30 ma. The initial response of an untuned receiver will be dependent on transmitted signal strength and to get an initial reading you may have to install transmitter antenna to obtain a signal strong enough. The point is, after an initial response try operating receiver on a weaker signal. This time operate receiver with

antenna-less transmitter bringing it in close enough to the receiver antenna to get a small reading. Start the tuning adjustment at the mixer I.F. can, (yellow slug), and slowly adjust slug for highest reading on meter. As the slug is peaked and the current rises to the saturation level, 20 to 30ma, back transmitter away to drop the current so an exact peak can be obtained. Do not try to peak any adjustment with current at saturation level, the input signal must be reduced so a peak can be realized. After the mixer has been peaked, go to the 1st I.F., (white slug), and repeat the above. In turn, back and weaken transmitted signal each time adjustment brings current level to saturation. In same manner peak the 2nd I.F. (black or blue slug), and last peak slug of antenna coil. While tuning you will note that adjustment to the mixer and 1st I.F. is somewhat critical but tends to broaden out at the 2nd I.F. and antenna coil, this is normal.

58. ( ) If you have tuned your receiver with a companion Controlaire transmitter you should get at least a 10 or 12 ma reading at a minimum distance of two foot from receiver antenna. This indicates receiver is of proper sensitivity and will give more than adequate range in the air. If your transmitter was of a different make the principles of tuning the receiver remain the same except that the sensitivity distances may vary from less than two feet up to 20 feet as signal output will vary when such transmitters are used antenna-less. One last bit of tuning information. Be sure your transmitter is in top operating order, batteries are good and tuning peaked for best R.F. output. If it has weak output the sensitivity distance expressed may vary slightly. If in doubt check and repeak your transmitters output with a field strength meter as per manufacturers instructions. This completes the Receiver Operating Test.

FINAL ASSEMBLY

Handle the chassis and reed bank with care during the following steps as they are attached together and undue strain can easily break reed bank coil wires.

59. ( ) To provide proper spacing of the receiver chassis above the bottom of receiver case, use Plio-Bond cement, and attach six paper rings to the bottom or copper side of receiver chassis as shown in Photo No. 2. Notice that three of the rings are clipped to a half ring configuration to allow clearance between land solder joints for an approximate level mounting position. After cement is dry, sight along bottom of the chassis and clip off any component lead that might extend beyond the height of the rings.

60. ( ) Install the rubber grommet in the hole provided at the end of the receiver case as shown in Fig. 8.

61. ( ) Install the chassis paper insulator in the bottom of case by using a spot or two of Plio-Bond cement. This will hold insulator in place during balance of assembly.

62. ( ) Thread all wires from the reed bank and chassis through rubber grommet, and while doing so, slide both the reed bank and chassis into position into receiver case. Use three No. 2 x 3/16" long sheetmetal screws to secure the reed bank to the bottom of the case. Do not, by mistake, use the ¼" long screws as by doing so the reed bank coil can be punctured by the front screw.

63. ( ) Before securing the chassis to the case, lift it up and notice the routing of the reed bank coil wires. Use a probe and position the wires between the paper rings for clearance then route them to the reed bank via the notch in the reed bank insulating board. This will prevent the wires from being squeezed by the chassis mounting and will prevents shorts. Secure chassis to the case with two No 2 x ¼" long sheetmetal screws. After installation notice the point where the reed bank coil wires go under the chassis. As a double check, the wires should be at the notch referred to above and by use of a toothpick type probe should show some freedom of movement. If wires appear very tight or compressed rework chassis mounting.

64. ( ) As a strain relief, tie a simple one loop knot in the antenna at a point 5/8" from where antenna attaches to the bottom terminal of antenna coil. After knotting, thread antenna through small hole in the end of receiver case.

65. ( ) Use plastic electrical tape and insulate the inside area of the top lid over the reed bank. After insulating, install top lid and this completes final assembly.

FINAL TUNING

Final receiver tuning is to be accomplished after the unit has been installed in its housing case. The adjustments made earlier under "Initial Operating Test" are close but the addition of the receiver case and its loading effect necessitate a recheck to insure the unit is peak tuned. To accomplish this, repeat the same procedure as described earlier, except this time when peaking antenna coil, do so with case lid on. The presence of the lid, on or off does not effect the I.F. tuning, but does effect the antenna coil slightly. REMEMBER, to get a peak on any coil requires that you weaken transmitted signal power to a point where meter current registers less than saturation. With current at this level a peak can be obtained.

Once your receiver has been properly tuned to your transmitter it should remain so indefinitely barring no physical accident such as crash damage, etc. Because the design of the receiver is stable, do not become a "TUNING ADDICT", to become such will only wear out slug friction pressure and they will become loose in the coils.

TRANSMITTER TONE ALIGNMENT

To finalize the adjustment to the reed bank an operational check must be accomplished to test operation of each reed. To do this, it will be necessary for you to align the tone channels of your transmitter so it is compatable with the reed frequencies of the O. S. bank. The O. S. bank has a response of about 270 CPS on the longest reed, with a separation of about 20 cycles between reeds, up to a top frequency of about 465 CPS on the shortest reed. If you are using a companion Controlaire transmitter that is compatable to the O. S. bank, only minor alignment is involved to take care of slight reed bank differences. The instructions for doing this are included with the transmitter. If you are using a transmitter of another make alignment may be more difficult, however it can be done. Because of the amount of text and illustrations involved we can not in these instructions give complete details on the alignment of every multi transmitter, however we do present the following information for your guidance.

Most multi transmitters, including Controlaire, have for tone stability, only a small adjustable frequency range for each channel. This range is controllable by a trim potentiometer and is about 30CPS on the high frequency channel down to about 15 CPS on the low. To center the frequency of any channel so the trim potentiometer will be within range to operate a specific reed, a padder condenser is used. This condenser is installed on each channel and is in parallel with the main condenser and coil that governs the highest tone frequency of the tone oscilator. As different channels are keyed, the key switch connects the padder condenser of

that channel in parallel with the main condenser and the resultant tone frequency is a product of the total capacitance in the tone oscilator circuit. In principal, on any channel to lower its center frequency more padding capacitance must be added and vice versa capacitance reduced to increase the frequency.

One last point, the main problem in aligning brand X transmitter is the actual physical location of the padder condenser for each channel and the amount of capacitance to add or subtract to center the channel where you want it. Because the chassis layout of all transmitters vary and we can not supply illustrations we can only suggest you contact the top radio control man in your area for further information. In conclusion where there is a will there is a way.

FINAL REED BANK ADJUSTMENT

After you have aligned your transmitter to operate the reeds of the bank, refer to Page 7 of the "Operating Instructions" and adjust reed bank as per information contained therein.

Trouble Shooting Procedure

Whenever trouble is encountered on a newly assembled receiver, the first order of action is a complete recheck of your assembly steps to see if a mistake has been made. Sometimes to prevent overlooking the same mistake a friend can do the recheck to help you out. Inspect for solder shorts between copper lands, mislocation of a resistor, improper solder joints, electrolytic condensers installed with wrong polarity, transistors misplaced or leads reversed. The point is to inspect the receiver to insure assembly is correct. If, after the recheck, the trouble cannot be located, then proceed with the following.

Most troubles, according to symptoms of malfunction, can be separated into three groups. The first are those that make the receiver nearly or completely inoperative such as very little or no pick-up of signal. The second is marginal operation such as good but insufficient sensitivity, or intermittant operation and the third are those isolated to reed bank operation and adjustment.

To find your trouble you must first classify your symptoms. If it is other than reed bank operation and adjustment, a voltage check of the receiver's test points is required to isolate the trouble to a particular transistor stage. To do this a Vacuum Tube Voltmeter will be required. Accomplish voltage check with receiver turned on but idling. Do not use a signal from your transmitter unless otherwise directed.

Voltage Test

Refer to page 2 of the Operating Instructions and notice the test points and divided circles on the receiver circuit diagram. These are voltage checkpoints and indicate the proper voltage at the points indicated in the circuit. In each circle there are two numbers, the top number indicating proper voltage and bottom number identifying to which copper land the measurement should be taken. The theory in the voltage check system of trouble isolation is that if a particular stage is functioning properly a certain amount of current will be flowing through the circuit at this point. Most points shown indicate the emitter side of each voltage dropping resistor that is installed in the emitter of each transistor stage. Since we cannot conveniently break the circuit and install a milliampmeter to measure the flow through each stage we associate current flow by knowing the voltage change across the emitter resistor. If the current flowing is less than normal so the voltage will be low at this point. If the voltage is higher so is the current that is flowing. If you examine the circuit closer you will notice that the common lead from your vacuum tube voltmeter is installed at the plus terminal of the receiver battery supply which is common to all transistor stages. If your voltage probe (DC) is connected to point 10 in the circuit you will be measuring the voltage difference across the emitter resistor of the 2N-1745 mixer transistor. If the voltage difference between plus and point 10 is .15 volts, it indicates normal current flow and that this stage is operating properly. If, on the other hand, the voltage was lower or higher exceeding the 20% tolerance you should suspect the current was improper and something is wrong with this stage. Now, one other point, to what degree of tolerance from the listed voltages should you assume is improper operation? In most cases this should be 50% from the listed values to be of a serious nature. The exception to this is at points (44), (96), and (63) where the tolerance should be limited to 20%. This superhet is designed to accept great tolerances and still give normal operation. In pursuit of your trouble measure the voltage at all checkpoints, mark them down for future reference, then consult the troubleshooting chart for further information.

Trouble Shooting Chart

Symptoms Group 1 and 2	Probable Cause
1. High current at idle or the meter pegged. Indicating serious short.	Receiver leads to batteries reversed. Solder short between copper lands. 50 mf electrolytic condensers installed with reversed polarity.
2. Same as 1 above except idle current limited to not more than 15 ma. Receiver inoperative.	Accomplish voltage check to isolate trouble. Check affected stage for land shorts and proper installation of components.
3. Receiver inoperative, local oscillator indicates inoperative to touch test. All voltages OK except at point 53.	Broken or inactive crystal. Open RF choke. Improperly installed or defective T-1324 transistor.
4. Same as above except trouble developed as result of severe shock damage.	Broken crystal.
5. Receiver very insensitive or inoperative. All voltages OK except at one checkpoint which is higher than normal tolerance. Tuning has been peaked.	Check affected stage for excessive current flow. Shorts between copper lands. Proper installation of components. Replace transistor if all other parts OK.
6. Same as 5 above. All voltages OK except at one checkpoint which is lower than normal tolerance.	Check affected stage for low current or open condition. Proper installation of components. Open IF or audio transformer depending on stage. Replace transistor if all other parts OK.

7. Same as 5 above except all voltages check OK.	Check for open or improperly installed coupling condensers in all stages. This would be the .005 mf disc in the mixer stage, the .02 mf disc in both the 1st and 2nd IFs and the 1 mf and 50 mf electrolytics in 1st audio stage. Open or defective 1N-295 diode.
8. Operation OK except receiver appears oversensitive at idle with meter wobble up to about 10 ma. Wobble or nervous condition disappears with transmitted carrier signal turned on.	Condition OK up to about 8 ma. and if excessive nervousness not caused by noise interference of close electrical devices sensitivity can be reduced by increasing value of resistor located in holes 44 and 47. Try 1000 ohms and recheck receiver sensitivity.
9. Operation OK except receiver appears slightly insensitive, less than 18" sensitivity as outlined under "Sensitivity Check". Batteries OK. Tuning peaked and OK.	Accomplish voltage check and if not isolated to one stage, decrease value of resistor located in holes 44 and 47. Decrease to not less than 100 ohms. Operate receiver at increased voltage.
10. Receiver tends to give erractic operation with strong signal from transmitter indicating extreme overloading.	1N-295 diode installed backwards. Check AGC voltage at point 42. Should reduce to zero or become negative with transmitted carrier signal turned on.

Reed Bank Trouble Shooting Chart

Symptoms Group 3 Reed Bank	Probable Cause
1. Receiver appears normal but reed bank is hard to drive.	Excessive reed to pole piece clearance. Channel tuning improper at transmitter. Drive signal weak or distorted from receiver, check for signal shape with oscilloscope. If distorted, replace 1 mf reed bank filter condenser. Check at point 63.
2. Poor simultaneous drive, but single channel drive OK.	Same as in 1 above. Poor simul mixing of tones in transmitter or unbalanced mixing. Specific reed frequencies require changing.
3. Interaction between adjacent reads, tends to drive with one tone.	Readjust transmitter tone as reed may be tuned on high frequency side or peak. Reed to pole piece clearance too close, readjust with more clearance. Frequency of reeds spaced too close.
4. Reed drives OK but servo does not operate.	Readjust reed contact clearance. Reed contacts dirty, clean with burnishing tool. Trouble not in reed bank.
5. Third reed starts to vibrate during normal simultaneous operation. Caused by harmonic of simul tones.	Readjust simul tones at transmitter to tune out unwanted third reed. Increase reed to pole piece clearance of offending reed. Extreme cases will require changing reed frequencies of one or more reeds by leading or clipping.

6. Two servos operate with only one reed vibrating.	Shorts between reed contact springs. Check for foreign matter. Trouble not in reed bank.
7. Engine vibration causes unwanted reed operation.	Receiver mounting too tight in aircraft, or unbalanced propeller causing rough engine operation. Receiver should be mounted so reed bank reeds assume vertical position in aircraft.