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Assembling
and Using Your...

Heathkit

**BALUN
COIL**

MODEL B-1

HEATH COMPANY

A Subsidiary of Daystrom Inc.

BENTON HARBOR, MICHIGAN

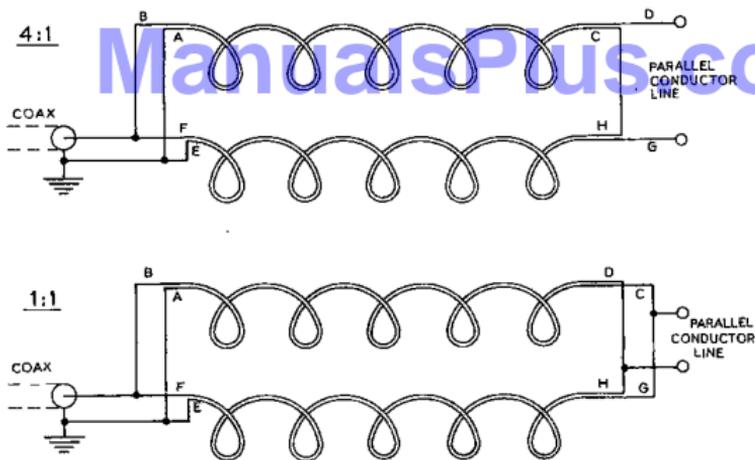
ASSEMBLY AND OPERATION OF THE HEATHKIT BALUN COIL

MODEL B-1



SPECIFICATIONS

Band Coverage:.....	80-40-20-15-11-10 meters
Impedance Matching:.....	75 ohms unbalanced to 300 ohms balanced or 75 ohms unbalanced to 75 ohms balanced
Power Capability:.....	250 watts input to transmitter <i>AM 1000w PEP</i>
Cabinet Size:.....	9" square x 5" deep
Net Weight:.....	2 1/2 pounds
Shipping Weight:.....	4 pounds



SCHEMATIC
HEATHKIT BALUN COIL
MODEL B-1

INTRODUCTION

The Heathkit Balun Coil Set, Model B-1 is a convenient transmitter accessory which has the capability of matching unbalanced coax lines, used on most modern transmitters, to balanced lines of either 75 ohms or 300 ohms impedance. Design of the bifilar-wound balun coils will enable transmitters to operate into balanced transmission lines such as used with dipoles, folded dipoles, or any balanced antenna system.

The Balun Coil Set can be used with transmitters and receivers without adjustment over a frequency range of 80 through 10 meters, and will easily handle power inputs of transmitters up to 250 watts.

CIRCUIT DESCRIPTION

An antenna with an open center, of which the half-wave type is an example, is inherently a balanced radiator. When fed with a parallel-conductor line, this balance is maintained throughout the system, including the transmission line.

If the antenna is fed at the center through a single coaxial line, this balance is upset because one side of the radiator is connected to the shield while the other is connected to the inner conductor. On the side connected to the shield, a current can flow down over the outside of the coaxial line, and the fields thus set up cannot be canceled by the fields on the inner conductor of the coaxial line. Hence, these antenna currents flowing on the outside of the line will be responsible for radiation.

Line radiation can be prevented by a number of devices whose purpose is to detune or decouple the line for antenna currents. One type of decoupling device is known as a balun (a contraction for balanced to unbalanced).

Most forms of baluns are of the linear type and consequently are a one-band device. In order to show the electrical characteristic of the Balun Coil Set, reference will be made to the linear form of balun.

Two transmission lines of equal length, having a characteristic impedance Z_0 (in this application $Z_0 = 150$ ohms) are connected in series at one end and in parallel at the other. At the series-connected end the lines are balanced to ground and will match an impedance equal to $2 Z_0$ or 300 ohms. At the parallel-connected end the lines will be matched by an impedance equal to $Z_0/2$ or 75 ohms. If the length is an odd multiple of $1/4$ wave length, one side of the parallel-connected end may be grounded and the balanced end will be effectively decoupled from the parallel-connected end with an impedance transformation of 4 to 1.

4 to 1 Impedance Transformation

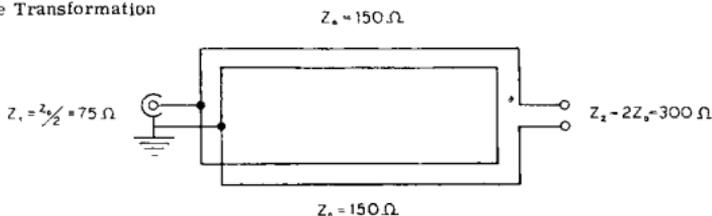


Figure A

Z_0 = Characteristic impedance of transmission line.

Z_1 = Unbalanced characteristic impedance.

Z_2 = Balanced characteristic impedance.

1 to 1 Impedance Transformation

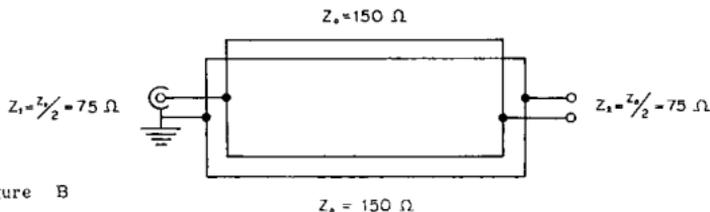


Figure B

If the two transmission lines are connected in parallel at both ends, the lines will be matched by an impedance equal to $Z_0/2$ or 75 ohms at both ends. As before, one side of either parallel-connected end may be grounded, and the other end will be balanced, effectively decoupled from the grounded end with an impedance transformation of 1 to 1.

If the two lines are wound into a coil, the inductances so formed will act as chokes and will tend to further isolate the balanced end from the grounded end. Also, due to the fact that the lines are now acting as chokes the frequency range is greatly extended.

PROPER SOLDERING PROCEDURE

Only a small percentage of Heathkit purchasers find it necessary to return an instrument for factory service. Of these, by far the largest proportion function improperly due to poor or improper soldering.

Correct soldering technique is extremely important. Good solder joints are essential if the performance engineered into the kit is to be fully realized. If you are a beginner with no experience in soldering, a half-hour's practice with odd lengths of wire and a tube socket will be a worthwhile investment.

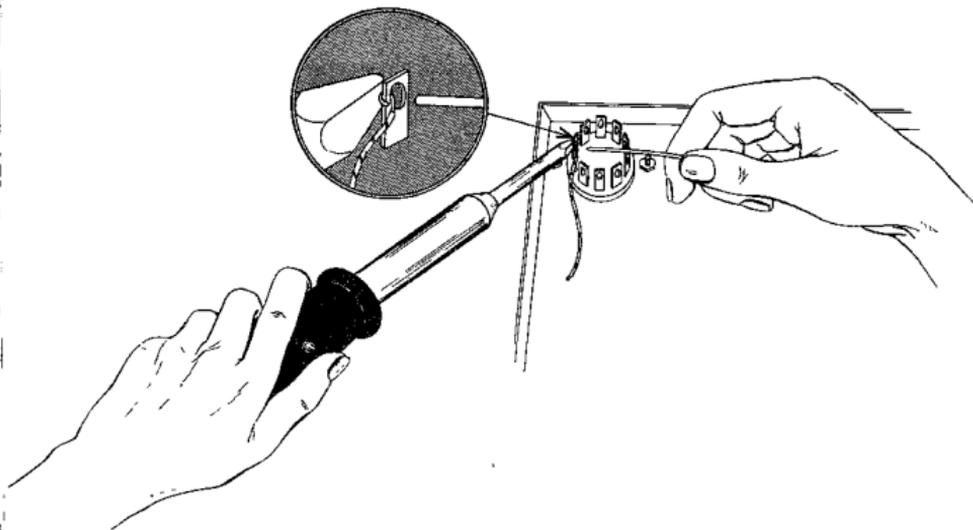
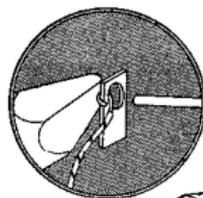
High quality solder of the proper grade is most important. There are several different brands of solder on the market, each clearly marked "Rosin Core Radio Solder." Such solders consist

of an alloy of tin and lead, usually in the proportion of 50:50. Minor variations exist in the mixture such as 40:60, 45:55, etc. with the first figure indicating the tin content. Radio solders are formed with one or more tubular holes through the center. These holes are filled with a rosin compound which acts as a flux or cleaning agent during the soldering operation.

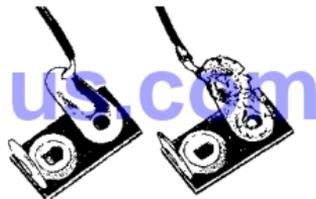
NO SEPARATE FLUX OR PASTE OF ANY KIND SHOULD BE USED. We specifically caution against the use of so-called "non-corrosive" pastes. Such compounds, although not corrosive at room temperatures, will form residues when heated. The residue is deposited on surrounding surfaces and attracts moisture. The resulting compound is not only corrosive but actually destroys the insulation value of non-conductors. Dust and dirt will tend to accumulate on these "bridges" and eventually will create erratic or degraded performance of the instrument.

NOTE: ALL GUARANTEES ARE VOIDED AND WE WILL NOT REPAIR OR SERVICE INSTRUMENTS IN WHICH ACID CORE SOLDER OR PASTE FLUXES HAVE BEEN USED. WHEN IN DOUBT ABOUT SOLDER, IT IS RECOMMENDED THAT A NEW ROLL PLAINLY MARKED "ROSIN CORE RADIO SOLDER" BE PURCHASED.

If terminals are bright and clean and wires free of wax, frayed insulation and other foreign substances, no difficulty will be experienced in soldering. Crimp or otherwise secure the wire (or wires) to the terminal, so a good joint is made without relying on solder for physical strength. To make a good solder joint, the clean tip of the soldering iron should be placed against the joint to be soldered so that the terminal is heated sufficiently to melt solder. The solder is then placed against both the terminal and the tip of the iron and will immediately flow out over the joint. Refer to the sketch below. Use only enough solder to cover wires at the junction; it is not necessary to fill the entire hole in the terminal with solder. Excess solder may flow into tube socket contacts, ruining the socket, or it may creep into switch contacts and destroy their spring action. Position the work so that gravity tends to keep the solder where you want it.



A poor solder joint will usually be indicated by its appearance. The solder will stand up in a blob on top of the connection, with no evidence of flowing out caused by actual "wetting" of the contact. A crystalline or grainy texture on the solder surface, caused by movement of the joint before it solidified is another evidence of a "cold" connection. In either event, reheat the joint until the solder flows smoothly over the entire junction, cooling to a smooth, bright appearance. Photographs in the adjoining picture clearly indicate these two characteristics.



A good, clean, well-tinned soldering iron is also important to obtain consistently perfect connections. For most wiring, a 60 or 100 watt iron, or the equivalent in a soldering gun, is very satisfactory. Smaller irons generally will not heat the connections enough to flow the solder smoothly over the joint and are recommended only for light work, such as on etched circuit boards, etc. Keep the iron tip clean and bright. A pad of steel wool may be used to wipe the tip occasionally during use.

Take these precautions and use reasonable care during assembly of the kit. This will insure the wonderful satisfaction of having the instrument operate perfectly the first time it is turned on.

NOTES ON WIRING

Read the notes on soldering and wiring on the inside rear cover. Crimp all leads tightly to the terminal before soldering. Be sure both the lead and terminal are free of wax, corrosion or other foreign substances. Use only the best rosin core solder, preferably a type containing the new activated fluxes such as Kester "Radio-TV Solder", Ersin "Multicore" or similar types.

Unless otherwise indicated, all wire used is insulated. Wherever there is a possibility of the bare leads on resistors and capacitors shorting to other parts or to chassis, the leads should be covered with insulated sleeving. This is indicated in the instructions by the phrase "use sleeving." Bare wire is used where the lead lengths are short and the possibility of short circuits are non-existent.

Leads on resistors, capacitors and transformers are generally much longer than they need to be to make the indicated connections. In these cases, the excess leads should be cut off before the part is added to the chassis. In general, the leads should be just long enough to reach their terminating points. Not only does this make the wiring much neater but in many instances, the excessively long leads will actually interfere with proper operation of the instrument.

The pictorials indicate actual chassis wiring and designate values of the component parts. We very strongly urge that the chassis layout, lead placement and grounding connections be followed exactly as shown. While the arrangement shown is probably not the only satisfactory layout, it is the result of considerable experimentation and trial. If followed carefully, it will result in a stable instrument operating at a high degree of accuracy and dependability.

Space has been provided for you to check off each operation as it is completed. This is particularly important in wiring and it may prevent omissions or errors, especially where your work is interrupted frequently as the wiring progresses. Some kit builders have also found it helpful to mark each lead in colored pencil on the pictorial as it is added.

STEP-BY-STEP ASSEMBLY INSTRUCTIONS

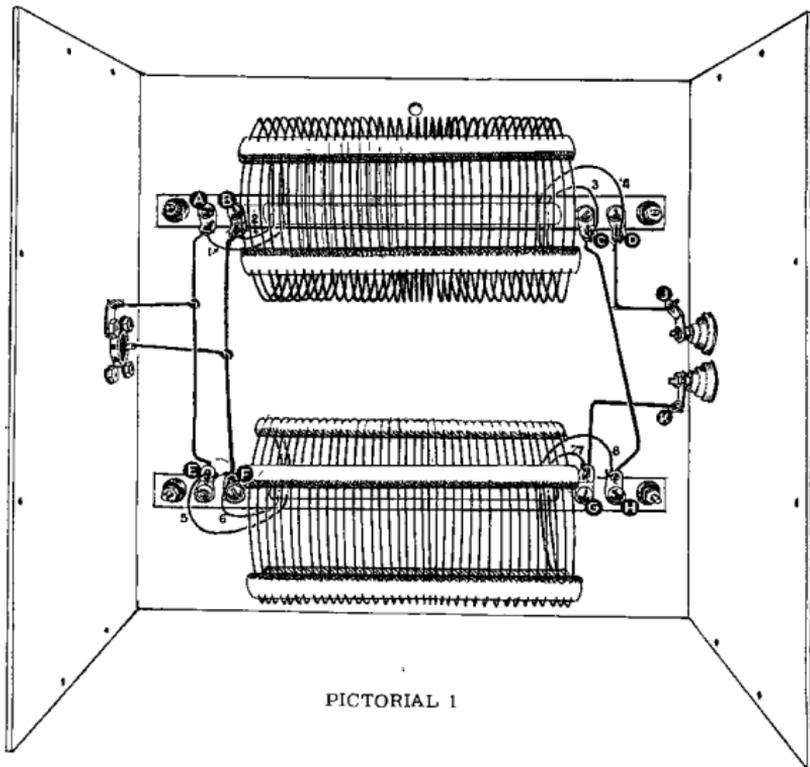
This manual is supplied to assist you in every way to complete the instrument with the least possible chance for error. We suggest that you take a few minutes now and read the entire manual through before any work is started. This will enable you to proceed with the work much faster when construction is started. The large fold-in pictorials are handy to attach to the wall above your work space. Their use will greatly simplify the completion of the kit. These diagrams are repeated in smaller form within the manual. We suggest that you retain the manual in your files for future reference, both in the use of the instrument and for its maintenance.

UNPACK THE KIT CAREFULLY AND CHECK EACH PART AGAINST THE PARTS LIST. In so doing, you will become acquainted with each part. Refer to the charts and other information shown on the inside covers of the manual to help you identify any parts about which there may be a question. If some shortage is found in checking the parts, please notify us promptly and return the inspection slip with your letter to us. Hardware items are counted by weight and if a few are missing, please obtain them locally if at all possible.

The abbreviation "NS" indicates that the connection should not be soldered as yet, for other wires will be added. When the last wire is installed, the terminal should be soldered and the abbreviation "S" is used to indicate this. Note that a number appears after each solder (S) instruction. This number indicates the number of leads connected to the terminal in question. For example, if the instructions read, "Connect a 47 K Ω resistor from socket E1 (S-2) to E6 (NS)," it will be understood that there will be two leads connected to the terminal at the time it is soldered. This additional check will help avoid errors.

We suggest you do the following before any work is started:

1. Attach the large fold-in pictorials to the wall above your work bench.
2. Go through the entire assembly and wiring instructions. This is an excellent time to read the entire instruction section through and familiarize yourself with the procedure.
3. Lay out all parts so that they are readily available. Refer to the general information inside the front and back covers of this manual to help you identify components.



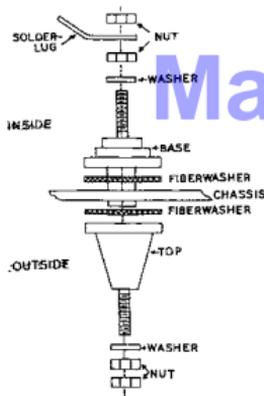


Figure 1

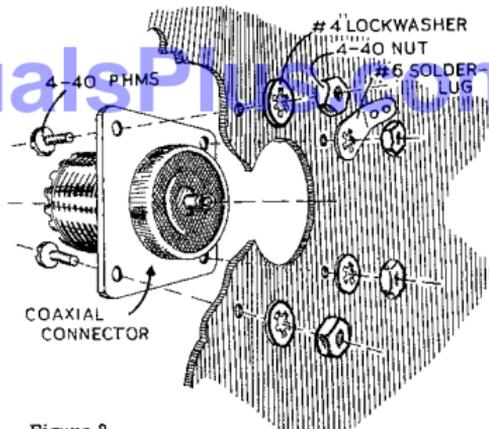


Figure 2

The following instructions are presented in a simple, logical step-by-step sequence to enable you to complete your kit with the least possible confusion. Be sure to read each step all the way through before proceeding. When the step is completed, check it off in the space provided.

- (✓) Mount the two feed-through insulators in the 5/16 holes as shown in Pictorial 1. Be sure to mount them with fiber compression washers on each side of the panel to avoid breaking. See Figure 1. Put the long end of the insulator on the outside of the panel. Place the flat metal washers next to the ceramic instead of between the nuts as supplied. Secure the units with a nut on each end. Do not overtighten. Place #6 solder lugs on the short end of the insulators and secure with a nut. Replace the other two nuts on the long end of the insulators.
- (✓) Mount the coax connector, using the four 4-40 x 1/4" panhead screws, 4-40 nuts, three #4 lockwashers, and one #6 solder lug. See Figure 2. Position the #6 solder lug as shown in Pictorial 1.
- (✓) Inspect and straighten any turns of the Balun coils that may have been bent in handling.
- (✓) Mount four #6 solder lugs on the polystyrene bar of both bifilar coils using four 6-32 x 3/8" screws and 6-32 nuts. See Figure 3. Position the solder lugs as shown in Pictorial 1. Do not overtighten.
- (✓) Place a #8 lockwasher on each of the four 8-32 x 1 1/2" screws. Insert the four screws through the 5/32 holes provided in the chassis. Slip a #6 x 3/4" spacer and a #6 flat fiber washer over each of the screws. Mount the bifilar coils, placing #8 flat fiber washers under each nut, as shown in Figure 3. Do not overtighten. Note the position of the solder lugs on the bifilar coil bars in Pictorial 1.

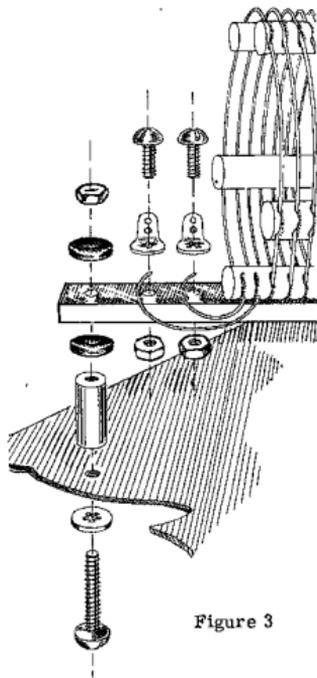


Figure 3

STEP-BY-STEP WIRING PROCEDURE

CONNECTIONS TO MATCH 75Ω UNBALANCED TO 300Ω BALANCED. See below for 75Ω unbalanced to 75Ω balanced connections.

- (✓) Connect the leads from the bifilar coils to the solder lugs on the polystyrene bar; lead 1 to solder lug A, lead 2 to solder lug B, lead 3 to solder lug C, and lead 4 to solder lug D. Cut off the excessive length from each lead (NS).
- (✓) Repeat the above connections on the other bifilar coil, lead 5 to solder lug E, lead 6 to solder lug F, lead 7 to solder lug G, and lead 8 to solder lug H (NS).
- (✓) Cut a piece of #14 wire 4" in length. Connect one end to solder lug B (S-2) and the other end to solder lug F (S-2).
- (✓) Cut a piece of #14 wire 1 3/4" in length. Form a small loop at one end and connect to the center of the wire going from solder lugs B and F. Connect the other end to the center conductor of the coax connector. Solder both connections.
- (✓) Cut a piece of #14 wire 4 3/4" in length. Bend and form the wire as shown in Figure 4. Connect one end to solder lug A (S-2) and the other end to solder lug E (S-2).

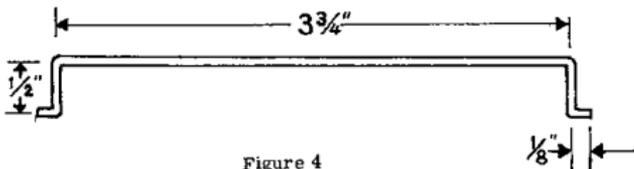


Figure 4

- (✓) Cut a piece of #14 wire 1 1/2" in length. Form a small loop at one end and connect to the wire going from solder lugs A and E. Connect the other end to the #6 solder lug mounted at the coax connector. Refer to Pictorial 1. Solder both of these connections.
- (✓) Cut a piece of #14 wire 2" in length. Bend the wire to right angles 7/8" in from one end. Connect the 7/8" end to solder lug J on the feed-through insulator (S-1) and the other end to solder lug D (S-2).
- (✓) Cut a piece of #14 wire 2 1/2" in length. Bend the wire to right angles 1 1/4" in from one end. Connect one end to solder lug K on the feed-through insulator (S-1) and the other end to solder lug G (S-2).
- (✓) Cut a piece of #14 wire 4 3/4" in length. Bend and form the wire as shown in Figure 4. Connect one end to solder lug C (S-2) and the other end to solder lug H (S-2).

CONNECTIONS TO MATCH 75Ω UNBALANCED TO 75Ω BALANCED

Connections from the bifilar coils to the coax connector will be the same as the preceding steps for connections to match 75Ω unbalanced to 300Ω balanced. Refer to Pictorial 2 for wiring.

- (✓) Cut a piece of #14 wire 4" in length. Connect one end to solder lug D (S-2) and the other end to solder lug H (S-2).
- (✓) Cut a piece of #14 wire 1 1/4" in length. Form a small loop at one end and connect to the wire going from solder lugs D and H. Connect the other end to solder lug K on the feed-through insulator. Solder both connections.

- (7) Cut a piece of #14 wire 4 3/4' in length. Bend and form the wire as shown in Figure 4. Connect one end to solder lug C (S-2) and the other end to solder lug J (S-2).
- (8) Position solder lug J on the feed-through insulator so that it points away from the bottom of the chassis.
- (9) Cut a piece of #14 wire 1 1/2' in length. Form a small loop on one end and connect it to the wire going from solder lugs C and G. Connect the other end to solder lug J. Solder both connections.

The Balun Coil Kit may be mounted inside or outside of the "Ham Shack", using two wood screws through the 3/16 holes.

- (10) After the Balun Coil Kit is mounted, slip the cover on and fasten with the twelve #6 sheet metal screws.

This completes the assembly and wiring of the Model B-1 Heathkit Balun Coil Set.

OPERATION AND APPLICATION

The Heathkit Balun Coil Set, Model B-1 may be used with any transmitter in the 100-watt to 150-watt class, such as the DX-100.

It is suggested at this point before connecting the Balun Coil Set to any transmitter that a check be made to see that the transmission line properly matches the antenna.

A balun of this type is simply a fixed-ratio transformer and does not make up for inaccurate matching elsewhere in the system. With a 300-ohm line on the balanced end, for example, a 75-ohm coax cable will not be matched unless the 300-ohm line actually is terminated in a 300-ohm load.

The Heathkit Reflected Power Meter, Model AM-2 makes an excellent instrument for checking the antenna and transmission system for mismatch. Connecting the Reflected Power Meter between the transmitter and Balun Coil Set, the antenna system can be adjusted for the lowest SWR (standing wave ratio) or lowest reflected power. In making these checks use the lowest power possible until a good match to the antenna is made.

The Heathkit Antenna Impedance Meter Model AM-1 may also be used for checking the antenna system for matching purposes. It is not within the scope of this manual to go into detail on how to adjust antenna systems for there are many articles on this subject.

The Balun Coil Set may be located any distance from the transmitter or from the antenna. Shown in Figure 5 are some of the possible methods of using the Balun Coil Set.

IN CASE OF DIFFICULTY

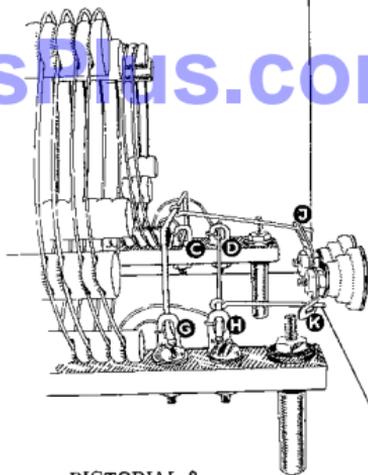
Due to the extreme simplicity of this kit, there is very little chance of trouble. However, a few possible indications of improper operation and their causes are outlined below:

Trouble

Transmitter fails to load up properly.

Possible Causes

Make certain balun coils are wired for correct impedance match.



PICTORIAL 2

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Open or shorted transmission lines, or in the Balun Coil Set itself.

Antenna and transmission line are mismatched.

Balun Coils get hot.

Check same possible causes mentioned above.

Too much power being fed to balun coils.

REPLACEMENTS

Material supplied with Heathkits has been carefully selected to meet design requirements and ordinarily will fulfill its function without difficulty. Occasionally improper instrument operation can be traced to a faulty tube or component. Should inspection reveal the necessity for replacement, write to the Heath Company and supply all of the following information:

- A. Thoroughly identify the part in question by using the part number and description found in the manual parts list.
- B. Identify the type and model number of kit in which it is used.
- C. Mention the order number and date of purchase.
- D. Describe the nature of defect or reason for requesting replacement.

The Heath Company will promptly supply the necessary replacement without charge. Please do not return the original component until specifically requested to do so. Do not dismantle the component in question as this will void the guarantee. If tubes are to be returned, pack them carefully to prevent breakage in shipment as broken tubes are not eligible for replacement. This replacement policy does not cover parts that may have been broken or damaged through carelessness on the part of the kit builder.

SERVICE

In event continued operational difficulties of the completed instrument are experienced, the facilities of the Heath Company Service Department are at your disposal. Your instrument may be returned for inspection and repair for a service charge of \$3.00 plus the price of any additional material that may be required. **THIS SERVICE POLICY APPLIES ONLY TO COMPLETED INSTRUMENTS CONSTRUCTED IN ACCORDANCE WITH THE INSTRUCTIONS AS STATED IN THE MANUAL.** Instruments that are not entirely completed or instruments that are modified in design will not be accepted for repair. Instruments showing evidence of acid core solder or paste fluxes will be returned not repaired.

The Heath Company is willing to offer its full cooperation to assist you in obtaining the specified performance level in your instrument. Factory repair service is available to you or you may contact the Technical Consultation Department by mail. For information regarding possible modification of existing kits, it is suggested that you refer to any one or more of the many publications that are available on all phases of electronics. They can be obtained at or through your local library, as well as at any electronic outlet store. Although the Heath Company sincerely welcomes all comments and suggestions, it would be impossible to design, test, evaluate and assume responsibility for proposed circuit changes for specific purposes. Therefore, such modifications must be made at the discretion of the kit builder according to information which will be much more readily available from some local source.

SHIPPING INSTRUCTIONS

Before returning a unit for service, be sure that all parts are securely mounted.

ATTACH A TAG TO THE INSTRUMENT GIVING
NAME, ADDRESS AND TROUBLE EXPERIENCED.

Pack in a rugged container, preferably wood, using at least three inches of shredded newspaper or excelsior on all sides. **DO NOT SHIP IN THE ORIGINAL KIT CARTON AS THIS CARTON IS**

NOT CONSIDERED ADEQUATE FOR SAFE SHIPMENT OF THE COMPLETED INSTRUMENT. Ship by prepaid express if possible. Return shipment will be made by express collect. Note that a carrier cannot be held liable for damage in transit if packing, in HIS OPINION, is insufficient.

SPECIFICATIONS

All prices are subject to change without notice. The Heath Company reserves the right to discontinue instruments and to change specifications at any time without incurring any obligation to incorporate new features in instruments previously sold.

WARRANTY

Heath Company warrants that for a period of three months from the date of shipment, all Heathkit parts shall be free of defects in materials and workmanship under normal use and service and that in fulfillment of any breach of such warranty, Heath Company shall replace such defective parts upon the return of the same to its factory. The foregoing warranty shall apply only to the original buyer, and is and shall be in lieu of all other warranties, whether express or implied and of all other obligations or liabilities on the part of Heath Company and in no event shall Heath Company be liable for any anticipated profits, consequential damages, loss of time or other losses incurred by the buyer in connection with the purchase, assembly or operation of Heathkits or components thereof. No replacement shall be made of parts damaged by the buyer in the course of handling or assembling Heathkit equipment.

NOTE: The foregoing warranty is completely void and we will not replace, repair or service instruments or parts thereof in which acid core solder or paste fluxes have been used.

HEATH COMPANY

<u>PART</u>	<u>PARTS</u>	<u>DESCRIPTION</u>
<u>No.</u>	<u>Per Kit</u>	
Coils-Wires		
40-101	2	Bifilar coil
340-1	1	length #14 Bare wire
Hardware		
71-2	2	Feed-through insulator
250-8	12	#6 Sbeet metal screw
250-9	8	6-32 x 3/8" RHMS
250-40	4	6-32 x 1 1/2" RHMS
250-52	4	4-40 x 1/4" PHMS
252-2	4	4-40 nut
252-3	12	6-32 nut
253-1	8	#6 flat fibre washer
254-1	4	#6 lockwasher
254-9	3	#4 lockwasher
255-5	4	#6 x 3/4" spacer
259-1	11	#6 solder lug
436-5	1	Coaxial jack
Metal Parts		
90-M63F167	1	Cabinet shell
200-M130F	1	Chassis
595-173	1	Instruction manual