ASSEMBLING AND USING YOUR *Heathkit*

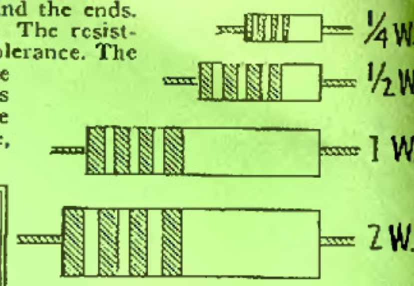
Impedance Bridge
Model IB-1

THE HEATH COMPANY
BENTON HARBOR, MICH

PRICE $1.00

USEFUL INFORMATION FOR KIT BUILDERS

Resistors are identified by a color code used in several bands around the resistors. There are two general types of resistors. One, the uninsulated type, has the connecting wires bound around the ends. The other, the insulated type, has the wire connected internally and coming out the ends. The resistance code uses three bands or colors, while a fourth, usually silver or gold, indicates the tolerance. The colors are arranged so that the first two indicate the first two figures of the resistance, while the third indicates the number of digits (zeros or multiplier) which follow the first two figures On uninsulated resistors, the body is the first figure, the end color the second figure, and the dot the number of digits. On insulated resistors, the band nearest the end is the first figure, the next band is the second figure and the third band the number of digits.



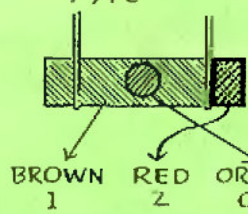
WATTAGE SIZES

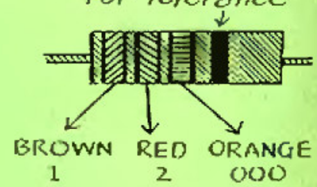
WATTAGE. Resistors are rated as to wattage (power dissipation) according to size. The chart shows approximate sizes which vary with manufacturers. To determine wattage size necessary multiply current through resistor in amperes by voltage drop across resistors in volts. Example — A plate loading resistor for a tube drawing 10 milliamperes (.01 Amperes) has a voltage on one side of 300 volts and on the other side 200 volts, giving a drop of 100 volts. Therefore 100 volts × .01A. = 1 Watt.

A higher wattage resistor can always be substituted for smaller size.

Uninsulated Insulated Color	Body Color First Ring First Figure	End Color Second Ring Second Figure	Dot Color Third Ring Number of Digits
Black	0	0	None
Brown	1	1	0
Red	2	2	00
Orange	3	3	,000
Yellow	4	4	0,000
Green	5	5	00,000
Blue	6	6	000,000
Violet	7	7	0,000,000
Grey	8	8	00,000,000
White	9	9	000,000,000

Examples





Some Popular Sizes of Resistors

RESISTANCE IN OHMS	BODY OR FIRST BAND	END OR SECOND BAND	DOT OR THIRD BAND
50	Green	Black	Black
250	Red	Green	Brown
1500	Brown	Green	Red
30,000	Orange	Black	Orange
220,000	Red	Red	Yellow
1 Megohm	Brown	Black	Green

The fourth ring or other end may be silver (10% tolerance) or gold (5% tolerance) or it may be omitted entirely which indicates 20% tolerance.

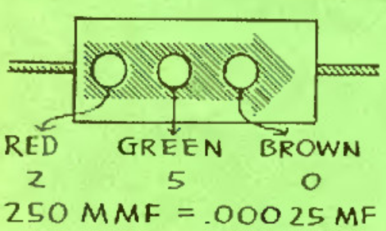
Condenser Code

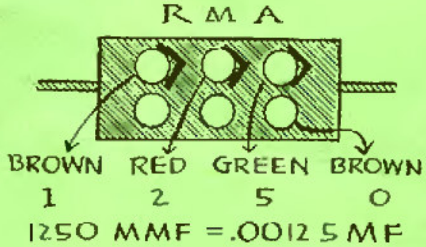
Condensers use the same code as resistors and are read in micromicrofarads.

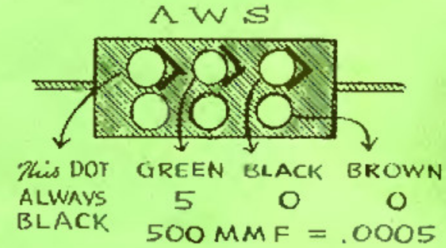
If there is one row of dots, they are read in direction of arrow or if manufacturer's name appears in the same direction as name. If two rows of dots appear, it can either be of two different codes: The RMA or the AWS (American War Standard). In the RMA, the top row of dots are the first three figures (carried to three figures), the bottom row are left to right the voltage rating, tolerance, and decimal multiplier.

In the AWS code, the top row of dots are the first three figures while the bottom row are, left to right, characteristic, tolerance, and decimal multiplier.

Examples



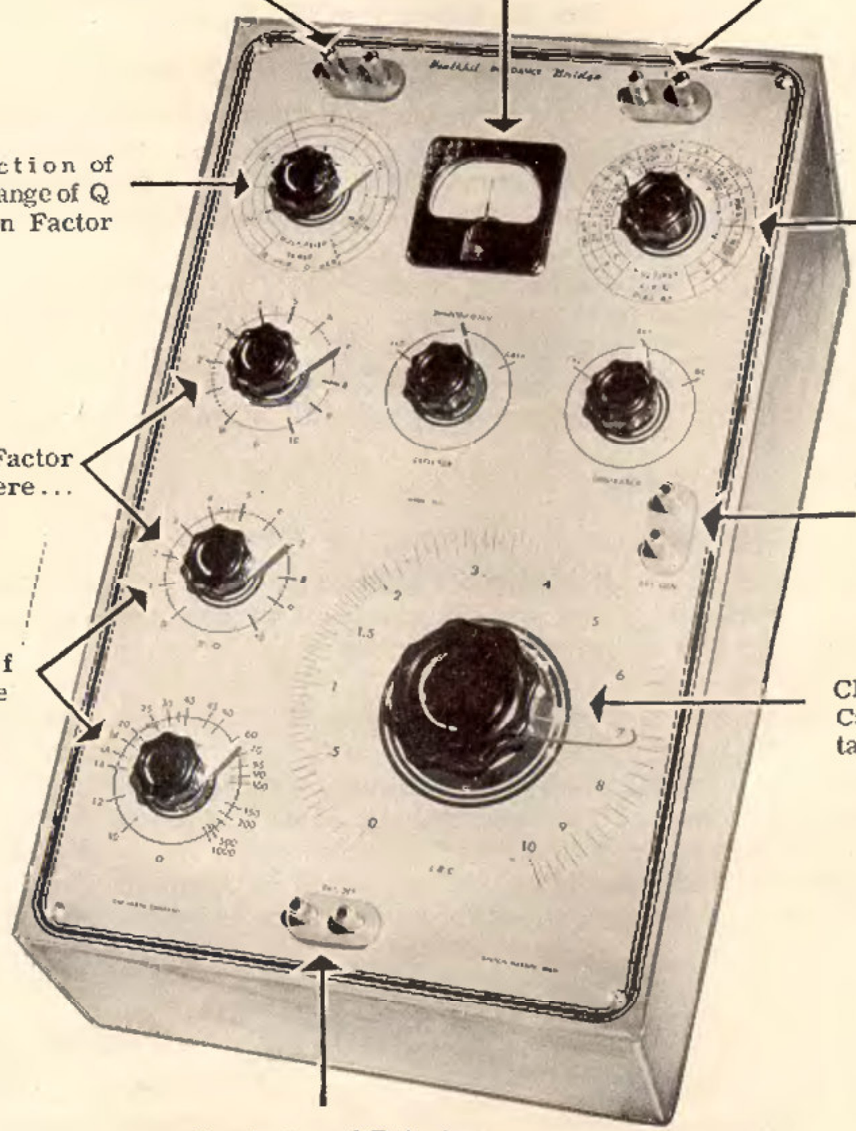




Some Commonly Used Sizes of Condensers

MMF.	MF.	FIRST DOT	SECOND DOT	THIRD DOT
10	.00001	Brown	Black	Black
50	.00005	Green	Black	Black
100	.0001	Brown	Black	Brown
250	.00025	Red	Green	Brown
500	.0005	Green	Black	Brown
1000	.001	Brown	Black	Red
3000	.003	Orange	Black	Red
10,000	.01	Brown	Black	Orange

Assembly and Operation of Heathkit Impedance Bridge Model IB-1



The HEATH COMPANY

BENTON HARBOR, MICHIGAN

The IB1 Heathkit Impedance Bridge

SPECIFICATIONS

Circuit:	4 Arm Impedance Bridge
D. C. Measurements:	6 Volt Burgess Battery No. F4BP
A. C. Measurements:	GR 1,000 cycle hummer. Other frequencies can be used by connection to a bridge.

RANGES

Resistance:	One milliohm to 10 megohm
Capacitance:	One micromicrofarad to 100 microfarad
Inductance:	One microhenry to 100 henries
Dissipation Factor:	.001 to 1
Storage Factor (Q):	1 to 1,000
Accuracy:	½ of 1% decade resistors are used. The accuracy is limited more by the interpretation of the scales and workmanship of assembly. The following is considered normal:

Resistance ± 3%
Capacitance ± 3%
Inductance ± 10%
Dissipation Factor ± 20%
Storage Factor ± 20%

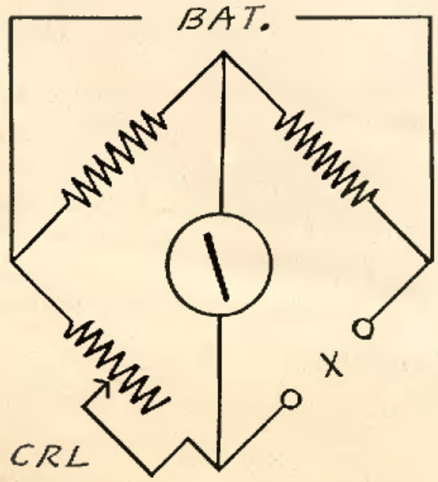
The accuracy will fall off at the extreme outer limits.

Weight: 9½ lbs.
Dimensions: 7½" high 10" wide 16" long

THE HEATHKIT IMPEDANCE BRIDGE

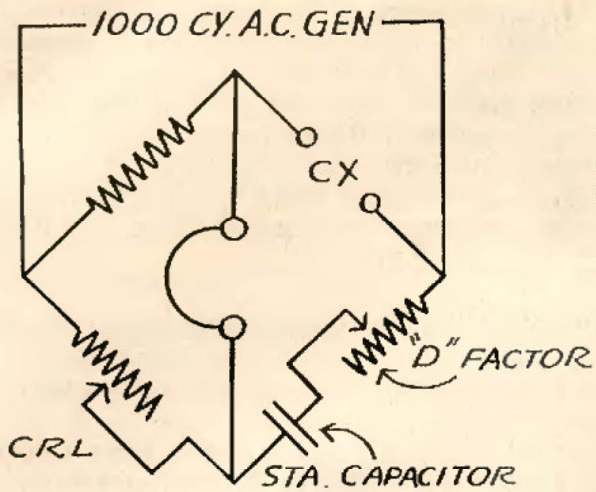
The Heathkit Impedance Bridge is a self powered 4 arm impedance bridge desigend especially for use in laboratories, service shops and schools where it is desirable to acquaint students with the use of a bridge. By use of switches, a number of basic bridge circuits are obtained.

DC resistance is measured with an internal 6 volt battery. This battery also powers an internal 1,000 cycle oscillator which provides the 1,000 cycle A.C. source for capacity and inductance measurements. In addition to the calibrated main resistance various combinations of resistance and resistance and capacitance may be switched into the arms of the bridge to extend its ranges and measure the dissipation and storage factors of the unknowns. All results are read directly on calibrated scales. Capacity and inductance are measured in terms of silver mica condenser standards which are factory matched and especially chosen for extreme stability.



RESISTANCE MEASUREMENT

A Wheatstone bridge of four resistance arms, the unknown being the fourth is used for resistance.

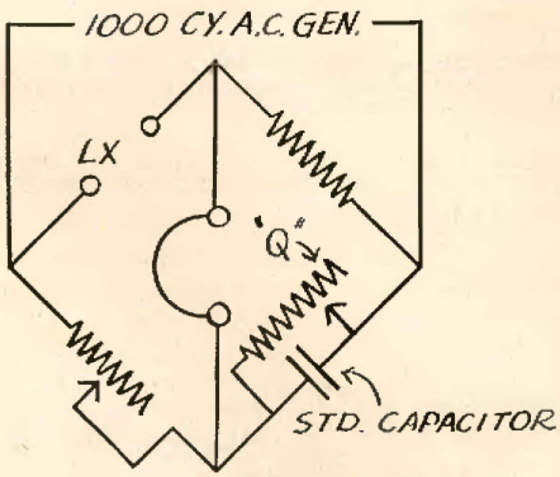


CAPACITY MEASUREMENT

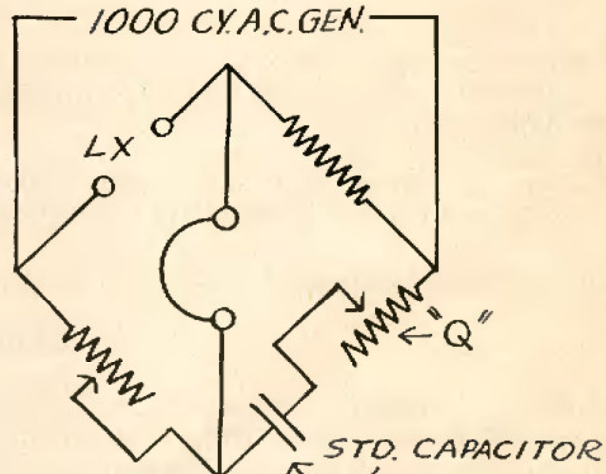
The capacity bridge circuit utilizes a standard capacitor in series with a variable resistance to obtain the dissipation factor.

INDUCTANCE MEASUREMENTS

Both the Maxwell and Hay bridge circuits are used to obtain the Q range of the instrument.



MAXWELL (LOW "Q")



HAY. (HIGH "Q")

CONSTRUCTION

Thoroughly familiarize yourself with the layout, pictorial and photoprints. Read the instructions completely through once.

Make a good mechanical joint of each connection--metal to metal as solder itself is not a good conductor and serves only to hold the connection rigid. Where a wire makes a connection take the bare wire through the hole and bring it back to the outside wire making a solid connection that can be pulled without coming loose. Use only good quality ROSIN CORE RADIO TYPE SOLDER. Other types will corrode and ruin delicate radio parts.

The quality of parts and design of this bridge place it in the laboratory equipment class. Its construction should not be under taken by anyone not experienced in radio assembly.

The accuracy of the bridge is dependent upon the wiring--heavy bus bar wire is supplied together with pictorial diagrams for positioning.

The resistance of the wiring is held to a minimum by the large bus wire. The capacity of the wiring is held to a minimum by utilizing an open rigid style of wiring as shown. The wiring as shown has been found to be the best--please follow the pictorials. The pictorials are divided into two levels. The lower level wires the deck of all two deck switches which is nearest the panel together with all associated parts. The upper level finishes the wiring by showing the connections to the second switch decks (i. e. the ones farthest from the panel.) The capacitor terminal strip has the two standard capacitors already mounted. These capacitors are selected silver micas which are factory matched into standard capacitors with a tolerance of less than $\frac{1}{2}$ of 1%. The dissipation factor of these capacitors is less than 30 parts in one million making them ideal as standards. The bracket which holds the capacitor terminal strip is held in place by the shafts of the Q and DQ potentiometers.

The 1,000 cycle hummer is mounted to its bracket with bolts through rubber grommets. This suspends the hummer in rubber and reduces the possibility of the note being transmitted to the panel. The hummer bracket is held in place by the shafts of the generator and detector switches.

In mounting the switches and controls, the shaft nuts should be left slightly loose while the pointer knob is installed. The pointer should be aligned with its panel marking by turning the switch. The knob should then be carefully removed and the switch shaft nut tightened securely.

The shaft of the General Radio main control extends too far through the panel as received. Before mounting, loosen the upper collar and slide shaft toward rear $\frac{1}{4}$"--retighten collar and then move rear upper contact $\frac{1}{4}$" on shaft so that it again makes proper contact with resistance winding.

The selector switch has one set of contacts on each side of each wafer. These contacts are staggered and care should be used to avoid wrong connections. Reference to the pictorial will avoid difficulty.

The wiring to the hummer and battery utilizes the flexible wire supplied. Spade lugs are provided for the battery wires to aid connections to the battery.

The wiring is easily accomplished by following the pictorial.

CALIBRATION

Main CRL Control. This control is adjusted by connecting the 1,000 ohm 1% calibrating resistor to the "R" terminal of the bridge. Set the selector switch to R, the multiplier switch to 1k ohms, the detector switch to shunt galvanometer, and the generator switch to DC.

Adjust the main CRL control to bring the galvanometer to null or "0" position, change the detector switch tc "galv" and again adjust for null. Loosen the CRL knob carefully, checking to see that null has not been disturbed and tighten the pointer knob with pointer exactly on 1. This completes the calibration of the main control.

The "D" and "Q" scales will be reasonably accurate by placing the pointer on "0" at extreme end of rotation, however, if maximum accuracy is desired these controls may be set with the resistance section of the bridge. To do so, disconnect the three controls from the bridge circuit. Connect the two used terminals, one control at a time to the "R" terminal of the bridge with heavy short leads.

Set up the bridge as described under "Main Control Calibration"--set the main control and multiplier to proper ranges to obtain resistances shown below--adjust the "D" or "Q" pot under calibration until the bridge is at balance and set the "D" or "Q" dial to the reading shown.
"D" control 800 ohms resistance pointer at 5.
"DQ" control 8000 ohms resistance pointer at 5.
"Q" control 32 ohms resistance pointer at 50.
This completes the calibration.

OPERATION

This unit is capable of six different types of measurements:

Resistance to direct current
Resistance to 1,000 cycle A.C.
Inductance with low Q
Inductance with high Q
Capacitance with low D
Capacitance with high D

When the D.C. resistance is to be found, proceed as follows:

a. Check the zero setting of the galvanometer.
b. Connect the unknown resistor to "R" terminals.
c. Set selector switch to "R".
d. Set detector switch to "shunted galv."
e. Set CRL pointer at about 1.
f. Set generator switch to D.C.
g. Turn multiplier switch to range which brings galvanometer nearest to zero and just to the left of zero.
h. Turn CRL pointer to bring galvanometer to zero.
j. Set detector switch to galvanometer and again bring galvanometer to zero by adjusting CRL pointer.
k. Turn generator switch to external.
l. Multiply "CRL" reading by multiplier setting to find resistance.

When the A.C. resistance at 1,000 cycles is to be found, proceed as follows:

a. Connect the unknown resistor to "R" terminals.
b. Set selector switch to "R."
c. Set detector switch to ext. detector.
d. Connect a set of sensitive headphones to ext. detector terminals.
e. Set generator switch to 1 Kc.
f. Set multiplier for minimum signal in headphones.
g. Adjust "CRL" pointer for "null" in headphones.
h. Turn generator switch to external.
j. Multiply "CRL" reading by multiplier setting to find resistance.

To find the inductance of reactors, proceed as follows:

a. Connect the unknown to "CL" terminals.
b. Set selector switch to "L-DQ".
c. Set detector switch to ext. detector.
d. Connect a set of sensitive headphones to ext. detector terminals.
e. Set generator switch to 1 Kc.
f. Set multiplier for minimum signal in headphones.
g. Adjust "CRL" and "DQ" knobs for a "null" in the headphones. This adjustment should be made turning the controls simultaneously as the controls interact.

If the DQ setting tends to go above 10:

h. Set selector switch to L-Q.
j. Adjust "CRL" and "Q" knobs for "null."
k. Turn generator switch to external.
l. Multiply "CRL" reading by multiplier setting to find inductance, the "Q" being read directly from the "DQ" or "Q" scale.

To find the capacity of a condenser, proceed as follows:

a. Connect the unknown to "CL" terminals.
b. Set selector switch to "C-DQ."
c. Set detector switch to ext. detector.
d. Connect a set of sensitive headphones to ext. detector terminals.
e. Set generator switch to 1 Kc.
f. Set multiplier for minimum signal in headphones.
g. Adjust "CRL" and "DQ" knobs for a "null" in the headphones. This adjustment should be made turning the controls simultaneously, as the controls interact.

If the "DQ" setting tends to go below 1:

h. Set selector switch to C-D.
j. Adjust "CRL" and "D" knobs for "null."
k. Turn generator switch to external.
l. Multiply "CRL" reading by multiplier setting to find capacity; the D is found using the proper dial reading and multiplier factor as found from the selector switch dial.

For greater indicating accuracy of DC resistance measurements, external batteries may be used as follows:

Provided the CRL dial is not turned below 1, the following external battery voltages in series with additional resistance may be used:

On multipliers	not more than	in series with
0.1, 1.0, 10, 100	$67\frac{1}{2}$V	not less than 1500 ohms
1k	135 V	not less than 4000 ohms
10k, 100k, 1 Meg	$202\frac{1}{2}$V	not less than 6500 ohms

IN CASE OF DIFFICULTY

The Engineering Department of the Heath Company is ready and willing to assist you. Write giving all details.

If you wish to send your instrument for service or calibration, attach a tag with your name and address together with the service desired to the instrument. Pack with at least three inches of padding all around in a substantial box. Mark "FRAGILE—DELICATE RADIO INSTRUMENT" and ship prepaid to the Heath Company. A reasonable service charge will be made for this service.

WARRANTY

The Heath Company limits its warranty on any part supplied with any Heathkit (except tubes, meters and rectifiers, where the original manufacturer's guarantee only applies) to the replacement within three (3) months of said part which, when returned with prior permission, postpaid, was, in the judgment of the Heath Company, defective at the time of sale.

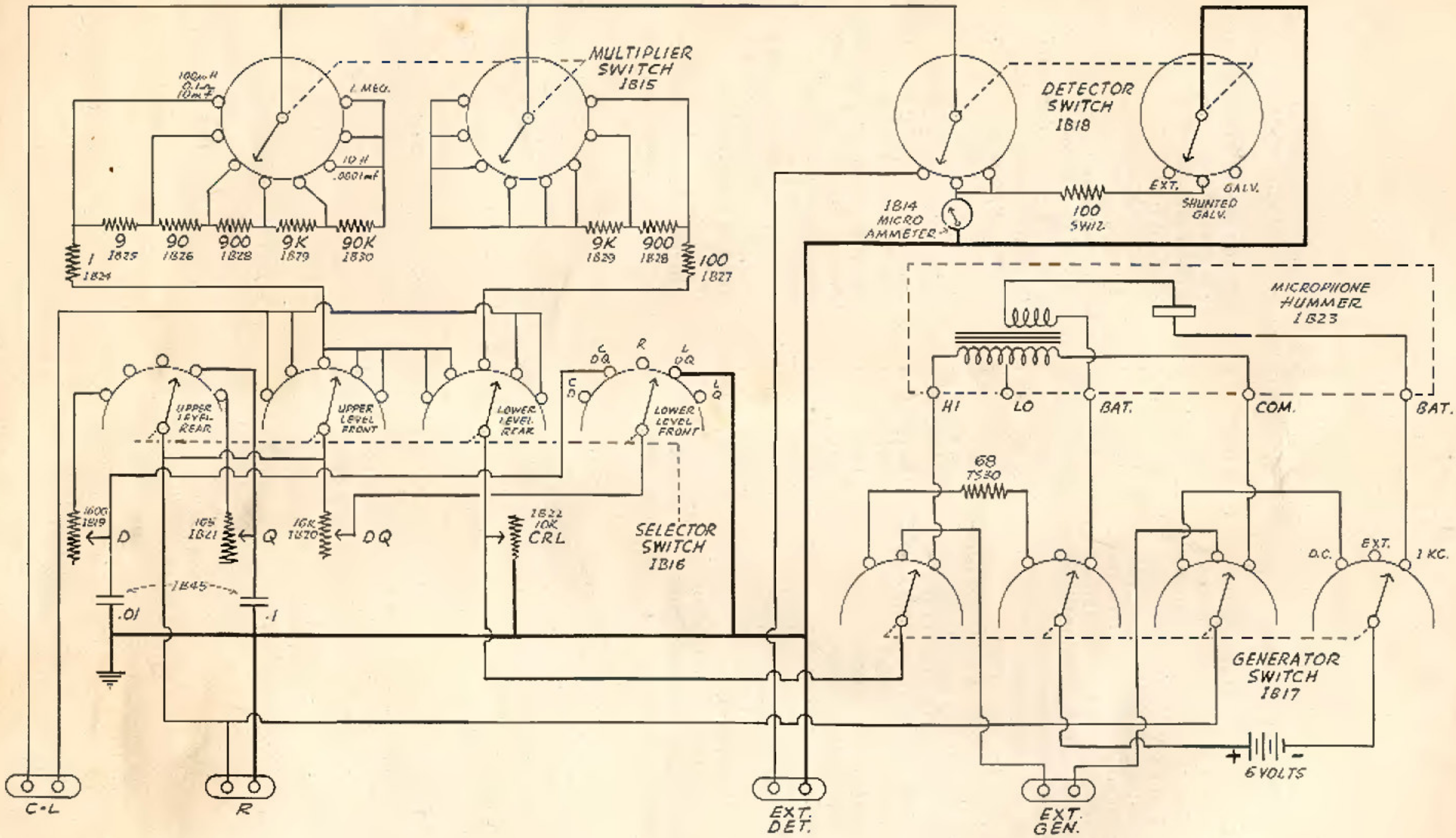
The assembler is urged to follow the instructions exactly as provided. The Heath Company assumes no responsibility for the operation of the completed instrument, nor liability for any damages or injuries sustained in the assembly or operation of the device.

HEATH COMPANY
Benton Harbor, Michigan

IB1 IMPEDANCE BRIDGE PARTS LIST

PART NO.	PIECES PER KIT	DESCRIPTION	PART NO.	PIECES PER KIT	DESCRIPTION
IB24	1	1 Ohm $\frac{1}{2}$ W $\frac{1}{2}$% Precision Res.	TC46	4	#6-5/8" Sheet Metal Screw for Panel
IB25	1	9 Ohm $\frac{1}{2}$ W $\frac{1}{2}$% Precision Res.	S22	4	#6-32X1/4" Nut
IB26	1	90 Ohm $\frac{1}{2}$ W $\frac{1}{2}$% Precision Res.	IB34	8	#10-32 Hex Nut
IB27	1	100 Ohm $\frac{1}{2}$ W $\frac{1}{2}$% Precision Res.	O33	7	Control Nuts
IB28	2	900 Ohm $\frac{1}{2}$ W $\frac{1}{2}$% Precision Res.	TS72	4	#6 Lock Washers
IB29	2	9000 Ohm $\frac{1}{2}$ W $\frac{1}{2}$% Precision Res.	IB36	8	#10 Lock Washers
IB30	1	90000 Ohm $\frac{1}{2}$ W $\frac{1}{2}$% Precision Res.	O101	3	Control Lock Washers
IB46	1	1000 Ohm $\frac{1}{2}$ W 1% Calibration Res.	IB37	8	Flat Fibre Washers
TS30	1	68 Ohm Resistor	IB38	8	#10 Nickel Plated Washer
SW11	1	100 Ohm Resistor	O28	7	Control Nickel Washers
IB45	1	Condenser Assembly	TC66	2	5/16" Grommet
IB22A	1	10,000 Ohm W. W. Control (CRL)	O37	2	#6 Solder Lugs
IB21	1	165 Ohm W.W. control (Q)	O109	8	#10 Solder Lugs
IB19	1	1600 Ohm W.W. control (D)	TS49	2	Spade Solder Lug for Battery
IB20	1	16,000 Ohm W.W. control (DQ)	IB42	1	Buss Bar Hook-up Wire (18 ft.)
IB18	1	2 Pole 3 Pos. Switch	IB43	1	#20 Bare Wire (18 in.)
IB15	1	2 Pole 8 Pos. Switch	IB44	1	Stranded Hook-up Wire (6 ft.)
IB17	1	4 Pole 3 Pos. Switch	IB14	1	Microammeter $2\frac{1}{2}$" square
IB16	1	4 Pole 5 Pos. Switch	IB23	1	Microphone Hummer
IB11	7	Indicator Knobs with Pointer	IB35	1	6 Volt Battery
IB12	1	Knob with Plastic Pointer	IB39	1	Condenser Mounting Brkt.
IB31	4	Binding Post Insulators	IB40	1	Hummer Mounting Brkt.
IB32	8	Binding Post Base	IB41	1	Battery Mounting Brkt.
IB33	8	Binding Post Thumb Screw	IB10A	1	Panel
O102	2	#6-3/8" Sheet Metal Screw	IB13	1	Cabinet
IB48	4	#6-32X1" Screw	IB1	1	Instruction Manual

IB51 5-13-49

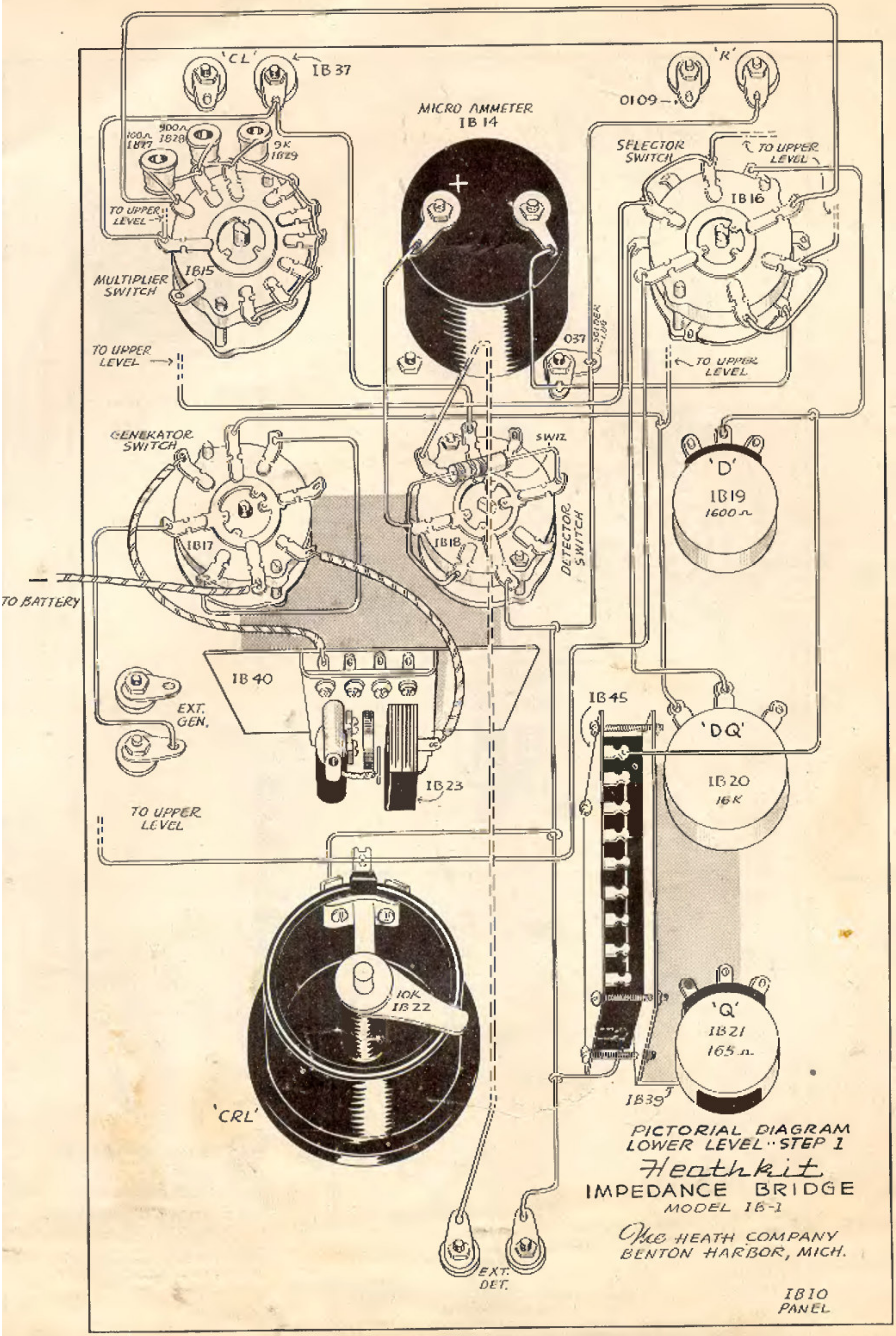


Heathkit IMPEDANCE BRIDGE

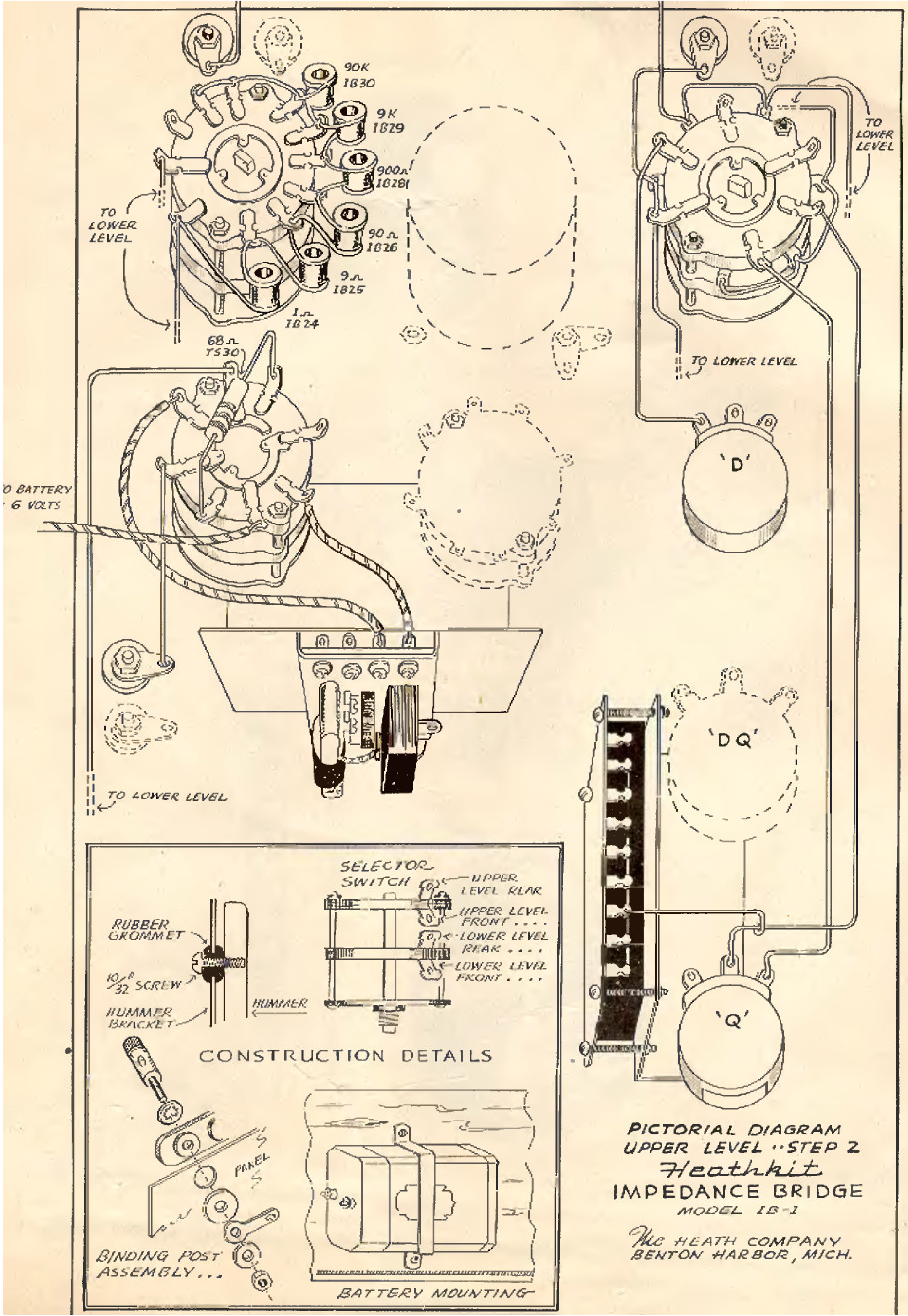
MODEL IB-1

The HEATH COMPANY
BENTON HARBOR, MICHIGAN

1852



PICTORIAL DIAGRAM
LOWER LEVEL - STEP 1
Heathkit
IMPEDANCE BRIDGE
MODEL IB-1
The HEATH COMPANY
BENTON HARBOR, MICH.



PICTORIAL DIAGRAM
UPPER LEVEL · · STEP 2
Heathkit
IMPEDANCE BRIDGE
MODEL IB-1

The HEATH COMPANY
BENTON HARBOR, MICH.

R M A Color Code on Transformers

I.F. TRANSFORMERS

Blue — Plate Lead
Red — B + Lead
Green — Grid
Black — Ground or AVC

If center tapped other grid is green and black striped.

AUDIO TRANSFORMERS

Blue — Plate Lead
Red — B + Lead
Brown — Other Plate on Push Pull
Green — Grid Lead
Black — Ground Lead
Yellow — Other Grid on Push Pull

POWER TRANSFORMERS PRIMARY — BLACK

High Voltage Plate — Red
Center Tap Red and Yellow Striped

Rectifier Filament — Yellow
Center Tap Yellow and Blue

Filament No. 1 — Green
Center Tap Green and Yellow

Filament No. 2 — Brown
Center Tap — Brown and Yellow

Filament No. 3 — Slate
Center Tap — Slate and Yellow

Soldering

The most important thing in good soldering is to heat the joint and allow the solder to flow into it. The solder should melt from contact with the joint rather than with the iron. Never use pastes or acids in radio work.

Use only rosin core solder. Never depend on the solder to hold a joint. Always make a firm connection with the wire before applying solder. To tin a soldering iron (soldering cannot be done with the bare copper) file the surface lightly while the iron is hot and then quickly apply a generous amount of rosin core solder while the filed surface is still bright. Wipe off excess solder with a cloth.

Tin all four sides of the tip in this manner.

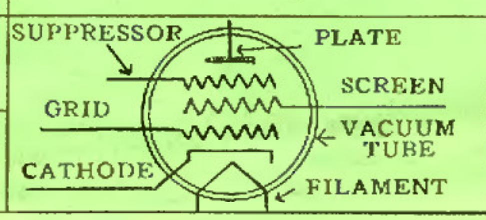
The terminals must be clean, and preferably tinned. On some terminals that are hard to solder to (nickel plated f.i.) it is desirable to pre-tin the surface before installation or connection. Clean (scrape or sandpaper) the surface, heat with iron and apply rosin core solder liberally. Wipe off or shake off excess solder.

Recommended Tools

A good electric soldering iron (100 watt with small tip)
Long or needle nose pliers 6".
Diagonal or side cutting pliers (5" or 6").
An assortment of screw drivers flat and Phillips type.

File. Round and flat types.
Purchase quality tools and you will enjoy and use them many years.
American Beauty soldering irons, Plomb, and Williams pliers are recommended.

Symbols Used in Radio Circuits

	ANTENNA OR AERIAL		VARIABLE CONDENSER		QUARTZ CRYSTAL
	CHASSIS OR GROUND		ELECTROLYTIC CONDENSER SHOWING POLARITY		CONNECTION OF TWO WIRES
	AIR CORE COIL		SWITCH		NO CONNECTION
	AIR CORE TRANSFORMER OR COIL		ROTARY SWITCH		FUSE
	R.F. CHOKE		SPEAKER		PHONE PLUG
	FILTER OR IRON CORE CHOKE . . .		METER	K =	1000
	IRON CORE TRANSFORMER		PILOT LIGHT	M =	1,000,000
	FIXED RESISTOR		PHONE JACK	Ω	OHM.
	VARIABLE RESISTOR OR POTENTIOMETER			MF =	MICROFARAD
	FIXED CONDENSER			MMF =	MICRO MICROFARAD

THE HEATH COMPANY . BENTON HARBOR, MICH.