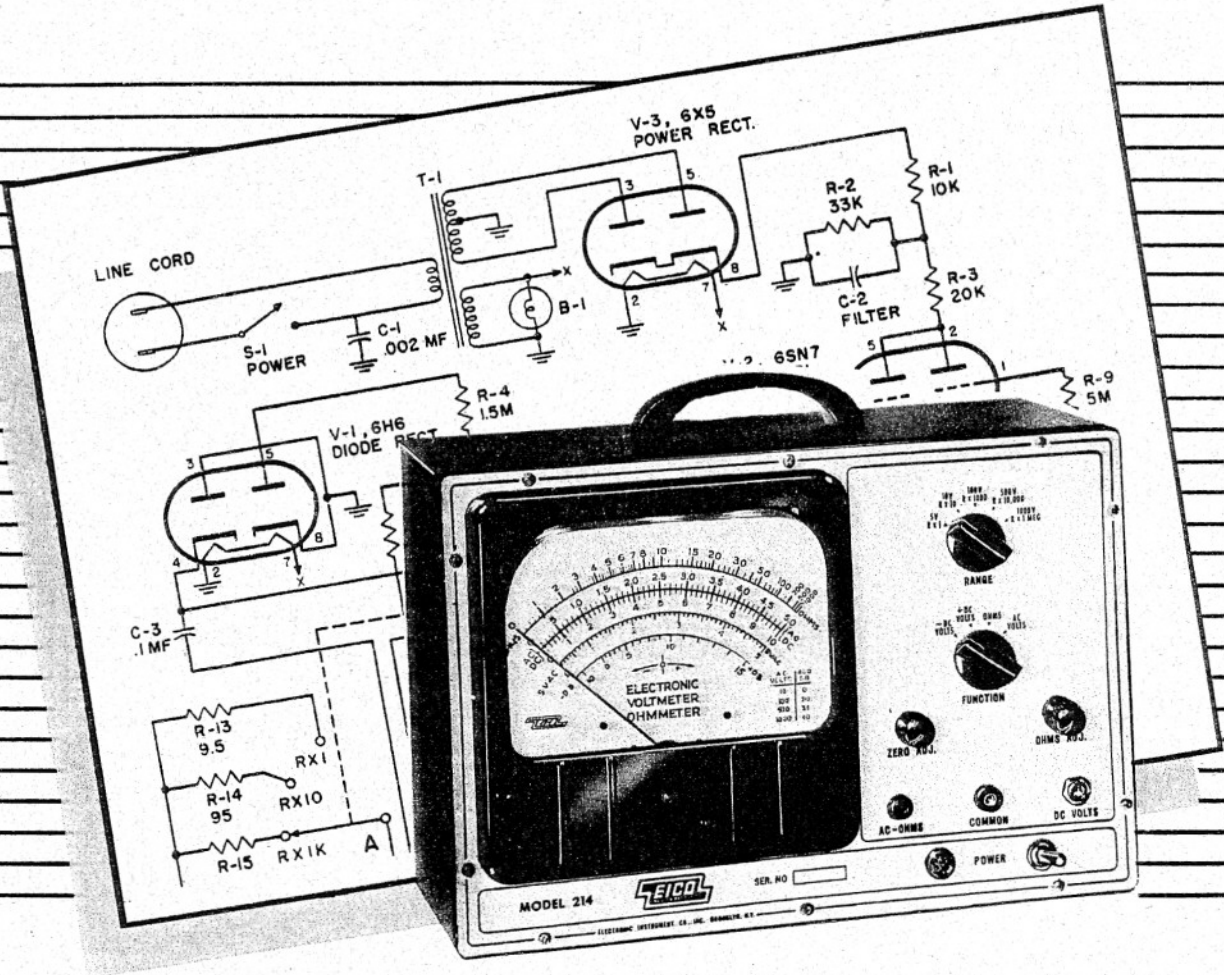




CONSTRUCTION MANUAL

Model 214 ELECTRONIC VOLT-OHM METER



Reg. U. S. Pat. Off.

ELECTRONIC INSTRUMENT CO., Inc.

33-00 NORTHERN BLVD., LONG ISLAND CITY 1, N. Y.

GENERAL INSTRUCTIONS

1) The Model 214 Electronic Volt-Ohm Meter is constructed very easily with the aid of fully detailed perspective drawings and step-by-step instructions. Before starting the actual construction, it is advisable to study the schematic and pictorial wiring diagrams until all of the steps are clear in your mind. Do not rush the construction, as careful work will result in a properly constructed instrument in the shortest time. In addition, it is suggested that you run all leads exactly as shown on the pictorial wiring diagrams, as this will make the wiring an easier job and insure proper operation of the instrument.

2) USE A GOOD GRADE OF ROSIN CORE SOLDER ONLY. UNDER NO CIRCUMSTANCES USE ACID CORE SOLDER OR ACID FLUX inasmuch as the acid flux can cause serious corrosion. Before soldering, make certain there is a good mechanical connection. The solder must flow before you remove the soldering iron as this will prevent rosin joints which are poor electrical conductors. If you are soldering close to a part, hold the ends of a pair of longnose pliers between the part and the solder joint. The pliers will conduct the heat away and prevent the component from being unduly overheated.

3) Carefully unwrap all the parts and check them in the space provided on the parts list. Note: In order to maintain the supply of kits and insure prompt delivery, we are forced to buy the same component from several sources (standard manufacturers' parts are interchangeable). You may find that the value of a component will vary within the allowable circuit tolerance. This means a resistance of 470,000 ohms may be substituted for, or may measure 510,000 ohms, etc. Any part supplied will work as well as the part for which it was substituted. No substitutions will be made on precision components.

CONSTRUCTION PROCEDURE

For your convenience, the construction of the instrument has been broken down into a logical series of Assembly Prints. Each Assembly Print consists of a detailed drawing and a table of step-by-step instruction so that no step can be overlooked. Space has been provided on the tables to check off each step as it is completed. Follow the order of the Assembly Prints to finish the mechanical assembly and the wiring quickly and easily.

PARTS LIST FOR MODEL 214

✓ Sym.	Description	Amt.	✓ Sym.	Description	Amt.	✓ Sym.	Description	Amt.
B1	pilot light.....	1	H25	brass meter washer.....	4	R9	5M ohm res. 1/2W.....	1
BT1	1.5 v battery.....	1	H26	ground lug.....	5	R10	1K ohm res. 1/2W.....	1
C1	.002 mfd cond.....	1	H27	pot grounding lug.....	1	R11	1K ohm res. 1/2W.....	1
C2	filter cond.....	1	H28	#10 lock washer.....	5	R12	2 K ohm pot adj.....	1
C3	.1 mfd cond.....	1	H29	fibre shldr. washer (J2)...	1	R13	9.5 ohm 1% res.....	1
C4	.01 mfd cond.....	1	H30	3/8 lock washer.....	10	R14	95 ohm 1% res.....	1
C5	.002 mfd cond.....	1	H31	3/8 flat washer.....	4	R15	9.5K ohm 1% res.....	1
H1	panel.....	1	H32	3/8 hex nut.....	9	R16	95K ohm 1% res.....	1
H2	chassis.....	1	H33	wire.....	roll	R17	9.5M ohm 1% res.....	1
H3	cabinet.....	1	H34	test lead wire.....	2	R18	5M ohm 1% res.....	1
H4	handle.....	1	H35	shielded wire.....	length	R19	4.5M ohm 1% res.....	1
H5	pilot light assembly.....	1	H36	#6 lock washer.....	3	R20	400K ohm 1% res.....	1
H6	line cord.....	1	H37	bare wire.....	length	R21	50K ohm 1% res.....	1
H7	wafer socket.....	3	H38	hex nut (J2).....	1	R22	50K ohm 1% res.....	1
H8	battery bracket.....	1	H39	hex nut (J3).....	1	R23	2M ohm res. 1/2W.....	1
H9	test prod (red).....	1	H40	#6 fibre washer.....	2	R24	3.3M ohm res. 1/2W.....	1
H10	test prod (black).....	1	J1	phone jack.....	1	R25	500K ohm res. 1/2W.....	1
H11	alligator clip.....	1	J2	pin jack.....	1	R26	5.6M ohm res. 1/2W.....	1
H12	bar knob.....	2	J3	banana jack.....	1	R27	1K ohm pot cal.....	1
H13	round knob.....	2	M1	meter.....	1	R28	1K ohm pot adj.....	1
H14	3/8 rubber grommet.....	1	P1	phone plug.....	1	R29	1K ohm pot cal.....	1
H15	1 lug terminal strip.....	1	P2	pin plug.....	1	R30	1K ohm pot cal.....	1
H16	3 lug terminal strip.....	1	P3	banana plug.....	1	R31	15M ohm res. 1/2W.....	1
H17	7/16 nut (S1).....	2	R1	10K ohm res. 2W.....	1	S1	SPST toggle switch.....	1
H18	6-32 X 1/4 screw.....	4	R2	33K ohm res. 2W.....	1	S2	range switch 3 p. 5 pos.....	1
H19	6-32 hex nut.....	4	R3	20K ohm res. 1/2W.....	1	S3	function switch 6 p. 4 pos... 1	
H20	10-24 screw.....	2	R4	1.5M ohm res. 1/2W.....	1	T1	transformer.....	1
H21	spaghetti.....	length	R5	2M ohm pot.....	1	V1	6H6 tube.....	1
H22	#6 X 1/4 PK screw.....	11	R6	1.5M ohm res. 1/2W.....	1	V2	6SN7 tube.....	1
H23	meter lug.....	2	R7	5M ohm res. 1/2W.....	1	V3	6X5 tube.....	1
H24	10-32 hex nut.....	6	R8	1M ohm res. 1/2W.....	1		instruction book.....	1

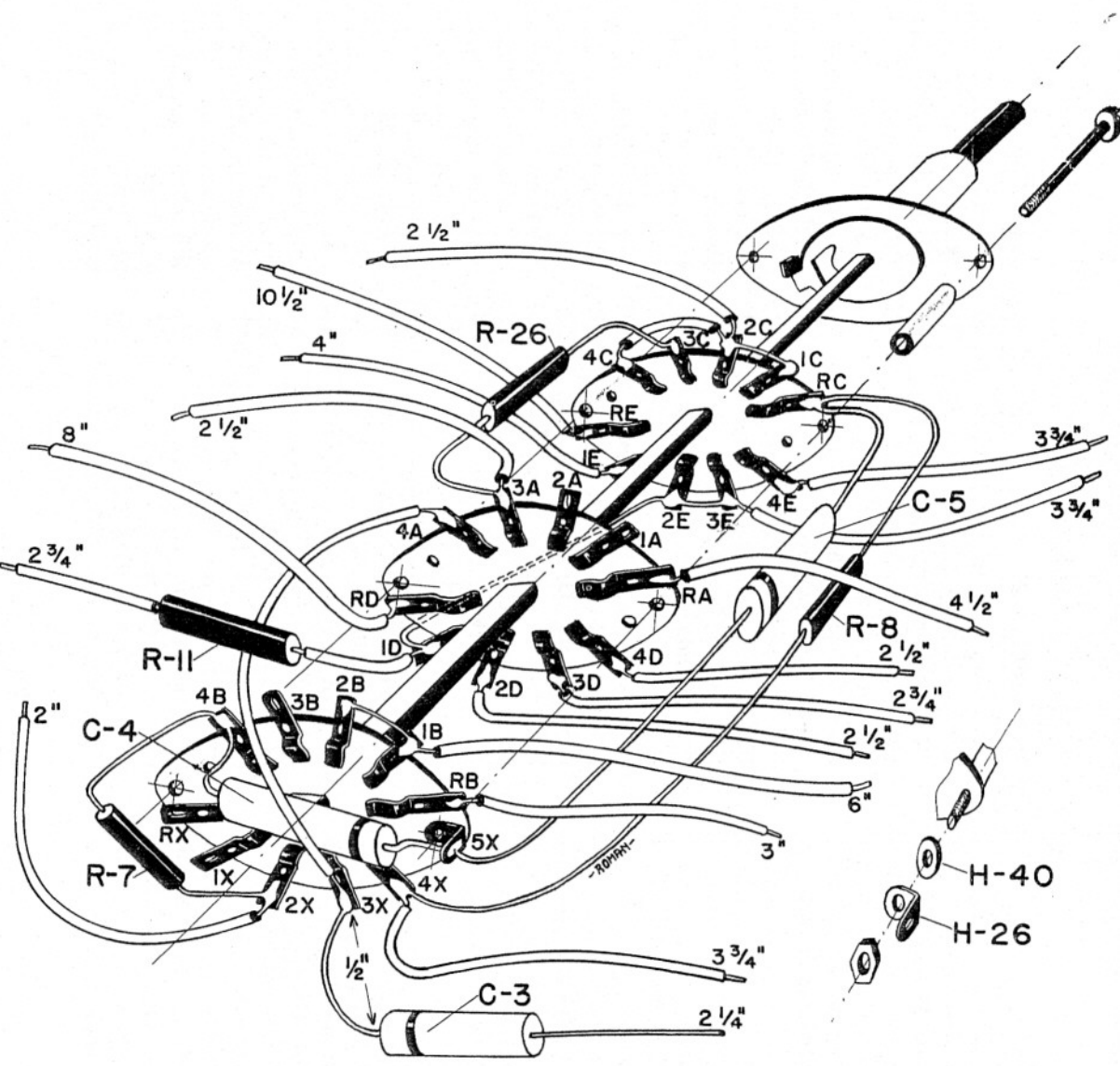
Step #1-1 Assembly: Remove the nut and lockwasher from the switch ass'y. screw (at 5X). Replace the lockwasher with the #6 fibre washer (H40) and the ground lug (H26). Fasten with the nut previously removed. See detail sketch.

PREWIRING OF FUNCTION SWITCH S3

(S) means solder, (C) means connect but do not solder.

Step#	Sym.	Description	From	To (Length)
1-2	C5	.002 mfd cond.	(C) RC	(C) 5X
1-3	R8	1M ohm res.	(S) RC	(C) 4X
1-4	H37	bare wire	(S) 1C	(C) 2C
1-5	H33	wire	(C) 2C	2 1/2"
1-6	H33	wire	(S) 2C	(S) 4C
1-7	R26	5.6M ohm res.	(S) 3C	(C) 3A
1-8	H33	wire	(S) RE	10 1/2"
1-9	H33	wire	(S) 1E	4"
1-10	H37	bare wire	(C) 2E	(C) 1D
1-11	H37	bare wire	(S) 2E	(C) 3E
1-12	H33	wire	(S) 3E	3 3/4"
1-13	H33	wire	(S) 4E	3 3/4"
1-14	H33	wire	(S) RA	4 1/2"
1-15	H33	wire	(S) 3A	2 1/2"
1-16	H33	wire	(S) 4A	(C) 3X
1-17	H33	wire	(S) RD	8"
1-18	R11	*1K ohm res.	(S) 1D	2 3/4"
1-19	H33	wire	(S) 2D	2 1/2"
1-20	H33	wire	(S) 3D	2 3/4"
1-21	H33	wire	(S) 4D	2 1/2"
1-22	H33	wire	(S) RB	3"
1-23	H33	wire	(C) 1B	6"
1-24	H37	bare wire	(S) 1B	(S) 2B
1-25	C4	.01 mfd cond.	(C) 4B	(S) 5X
1-26	R7	5M ohm res.	(S) 4B	(C) 2X
1-27	H33	wire	(S) 2X	2"
1-28	C3	.1 mfd cond.	(S) 3X	2 1/4"
1-29	H33	wire	(S) 4X	3 3/4"

*With spaghetti



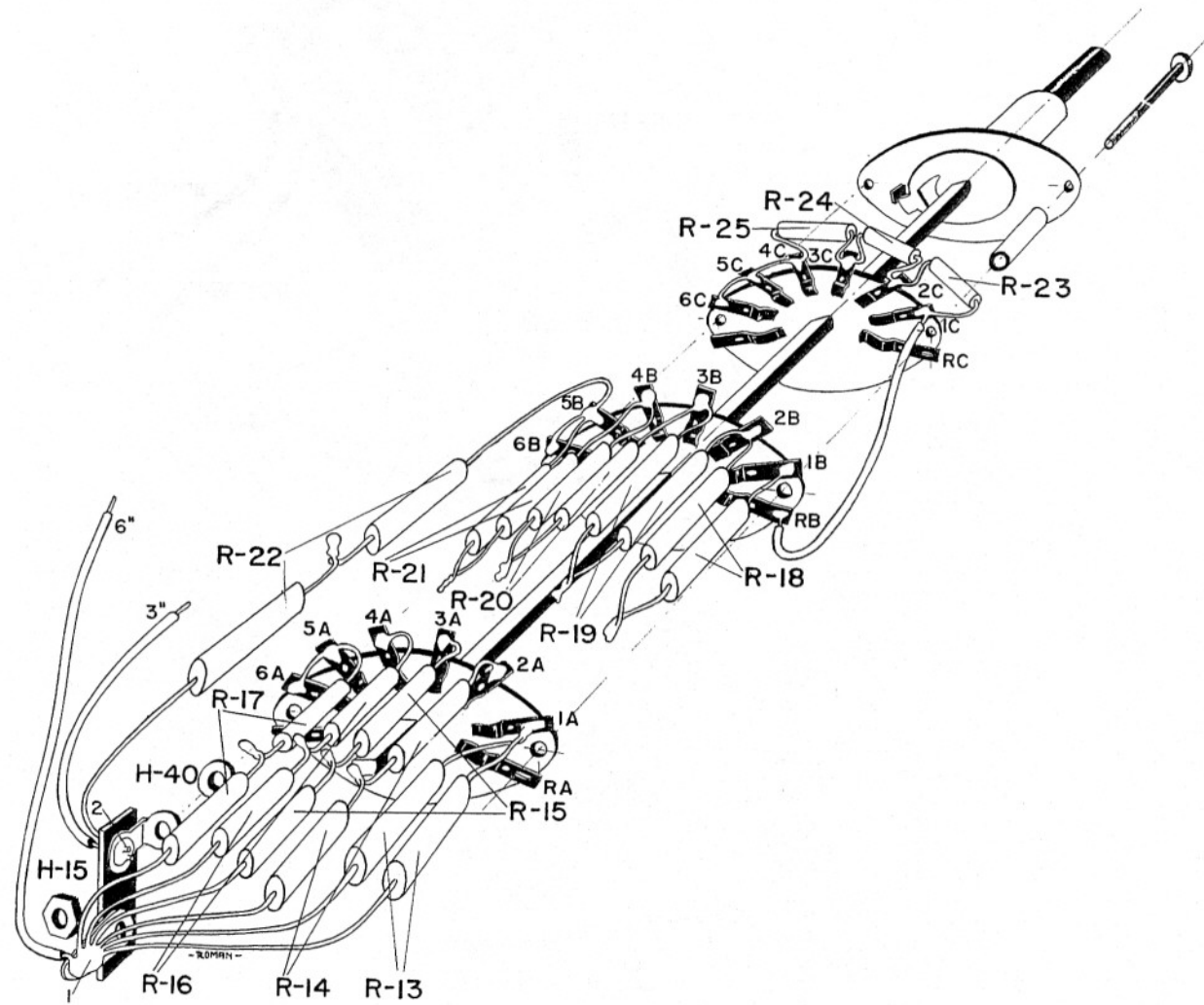
Step #2-1 Assembly: Remove the nut and lockwasher from the switch ass'y. screw (next to 6A). Replace the lockwasher with the #6 fibre washer (H40) and the 1 lug terminal strip (H15). Fasten with the nut previously removed. See drawing.

PREWIRING OF RANGE SWITCH S2

(S) means solder, (C) means connect but do not solder.

Step#	Sym.	Description	From	To (Length)
2-2	H33	wire	(C) 1C	(S) RB
2-3	R23	2M ohm res.	(S) 1C	(C) 2C
2-4	R24	3.3M ohm res.	(S) 2C	(C) 3C
2-5	R25	500K ohm res.	(S) 3C	(C) 4C
2-6	H37	bare wire	(S) 4C	(C) 5C
2-7	H37	bare wire	(S) 5C	(S) 6C
2-8	R18	5M ohm res.	(C) 1B	(C) 2B
2-9	R19	4.5M ohm res.	(S) 2B	(C) 3B
2-10	R20	400K ohm res.	(S) 3B	(C) 4B
2-11	R21	50K ohm res.	(S) 4B	(C) 5B
2-12	H37	bare wire	(C) 5B	(S) 6B
2-13	R22	50K ohm res.	(S) 5B	(C) H15#2
2-14	R13	9.5 ohm res.	(S) 1A	(C) H15#1
2-15	R14	95 ohm res.	(S) 2A	(C) H15#1
2-16	R15	9.5K ohm res.	(S) 3A	(C) H15#1
2-17	R16	95K ohm res.	(S) 4A	(C) H15#1
2-18	R17	9.5M ohm res.	(C) 5A	(C) H15#1
2-19	H37	bare wire	(S) 5A	(S) 6A
2-20	H33	wire	(S) H15#2	3"
2-21	H33	wire	(S) H15#1	6"

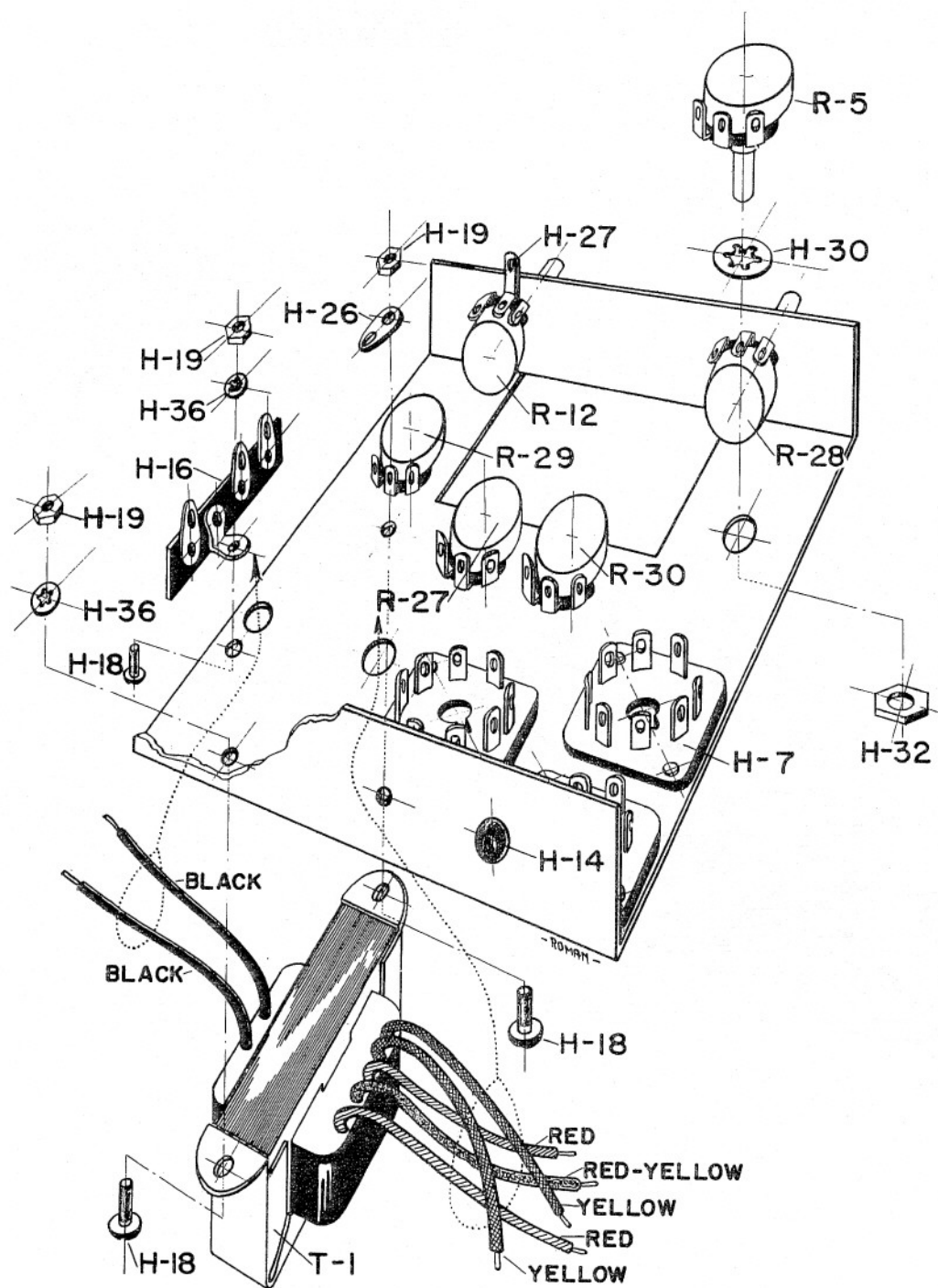
NOTE: Each of the resistors R13, R14, R15, R16, R17, R18, R19, R20, R21, and R22 is actually a matched pair as shown in the drawing. The two resistors that form a matched pair will be found inserted together in one sleeve marked with the resistance value. All of the matched pairs are to be wired in series except R13, which is wired in parallel. In the case of the series matched pairs, twist two ends together and solder as shown.



MODEL 214

ASS'Y

PRINT 2



MOUNTING TO THE CHASSIS

Step#	Sym.	Description	Mounted With
3-1	R5	2M ohm pot	1#H30, 1#H32
3-2	R30	1K ohm pot	1#H30, 1#H32
3-3	R27	1K ohm pot	1#H30, 1#H32
3-4	R29	1/2K ohm pot	1#H30, 1#H32
3-5	*R12	2K ohm pot	1#H30, 1#H27 1#H32
3-6	*R28	1K ohm pot	1#H30, 1#H32
3-7	H16	3 lug term. str.	1#H18, 1#H36 1#H19
3-8	T1	power xfmr.	2#H18, 2#H19 1#H36, 1#H26
3-9	H14	3/8 grommet	

*The 3/8 hex nuts (H32) on the 1K ohm pots (R12 & R28) must be temporarily removed later on to attach the chassis to the panel.

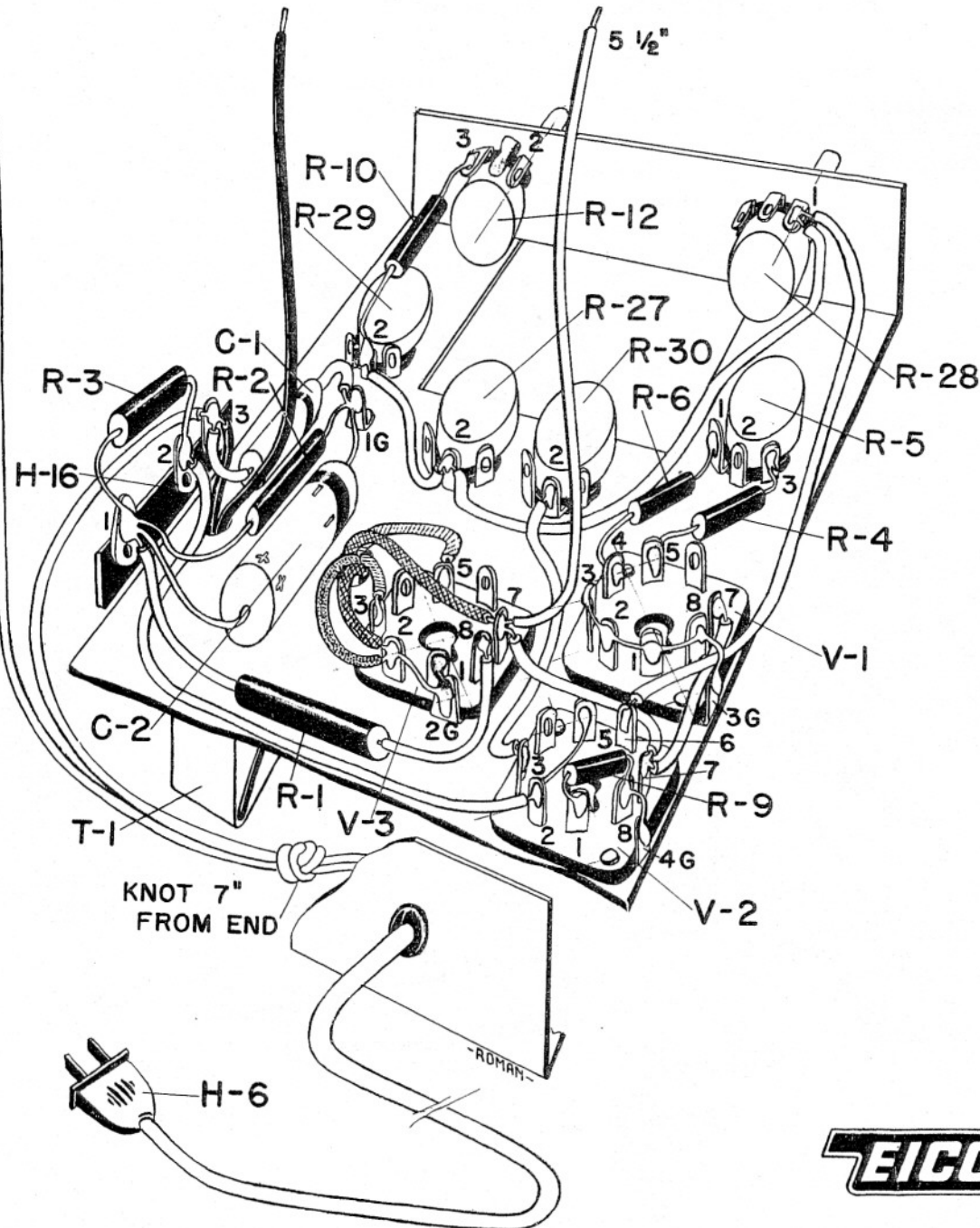


ASS'Y PRINT 3

MODEL 214

CHASSIS WIRING

(S) means solder, (C) means connect but do not solder.



Step#	Sym.	Description	From	To (Length)
4-1	H33	wire	(C) H16#2	(C) V2#2
4-2	H37	bare wire	(S) V2#2	(S) V2#5
4-3	T1	red wire	T1	(S) V3#3
4-4	T1	red wire	T1	(S) V3#5
4-5	T1	red-yellow wire	T1	(C) V3#2
4-6	T1	yellow wire	T1	(C) V3#2
4-7	H37	bare wire	(S) V3#2	(C) 2G
4-8	H37	bare wire	(S) V3#1	(S) 2G
4-9	T1	yellow wire	T1	(C) V3#7
4-10	H33	wire	(C) V3#7	(C) V2#7
4-11	H33	wire	(S) V3#7	5 1/2"
4-12	H33	wire	(S) V2#7	(S) V1#7
4-13	H37	bare wire	(S) V1#3	(C) V1#2
4-14	H37	bare wire	(S) V1#2	(C) V1#1
4-15	H37	bare wire	(S) V1#1	(C) V1#8
4-16	H37	bare wire	(S) V1#8	(S) 3G
4-17	R4	1.5M ohm res.	(S) V1#5	(S) R5#3
4-18	R6	1.5M ohm res.	(S) R5#1	(C) V1#4
4-19	H33	wire	(S) V2#6	(C) R28#1
4-20	H33	wire	(S) R28#1	(C) R27#2
4-21	H33	wire	(S) V2#3	(C) R30#2
4-22	R10	1000 ohm res.	(S) R12#3	(C) R29#2
4-23	H33	wire	(S) R29#2	(C) R27#2
4-24	R9	5M ohm res.	(S) V2#1	(C) V2#8
4-25	H37	bare wire	(S) V2#8	(S) 4G
4-26	R3	20K ohm res.	(S) H16#2	(C) H16#1
4-27	R1	*10K ohm res.	(S) V3#8	(C) H16#1
4-28	T1	black wire	T1	(C) H16#3
4-29	C1	.002 mfd cond.	(C) H16#3	(C) 1G
4-30	R2	*33K ohm res.	(C) H16#1	(C) 1G
4-31	C2	*filter cond.	(S) H16#1	(S) 1G
4-32	H6	line cord (1 lead)		(S) H16#3
4-33	H27	pot grounding lug		(S) R12#2

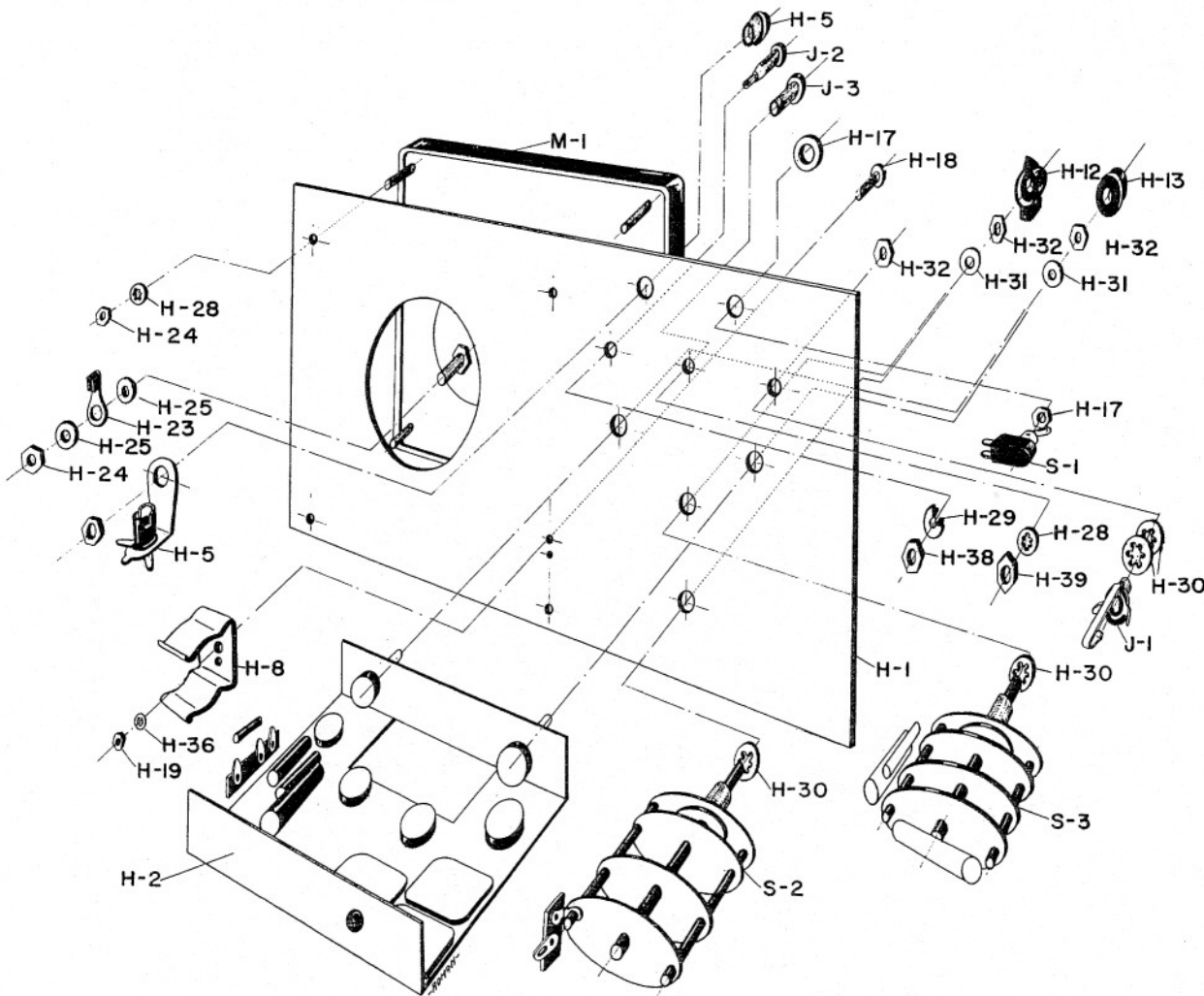
*With spaghetti

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ASS'Y PRINT 4

MODEL 214

MOUNTING PANEL



<u>Step#</u>	<u>Sym.</u>	<u>Description</u>	<u>Mounted With</u>
5-1	H5	pilot light ass'y.	associated hdwe.
5-2	J2	pin jack	1#H29, 1#H38
5-3	J3	banana jack	1#H28, 1#H39
5-4	S1	SPST toggle switch	2#H17
5-5	J1	phone jack	2#H30, 1#H32
5-6	S3	function switch	1#H30, 1#H31 1#H32
5-7	S2	range switch	1#H30, 1#H31, 1#H32
5-8	H2	chassis	2#H31, 2#H32*
5-9	H8	battery bracket	1#H18, 1#H36, 1#H19
5-10	M1	meter movement	4#H28, 4#H24
5-11	H23	meter lugs	4#H25, 2#H24

*3/8 hex nuts previously mounted - remove temporarily and replace after the pot shafts are through the panel.

KNOB PLACEMENT

Step# 5-12: Place the small round knobs (H13) on the shafts of the OHMS ADJ. and ZERO ADJ. potentiometers respectively, and tighten the set screws.

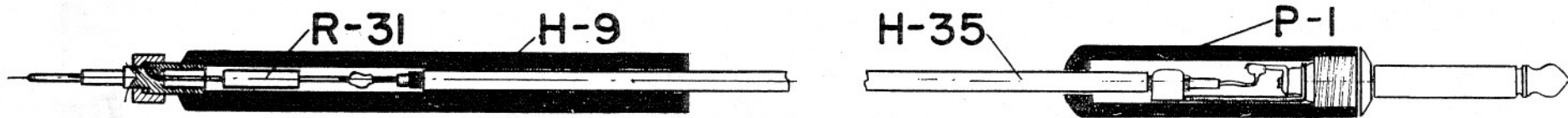
Step# 5-13: Place the bar knobs (H12) on the shafts of the FUNCTION switch, S3, and the RANGE switch, S2, and tighten the set screws. Rotate the switches counter-clockwise as far as they will go. Loosen the set screws, and line up the FUNCTION switch and RANGE switch knobs with the markers for the "-DC VOLTS" and "5V, RX1" positions respectively. Tighten the set screws. The knobs now indicate properly.



ASS'Y PRINT 5

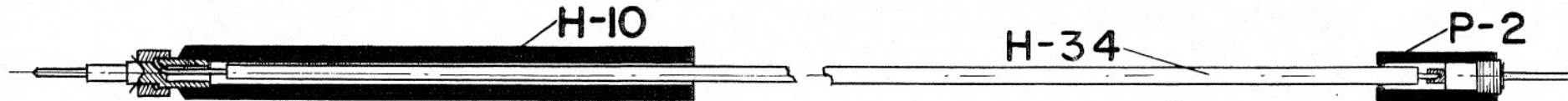
MODEL 214

DC TEST LEAD



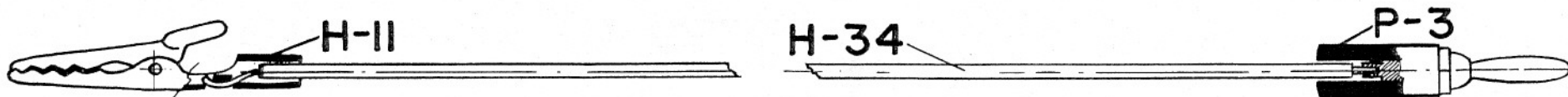
Strip ends of shielded wire, H35, as shown. Solder one end of inner conductor to 15M ohm resistor, R31. Be sure that shielding is well separated from exposed inner conductor. Unscrew ring nut from tip of test prod, H9. Slide cable through prod, resistor first, until resistor lead protrudes from small hole in prod tip. Wind protruding lead once around tip and secure with ring nut. Unscrew cover from phone plug, P1, and slide other end of the shielded wire through it. Solder inner conductor to short terminal lug of P1. Insert exposed shielding in clamp at the end of the long terminal. Crimp it so that the cable is held securely. Solder shielding to clamp. Make sure that shielding is well separated from exposed end of inner conductor. Slide cover to end of plug and screw tight.

AC TEST LEAD



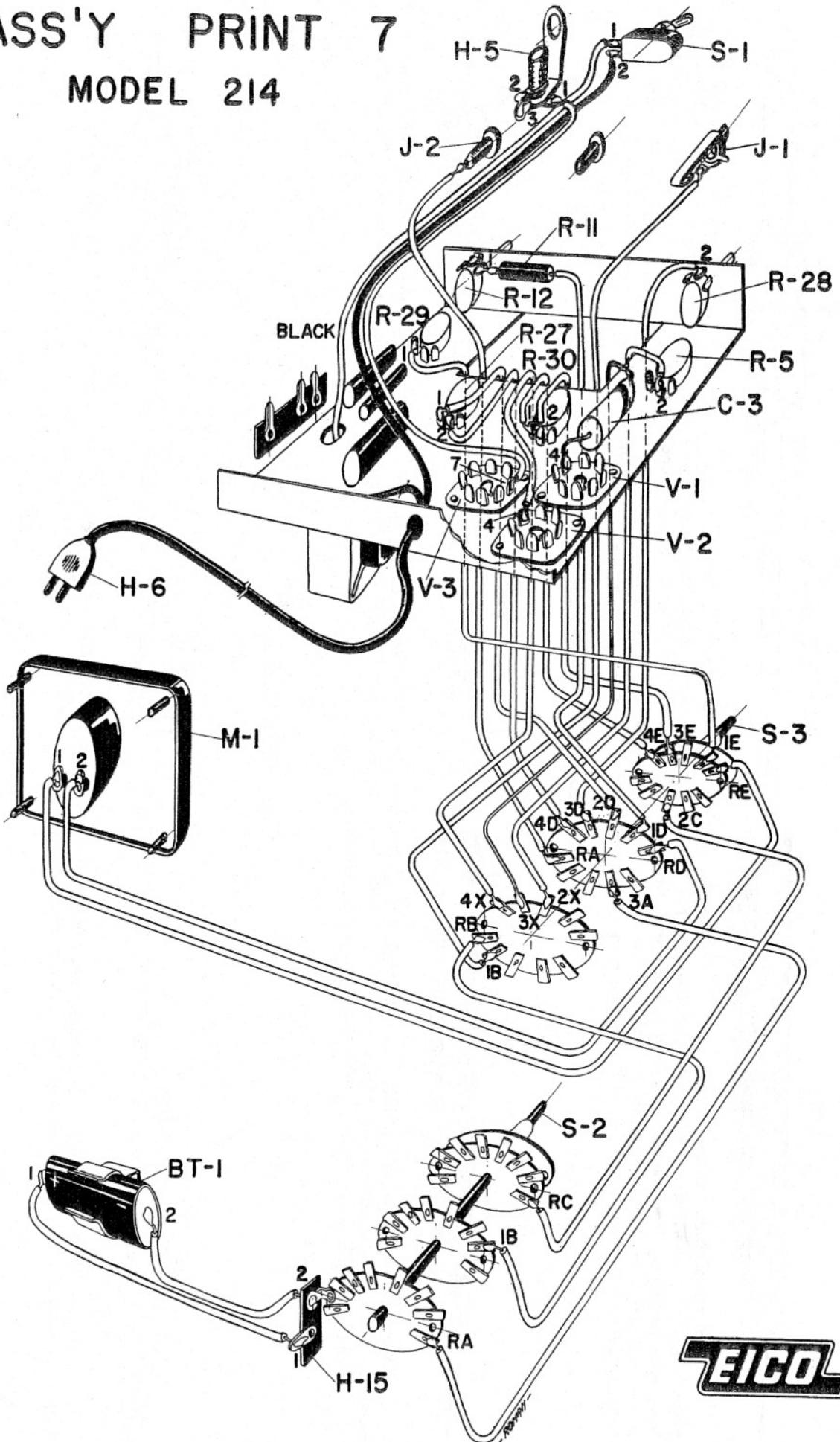
Strip ends of test lead wire, H34. Remove ring nut from black test prod, H10. Slide wire through prod until one stripped end protrudes from small hole in prod tip. Wind exposed wire around prod tip and secure with ring nut. Unscrew cover from pin plug, P2, and slide other end of wire through it. Solder end of wire to terminal on pin plug. Slide cover to end of plug and screw tight.

COMMON TEST LEAD



Strip ends of test lead wire, H34. Solder one end to alligator clip, H11. Unscrew cover from banana plug, P3, and slide other end of wire through it. Solder end of wire to terminal on banana plug. Slide cover to end of plug and screw tight.

ASS'Y PRINT 7 MODEL 214



FINAL WIRING

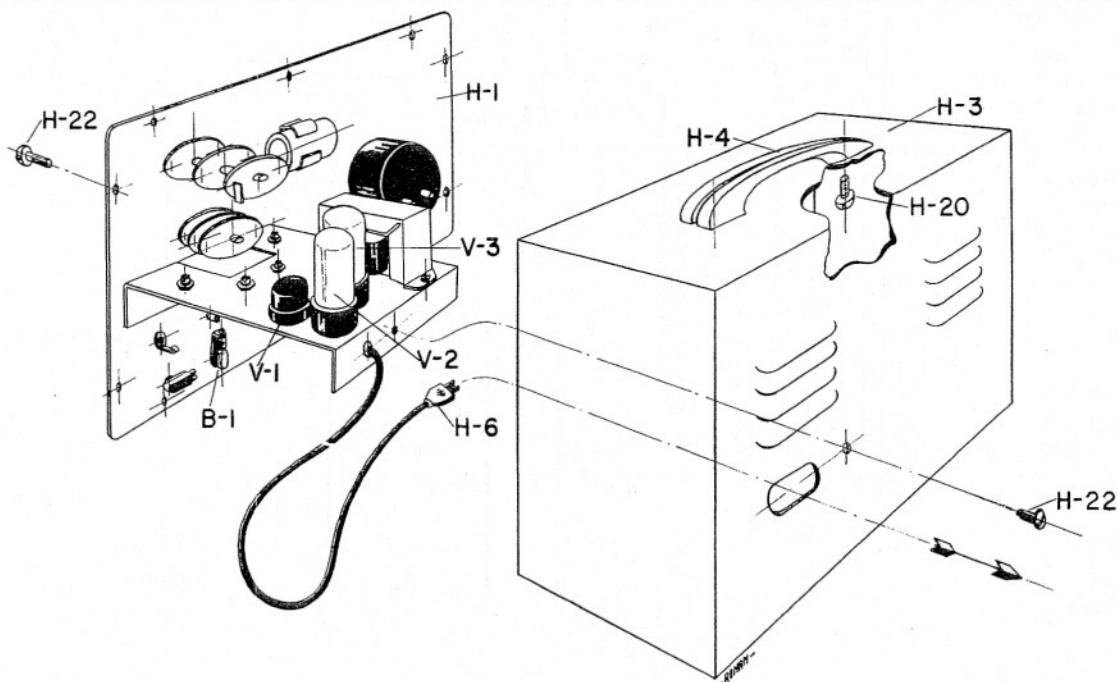
Step#	Sym.	Description	From	To	Step#	Sym.	Description	From	To
6-1	H33	wire	*S3#3E	(S) R30#2	6-13	H33	wire	*S3#RE	(S) M1#1
6-2	H33	wire	*S3#4E	(S) R30#1	6-14	H33	wire	*S3#2C	(S) S2#RC
6-3	H33	wire	*S3#4X	(S) V2#4	6-15	H33	wire	*S3#RD	(S) M1#2
6-4	H33	wire	*S3#4D	(S) R27#2	6-16	H33	wire	*S3#3A	(S) S2#RA
6-5	H33	wire	*S3#2D	(S) R27#1	6-17	H33	wire	*S3#RB	(S) S2#1B
6-6	H33	wire	*S3#3D	(S) R28#2	6-18	H33	wire	*H15#1	(S) BT1#1
6-7	H33	wire	*S3#1E	(S) R29#1	6-19	H33	wire	*H15#2	(S) BT1#2
6-8	H33	wire	*S3#2X	(S) R5#2	6-20	T1	power xfmr.	black	(S) S1#1
6-9	C3	.1 mfd cond.	*S3#3X	(S) V1#4	6-21	H6	line cord	lead	(S) S1#2
6-10	R11	1K ohm res.	*S3#1D	(S) R12#1	6-22	H37	bare wire	(S) H5#2	(S) H5#3
6-11	H33	wire	*S3#1B	(S) J1	6-23	H33	wire	*V3#7	(S) H5#1
6-12	H33	wire	*S3#RA	(S) J2					

*Soldered in previous steps

FINAL STEPS

You have now completed the mechanical assembly and the wiring of your instrument. Insert the tubes and the pilot light as shown in the figure below. Check the wiring carefully for errors or omissions. If you have an ohmmeter, measure the resistance from V3, pin 8 to ground (before connecting the instrument to the power line). If it is less than 40,000 ohms, check the rectifier circuit. Insert the plug on the line cord into the 115 VAC power supply and turn the instrument on. If you have a voltmeter, check to see if you have the following voltages to ground (within 20%): V2, pins 2 & 5 — 90v; V2, pin 3 — 2 to 3v; V2, pin 6 — 2 to 3v. If these voltages are not present, check the wiring and components in the circuits involved. Whether you have made the voltage and resistance checks or not, proceed with these remaining steps. Check to see that rotation of the "ZERO ADJ." potentiometer results in movement of the meter pointer. Set the FUNCTION switch at "OHMS" and observe whether the meter pointer swings to the right as it should. Check to see whether the "OHMS ADJ." potentiometer can adjust the meter pointer to full-scale deflection.

After you have made these checks, proceed with the calibration. The calibration procedure is described completely in the MAINTENANCE section of the Instruction Book. After calibration, mount the handle (H4) with two 10-24 screws (H20), and then insert the instrument in the cabinet, securing it with the #6 X 1/4 PK screws (H22) as shown in figure below.



If the instrument fails to operate properly, make certain that the wiring and the components in the circuit are correct. Almost all troubles reported to us in the past, have had improper wiring as their cause. If the wiring is correct, test for continuity and check individual components for breakdown. If you are still having difficulty, write to our engineering department (Electronic Instrument Co., Inc., 84 Withers Street, Brooklyn 11, New York) listing all indications which might be helpful. If desired, you may return the instrument to our factory, where it will be placed in operating condition and calibrated for \$4.00 plus the cost of parts replaced due to their being damaged in the construction of the instrument. Pack the unit very carefully; in the original shipping carton, if possible. Send it to the above address, pre-paid Railway Express. The instrument will be returned as soon as possible, express collect.

