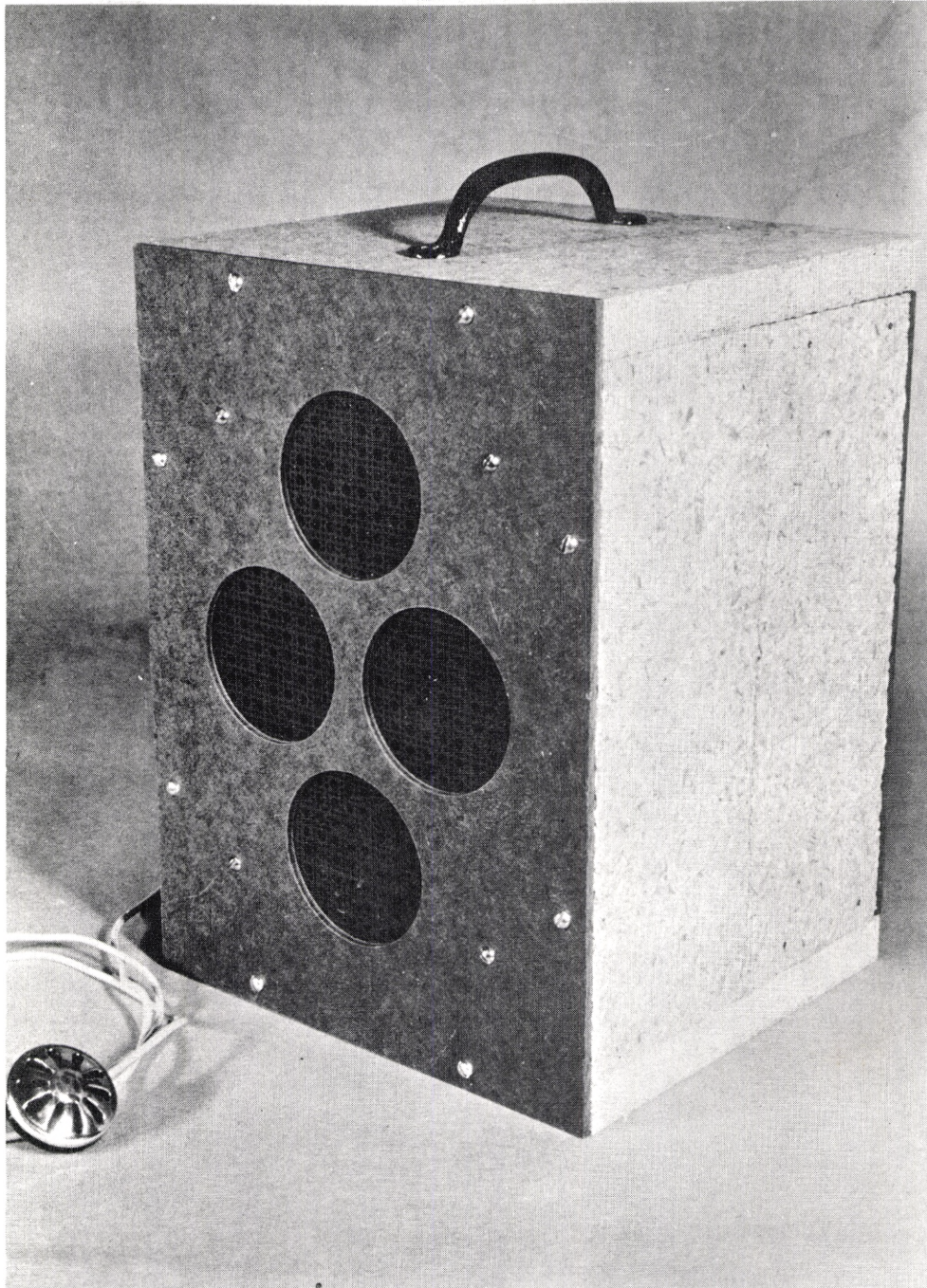


2.3418

Elect ~~Set~~ ^{Training}
Materials

● 4-H PORTABLE P.A. SYSTEM



● University of California

Agricultural Extension Service

4-H-Ag131

To simplify information, trade names of products have been used. No endorsement of named products is intended, nor is criticism implied of similar products which are not mentioned.

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FEBRUARY 1966--1M

4-H PORTABLE P.A. SYSTEM

The author is R. J. Coffelt, Department of Agricultural Engineering, Davis,
Division of Agricultural Sciences.

This fully portable, versatile, and relatively compact transistorized amplifier probably will be used mainly as a public address system. With the use of an inexpensive microphone, it will reproduce and amplify a speaker's voice with clarity and enough volume to cover audiences of 200 or more. If desired, you can feed the output from a radio or from a record player to the amplifier and project it to cover large audiences. Using an inexpensive induction pickup on the handpiece of a telephone, you can amplify a conversation for listening by more than one person. To isolate or listen to motor or engine noises, bearings, valves, termites in wood, fan noises, and many other interesting noise sources, replace the usual microphone with a contact microphone equipped with a wire probe fastened to the mounting arm or with an old crystal phonograph cartridge in which the needle has been replaced with a wire 3 or 4 inches long.

All electronic components are readily available at local electronics suppliers, or they may be ordered from a mail order electronics firm. The wood, screws, nails, and other hardware are sold at any lumber and hardware store.

This amplifier costs between \$18 and \$20, including microphone, wood, glue, nails, and all the other parts required.

Parts should be substituted only as indicated in the parts list. Various microphones, such as the one specified, may have widely differing outputs; and speakers of the same size, but made by different manufacturers, may vary in efficiency.

We suggest that you have all electronic components on hand before cutting and drilling any holes in the wood parts. You may need to make minor changes if the electronics distributor has substituted some parts of like function but different mounting size.

HOW TO MAKE SPEAKER AND AMPLIFIER CASES (Pages 11 to 20)

1. Cut parts numbered 1 through 4 in the drawings from 3/4-inch-thick particle board; however, they may be made from 3/4-inch pine or plywood. Make all other parts from 1/8-inch-thick hardboard or Masonite.
2. Refer to the drawings for dimensions to determine the amount of material you need. Keep in mind a parts layout to help you use material economically.
3. Do all the sawing and drilling from the smooth side of the Masonite to avoid splintering.
4. Carefully cut out and drill the pieces. Accurate cutting and drilling will assure easy assembly and good fit of the pieces. To facilitate assembly, use flat unwarped material.
5. The 2 1/2-inch-diameter holes in the speaker front (part 5) can be made with a holesaw, a circle cutter, an adjustable auger bit, or a jigsaw. If these tools are not available, you can use a pattern of small holes instead of the four large ones.
6. The 1/8-inch by 1/8-inch grooves in parts 2 and 3 should be made with a circular saw with a blade 1/8 inch thick; however, you can make them by carefully using a backsaw or handsaw.
7. To assemble amplifier case, fasten parts 3 to the ends of parts 4 with nails and glue (see page 18). Be sure the pieces are aligned properly and the corners of the case are square.
8. Slide part 8A into the grooves on the back of the case so that the side with the single hole is flush with one end of the case. Hold the part in place with a friction-catch screw. Do not fasten on part 7.
9. To assemble speaker case, fasten one of the parts 1 to parts 2 with glue and nails (see page 19). Note in the exploded view that the sides of parts 2 which are farthest from the grooves are mounted flush with the front edge of part 1.
10. Insert part 6 into the grooves provided in parts 2, with the smooth surface facing away from the front of the unit. If this part fits loosely, use glue in the grooves to prevent speaker vibration. Now fasten the other part 1 with glue and nails.
11. Mount the speaker on part 5 with the grill material between it and the board. Use #6-32 by 5/8-inch machine screws to hold it in place.
12. Solder the speaker cable to the lugs on the speaker. Tie a knot in the cable several inches from the speaker and insert the free end through the small hole in part 6. Fasten part 5 to the case with #6 by 5/6-inch wood screws.

13. Now mount the friction catches on parts 1. They are most easily mounted before assembling the speaker case, and you can do this by predetermining their approximate location. To obtain the best fit, however, first assemble both cases to determine mounting centers by exact measurement.

HOW TO WIRE THE AMPLIFIER (Pages 21 to 27)

CAUTION

1. Be sure to mount parts in the correct positions on the panel and circuit board.
 2. Observe carefully the polarity of the battery and of the electrolytic capacitors (condensers) when mounting them.
 3. Use only rosin-core solder.
 4. Use clean, tinned soldering iron.
 5. Do not overheat the transistors (or any other parts) when soldering, for heat may damage them.
1. Cut the leads of the TA-12 output transformer (T2, the larger of the two transformers) to the following lengths: blue, 2 inches; brown, 3 1/2 inches; red, 2 1/2 inches. Do not cut the green leads.
 2. Similarly, cut the leads of the TA-58 driver transformer (T1) as follows: red, 3 inches; blue, 3 inches; yellow, 4 inches; black, 2 1/2 inches; green, 1 1/2 inches.
 3. Strip off the insulation from the transformer leads to about 1/2 inch back from the ends.
 4. Wire the amplifier panel. Place the amplifier front panel (part 7) as shown in the pictorial, that is, with the holes for mounting the components at the top and the rough Masonite surface facing you.
 5. Mount the transformers, the volume control (R1), the input jack (J1), the three-lug terminal strip, and the 2N554 power transistors (Q3 and Q4) as shown in the pictorial. All screws used for mounting parts are #6-32 by 5/8-inch machine screws, except the lower screw on T1 and the upper screw on T2, which are #6-32 by 2 inches. Put a solder lug under each of the lower nuts on the 2N554 transistors, since these serve as collector connections. The small metal tab on the shaft end of the volume control may be bent over to clear the panel, or an indentation for it may be cut in the panel with a knife.

6. Solder a solder lug on each of the ends of the speaker leads (green wires) of transformer T2.
7. Solder a short length of bare wire (strip insulation off hookup wire) to the button on the base of each PR-2 flashlight lamp (R11 and R12), and a separate length of wire to the metal shell of each lamp. Make the connection to the shell at the point near the notch in the flange where there is already a spot of solder. If soldering to the shell proves difficult, use a small amount of noncorrosive soldering paste.
8. Mount resistors R10, R11, R12, and R13 on the terminal strip, and wire the rest of the panel as shown in the pictorial. Attach one end of a 5 1/2-inch length of hookup wire to the center lug of the volume control, a 4-inch length of wire to the topmost lug of the terminal strip, and a 3 1/2-inch length to the second lug from the top of the terminal strip. Later, you will connect the other ends of these wires to the circuit board.
9. Cut a 4-inch length of black hookup wire and a 6 1/2-inch length of red hookup wire. Solder a solder lug to one end of each wire. Connect the remaining end of the red wire to the topmost lug of the terminal strip. Solder the remaining end of the black wire to the switch on R1 as shown in the pictorial. The red wire later will be connected to the positive (+) terminal of the battery, and the black wire connected to the negative (-) terminal of the battery.
10. To wire the circuit board, place the circuit board (part 10) as shown in the pictorial. The smooth Masonite surface should face you, and the side with the greatest number of holes should be at the top.
11. Place the components on the board as shown in the pictorial, with their leads inserted through the holes in the board. Cut off the leads so that they protrude approximately 1/4 inch beyond the opposite side of the board, and bend them at right angles to hold the parts on the board. All leads are long enough to reach the appropriate holes, so that only two length of hookup wire are necessary. One length goes from the upper second hole from the left junction of C7 and R8 to the upper second hole from the right junction of R7, red T1 lead, and lead to R13. The other length goes from the lower left hole at the bottom end of C3 to the lower third hole from the right junction of C6, R9, and R6. When all parts have been mounted on the board, solder together all wires coming through a single hole. In mounting capacitors C1, C2, C3, C5, C6, and C7, make sure that the ends marked (+) are placed as shown in the pictorial.
12. Solder the lead coming from the topmost lug of the terminal strip to the wires coming through the lower left hole of the circuit board. Connect the wire from the lug of the terminal strip which is second from the top, and also the red lead of T1, to the wires coming through the upper second hole from the right on the circuit board. Solder the wire coming from the center lug of the volume control to the positive (+) lead of C1 where it

comes through the circuit board. Connect the blue lead of T1 to the collector lead of transistor Q2 where it comes through the circuit board. In soldering these leads from the front panel to the circuit board, make the connections on the back (rough side) of the board.

13. At this point, carefully check the wiring to be sure it has been done correctly.
14. Screw a #6-32 nut onto each of the 2-inch screws protruding from the front panel, so that they are approximately 1/4 inch from the ends of the screws. Mount the circuit board by placing it so that the 2-inch screws pass through the holes in the corners of the board. Screw #6-32 nuts onto the threads which protrude beyond the board and tighten them.
15. Place the completed assembly in the amplifier case and secure the front panel with #6 by 5/8-inch wood screws.
16. Mount the two fahnstock clips on the back of the amplifier case (part 8A) with #6-32 by 5/8-inch screws. Place the lugs connected to the speaker leads (green wires) over the threads protruding on the inside and secure them with #6-32 nuts.
17. To install the battery, remove the binding nuts from the battery and insert the threaded terminals through the battery holder board (part 9). Connect the battery leads, and replace the nuts on the binding posts. Now slide the battery holder into the grooves in the sides of the amplifier case. When connecting the battery, make sure the polarity is correct, that is, red lead positive (+), black lead negative (-).
18. Slide the back cover (part 8B) into the grooves provided and secure it with a friction-catch screw.

Testing

Connect the speaker leads to the fahnstock clips; then plug the microphone into the input jack after attaching the phono plug to the microphone leads. The speaker should be pointed away from the microphone to reduce squealing or feedback. Turn on the unit. If feedback occurs, reduce the volume control setting until it ceases. The loudness and quality of the sound may be affected greatly by how the microphone is held (cupping hand around microphone, speaking directly at or past the microphone, etc.) and the speaker's distance from the microphone. Experiment to determine the correct placement of the speaker with respect to the microphone, the correct volume control setting, and the correct method of holding the microphone.

If the unit does not operate, carefully recheck the wiring. Also check the battery voltage and the speaker and microphone connections.

PARTS LIST FOR P.A. SYSTEM

Parts numbers	Parts required	Description	Manufacturers' parts numbers	Notes
R1	1	10-K* potentiometer with switch and knob	Monarch VCS-100	Japanese import
R2, R7	2	10-K fixed resistor		1/2 watt
R3	1	100-K fixed resistor		1/2 watt
R4	1	470-ohm fixed resistor		1/2 watt
R5	1	5.6-K fixed resistor		1/2 watt
R6	1	1-K fixed resistor		1/2 watt
R8	1	100-ohm fixed resistor		1/2 watt
R9	1	47-ohm fixed resistor		1/2 watt
R10	1	10-ohm fixed resistor		2 watt
R11, R12	2	flashlight bulb or 1-ohm, 1/2-watt fixed resistor	PR-2	Lamp filament makes a good resistor.
R13	1	470-ohm fixed resistor		2 watt
C1, C5	2	20-mfd ** electrolytic capacitor	Aerovox SRE bantam or equivalent	Any value between 1 and 25 mfd will work.
C2, C6	2	100-mfd electrolytic capacitor	Aerovox SRE bantom or equivalent	Any value between 50 and 100 mfd will work.

*K = 1000 ohms

**mfd = microfarad

PARTS LIST FOR P.A. SYSTEM

Parts numbers	Parts required	Description	Manufacturers' parts numbers	Notes
C3, C7	2	200-mfd electrolytic capacitor	Aerovox SRE bantam or equivalent	Any value between 100 and 200 mfd will work.
C4	1	0.25-mfd paper capacitor	Sprague 2TM-P25	May be omitted, causing poorer sound quality.
Q1, Q2	2	transistor	Texas Inst. 2N1380	
Q3, Q4	2	transistor	Motorola 2N554	Other transistors that work as well are 2N301, 2N555, 2N234A, 99 power.
T1	1	driver transformer	Stancor TA-58	100-ohm primary 200-ohm C.T. secondary
T2	1	output transformer	Stancor TA-12	20-ohm C.T. primary 8-ohm secondary
Spkr.	1	6" x 9" PM speaker	Oxford 69 CMS	3.2-ohm V.C., 8-ohm voice coil would be better.
J-1	1	input jack	Switchcraft 3501 FA	
P-1	1	input plug	Switchcraft 3501 M	
L	6	solder lug, #8	General Cement #7451-C	
F	2	fahnstock clip	General Cement #H 594-F	3/4" long
T	1	terminal strip, 3-lug	Cinch Jones #53-E	

PARTS LIST FOR P.A. SYSTEM

Parts numbers	Parts required	Description	Manufacturers' parts numbers	Notes
--	13	#6-32 x 5/8" machine screws	General Cement 5653-C	Longer screws can be used.
--	2	#6-32 x 2" machine screws	General Cement H 1076-F	
--	19	#6-32 x 5/16" hex nuts	General Cement H 1807-F	
--	20 ft	speaker wire, #24	Belden #8782	
--	3 ft	hookup wire, #22 solid	Belden #8530	half red, half black
B1	1	battery, 12-volt	Burgess TW2	
M	1	crystal lapel microphone	Monarch Mc-105	Japanese import
∞	1 ft	wire solder, 1/16" dia.		rosin core
1	2	3/4" thick particle board, plywood, or pine	Size 7 1/8" x 8"	speaker top and bottom
2	2	3/4" thick particle board, plywood, or pine	3 1/2" x 9 1/2"	speaker sides
3	2	3/4" thick particle board, plywood, or pine	3 1/2" x 9 15/32"	amplifier sides
4	2	3/4" thick particle board, plywood, or pine	3" x 6 1/2"	amplifier top and bottom
5	1	1/8" thick Masonite	8" x 11"	speaker front
6	1	1/8" thick Masonite	6 3/4" x 9 1/2"	speaker back
7	1	1/8" thick Masonite	8" x 9 1/2"	amplifier front

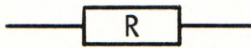
PARTS LIST FOR P.A. SYSTEM

Parts numbers	Parts required	Description	Size	Notes
8 A	1	1/8" thick Masonite	1 1/2" x 6 3/4"	amplifier back
8 B	1	1/8" thick Masonite	6 3/4" x 8"	amplifier back
9	1	1/8" thick Masonite	3" x 6 3/4"	battery holder
10	1	1/8" thick Masonite	2 1/2" x 5 1/2"	circuit board
11	1	Reynolds lincane perforated aluminum	6" x 9"	speaker grill
--	16	5d finishing nails	1 3/4" long	
--	16	#6 roundhead, wood screws	5/8" long	
--	1	handle, screen-door pull	4" long	Stanley #479
--	2	ball-friction catch		
--	--	glue		white wood glue

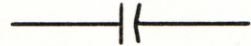
LEGEND



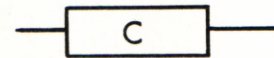
Schematic representation of a resistor.



Pictorial representation of a resistor.



Schematic representation of a capacitor.



Pictorial representation of a capacitor.

B

Letter signifying base of transistor.

C

Letter signifying collector of transistor.

E

Letter signifying emitter of transistor.

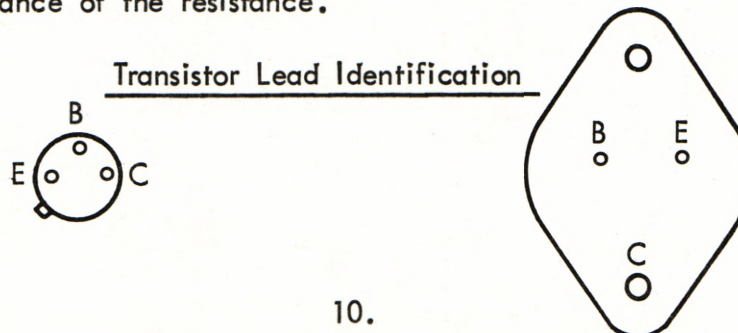
Resistor color code

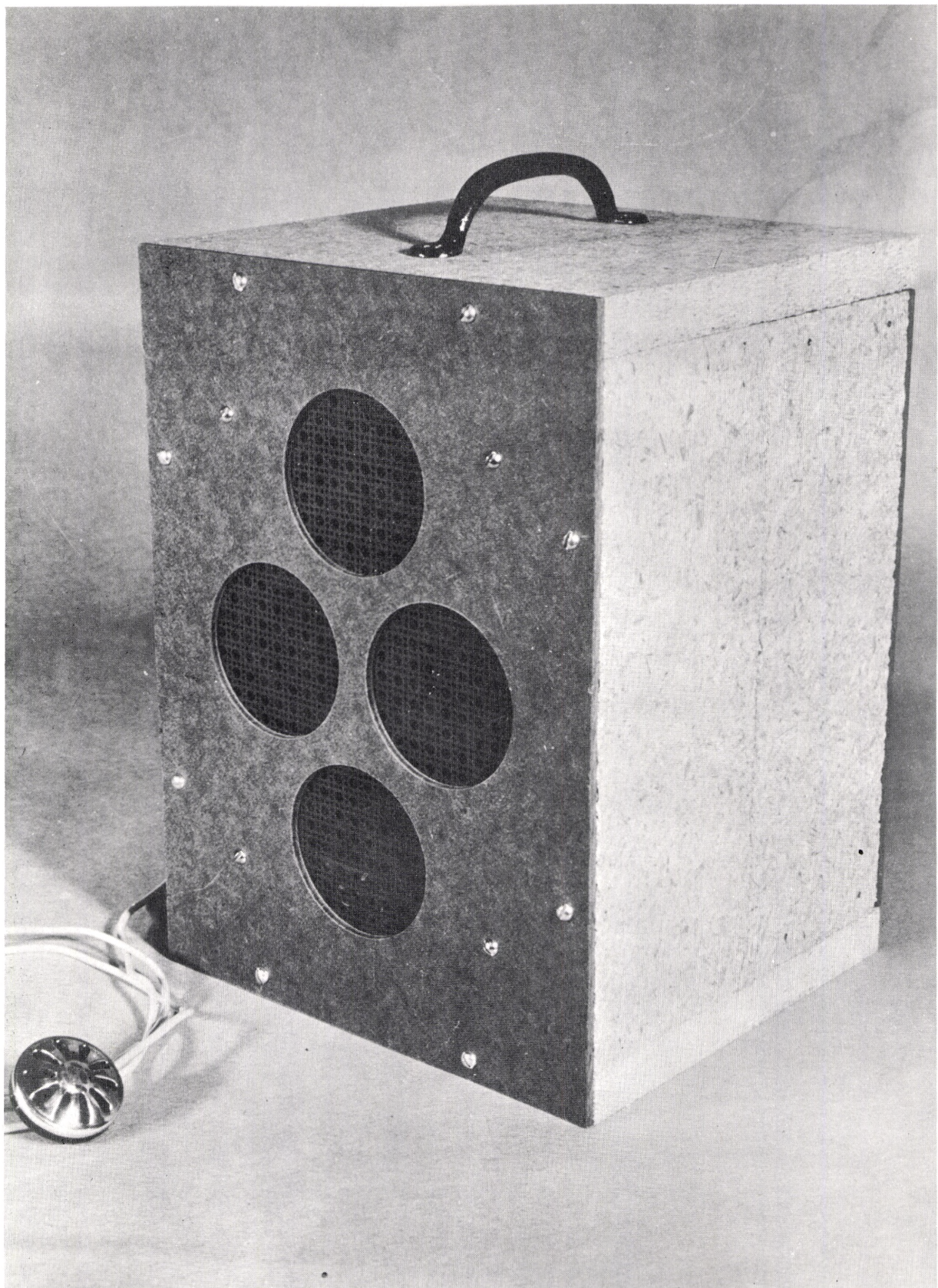
Color	Significant figure	Decimal multiplier
Black	0	1
Brown	1	10
Red	2	100
Orange	3	1,000
Yellow	4	10,000
Green	5	100,000
Blue	6	1,000,000
Violet	7	10,000,000
Grey	8	100,000,000
White	9	1,000,000,000

Examples:

Brown black black	10 ohms
Brown black brown	100 ohms
Green blue red	5,600 ohms
Brown black yellow	100,000 ohms

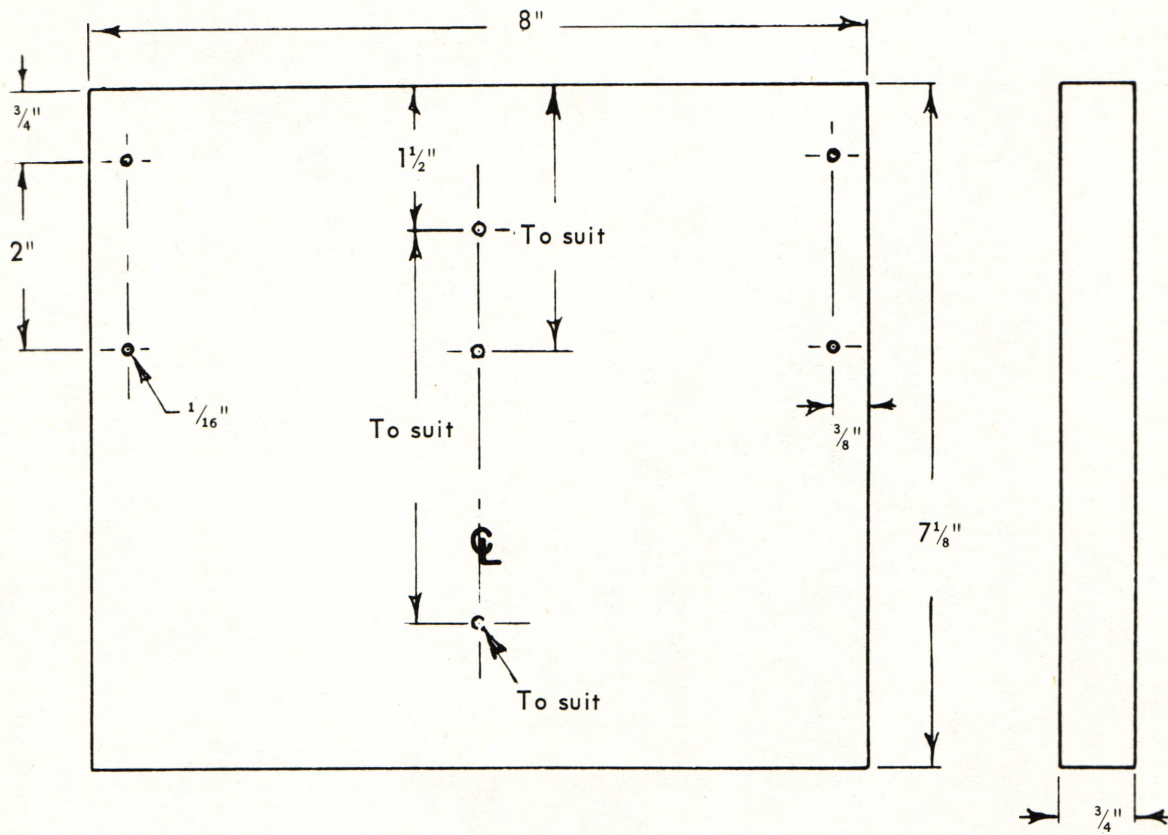
Usually there is one other band on a resistor of gold or silver color. This band signifies the tolerance of the resistance.





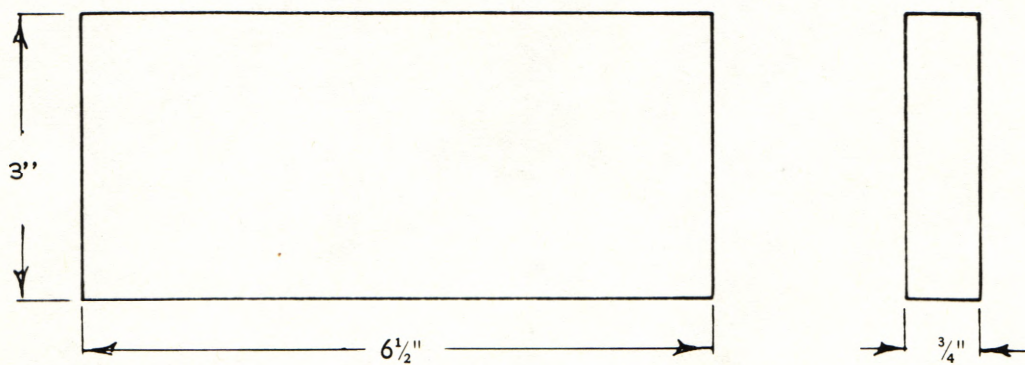
Completed P. A. System

P. A. System



Speaker Top and Bottom

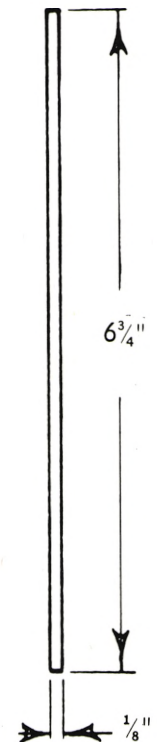
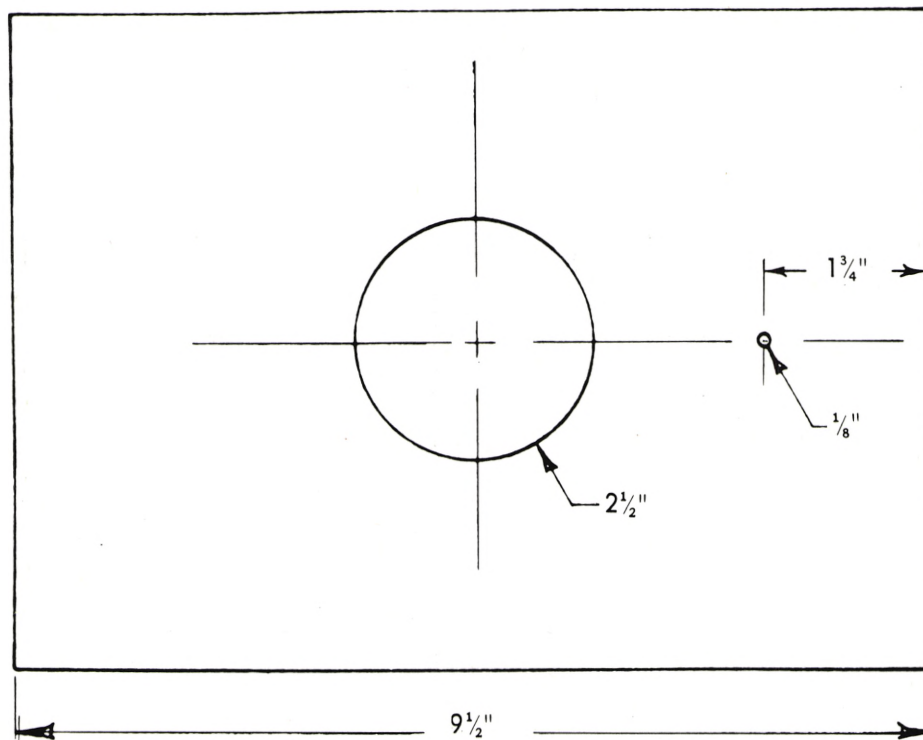
Part 1, (two required)



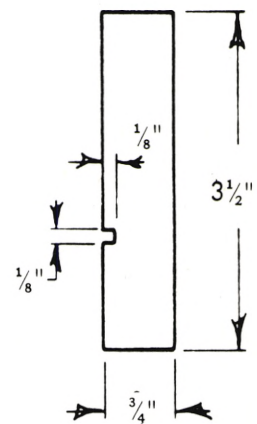
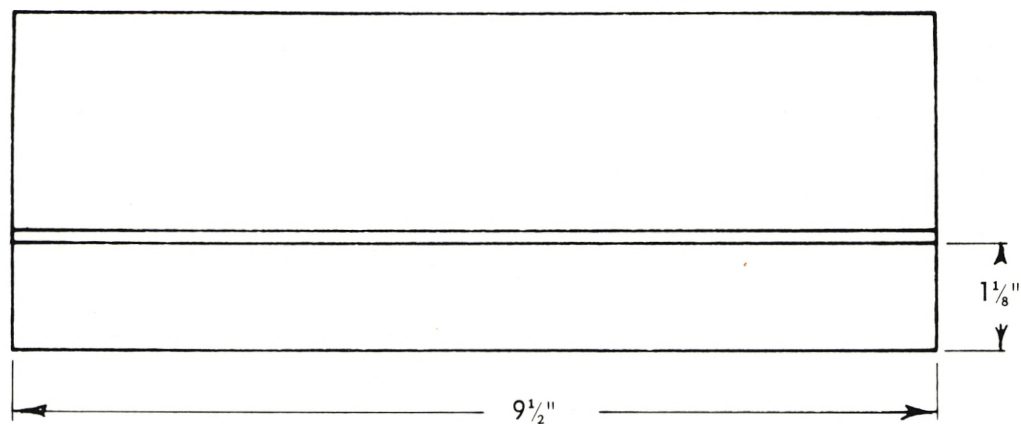
Amplifier Top and Bottom

Part 4 (2 required)

P. A. System



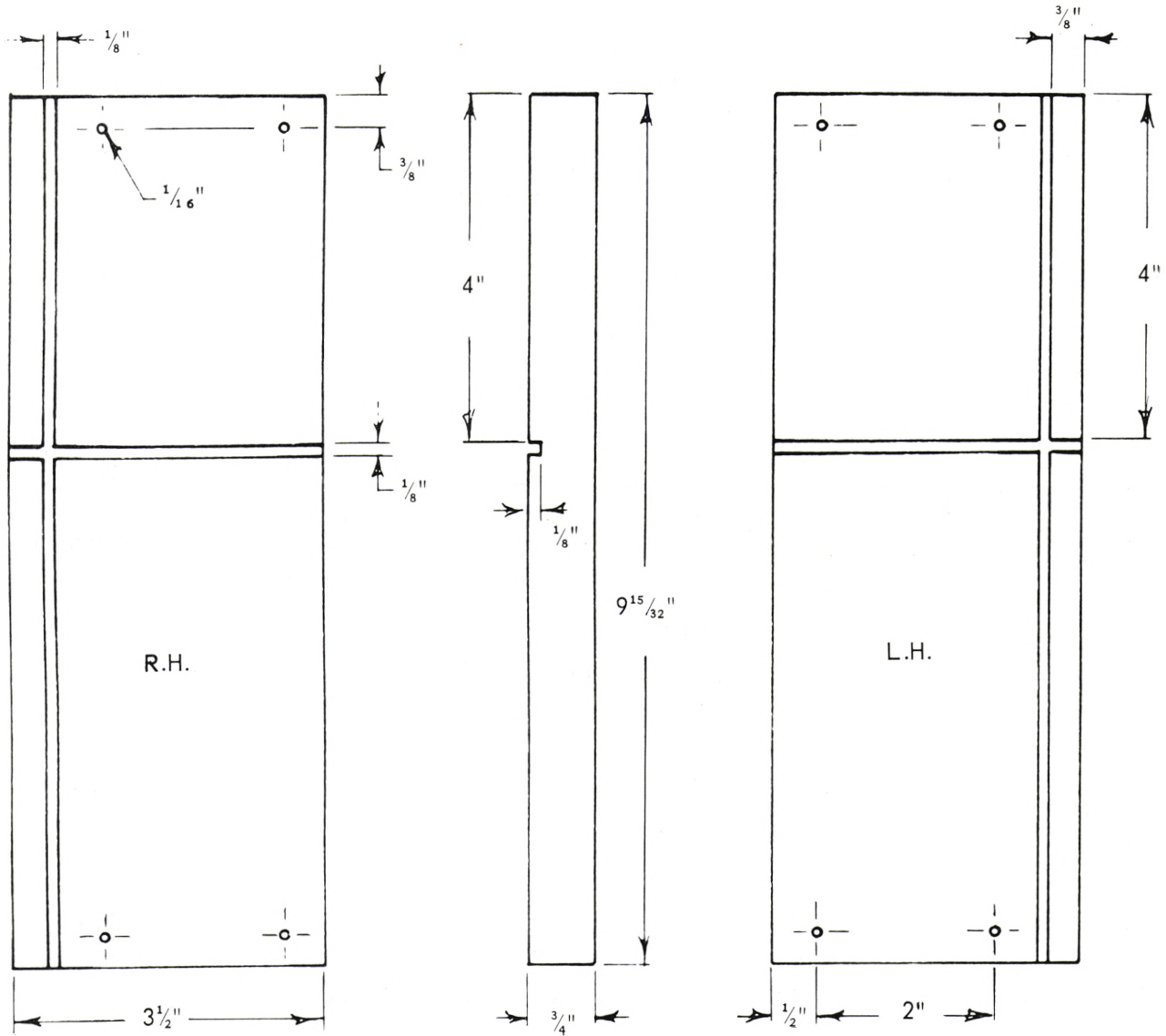
Speaker Back, Part 6



Speaker Sides

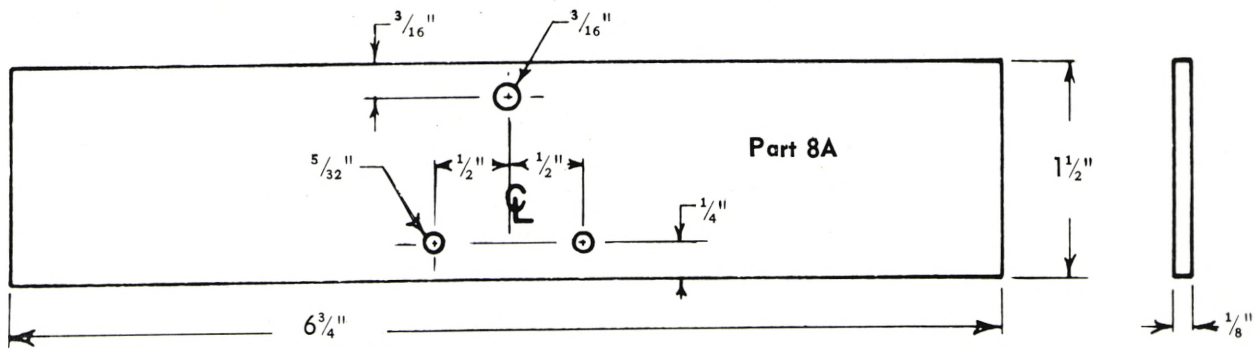
Part 2 (2 required)

P. A. System



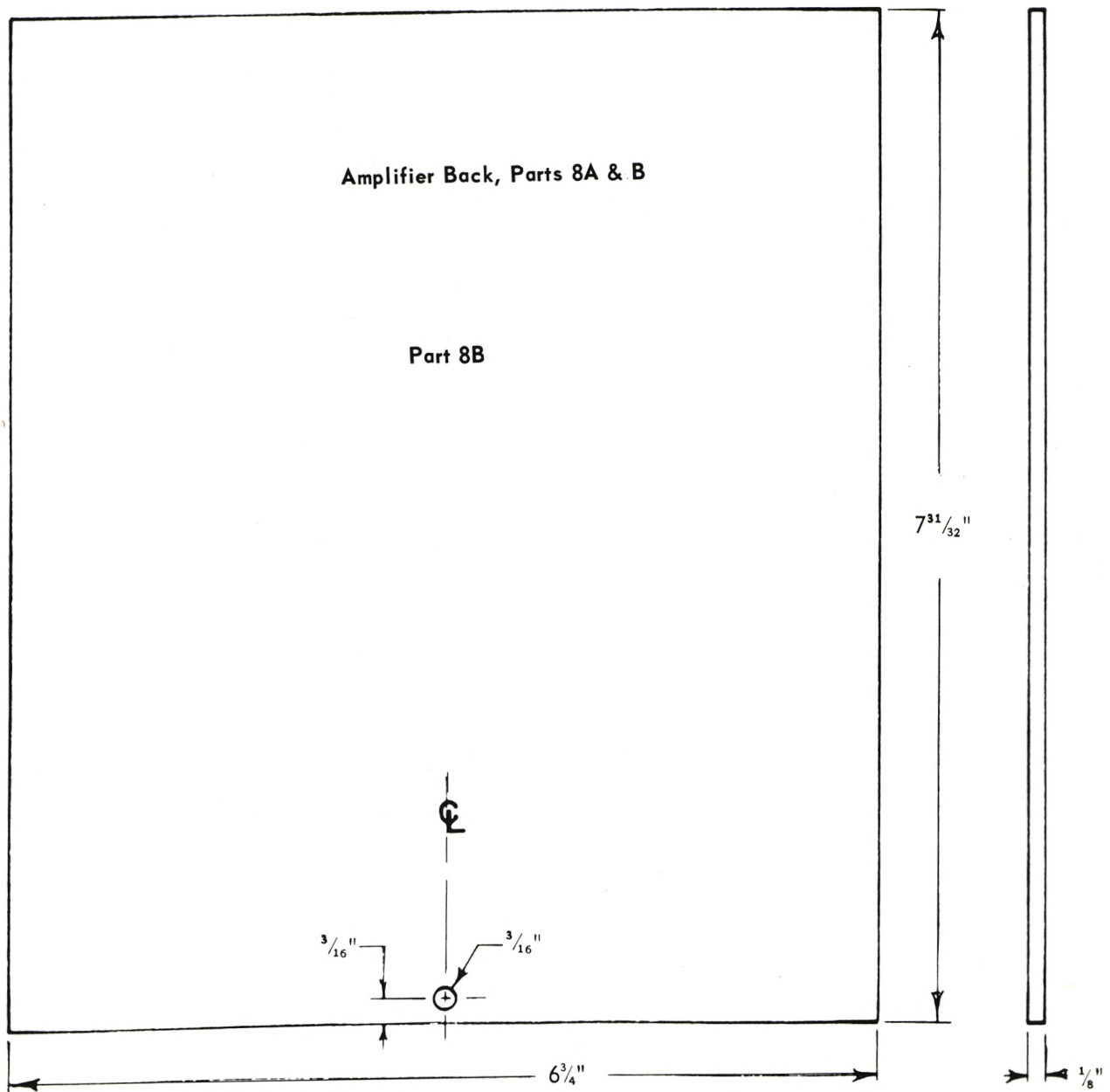
Amplifier Sides, Part 3

P. A. System

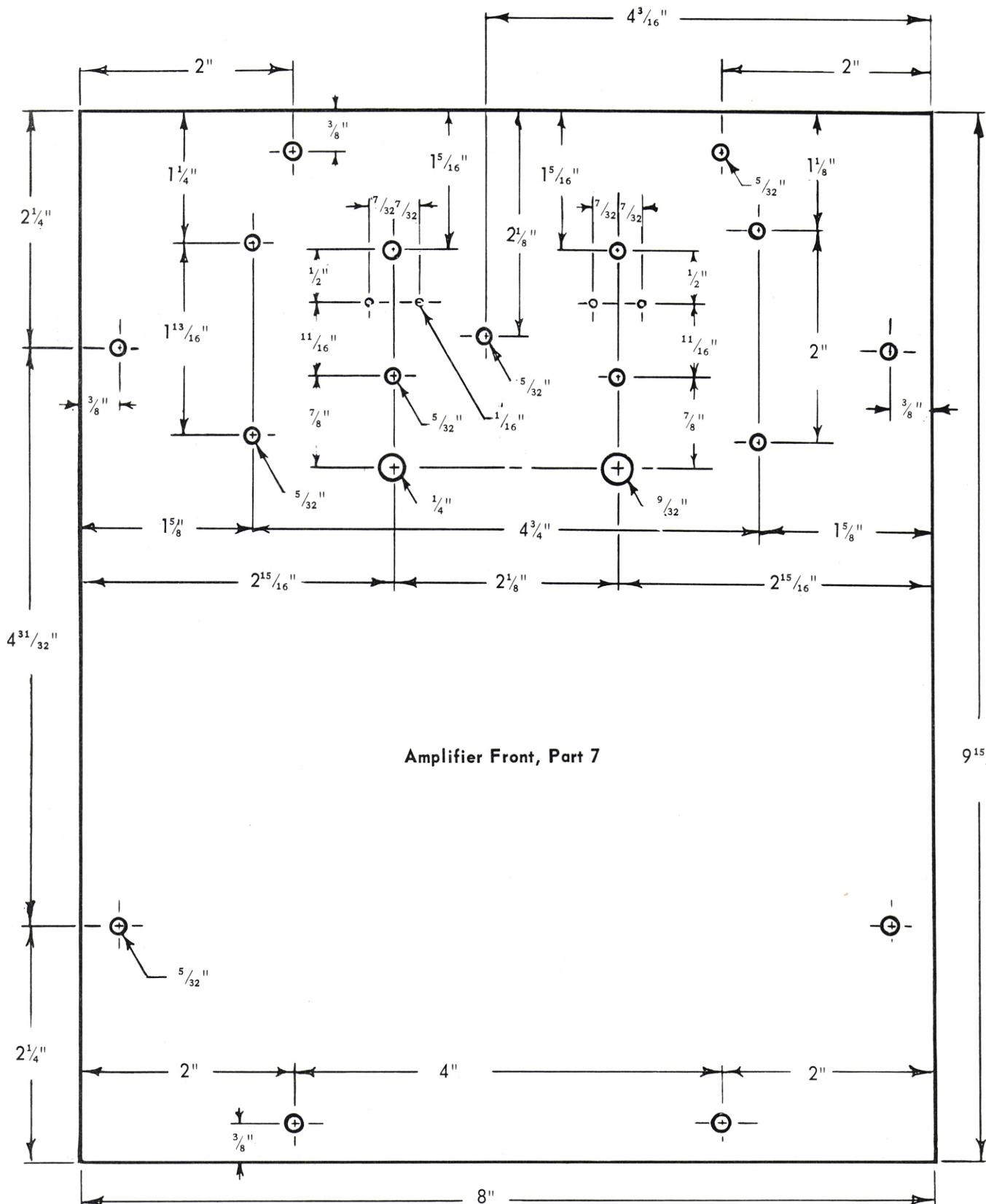


Amplifier Back, Parts 8A & B

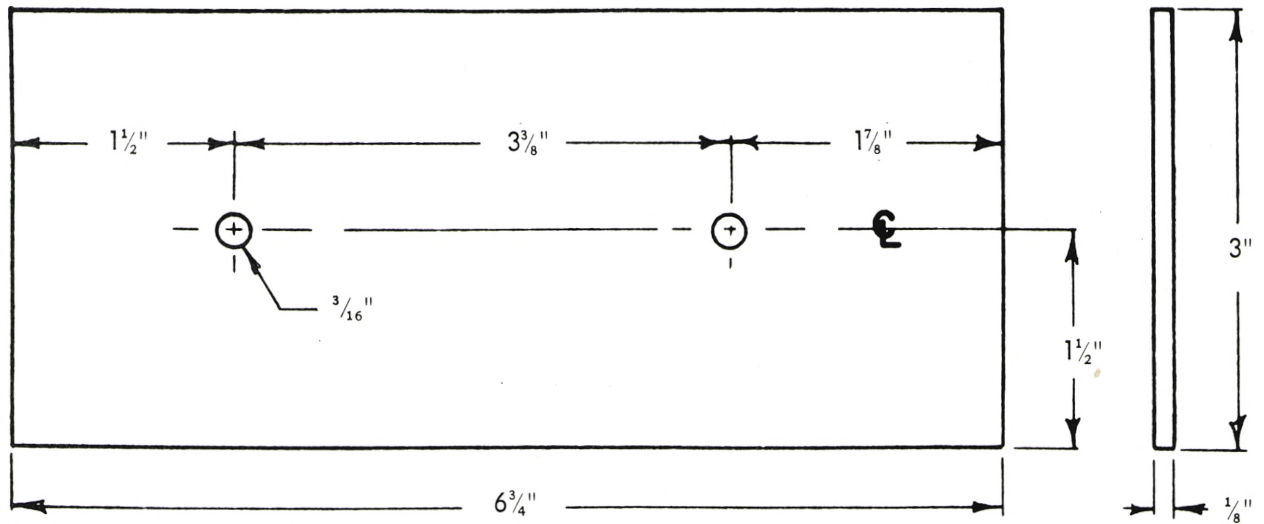
Part 8B



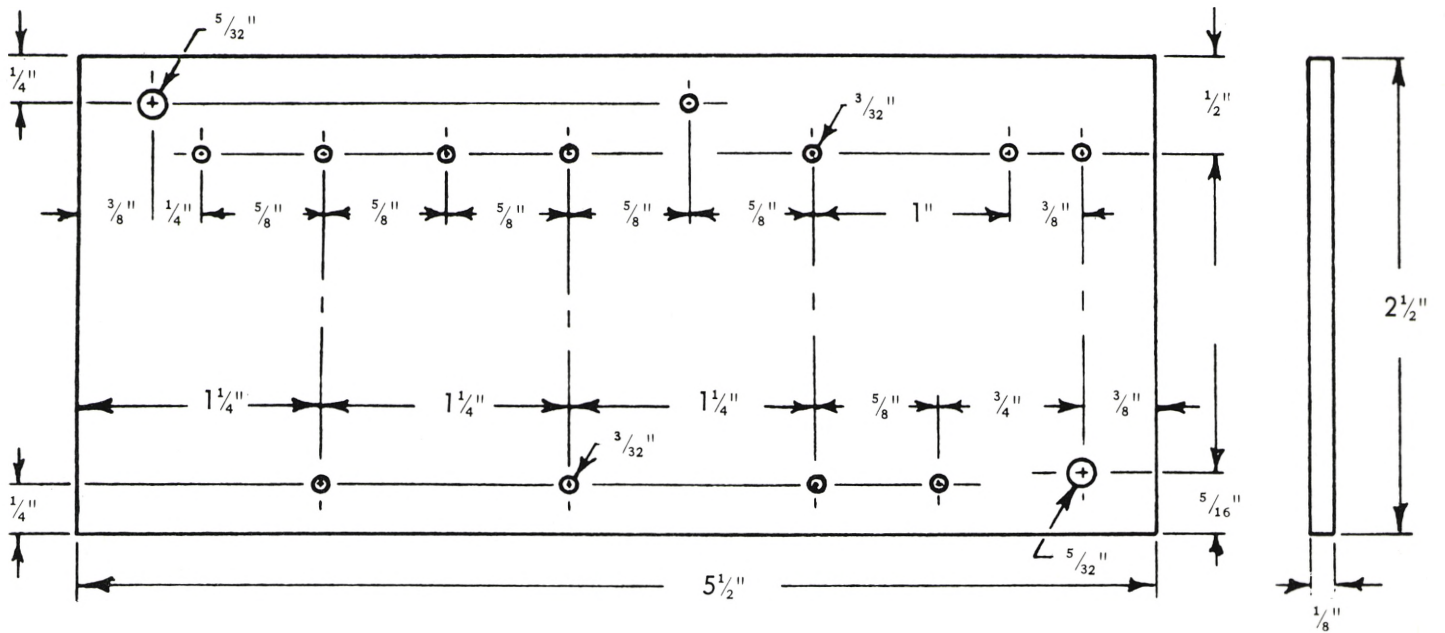
P. A. System



P. A. System

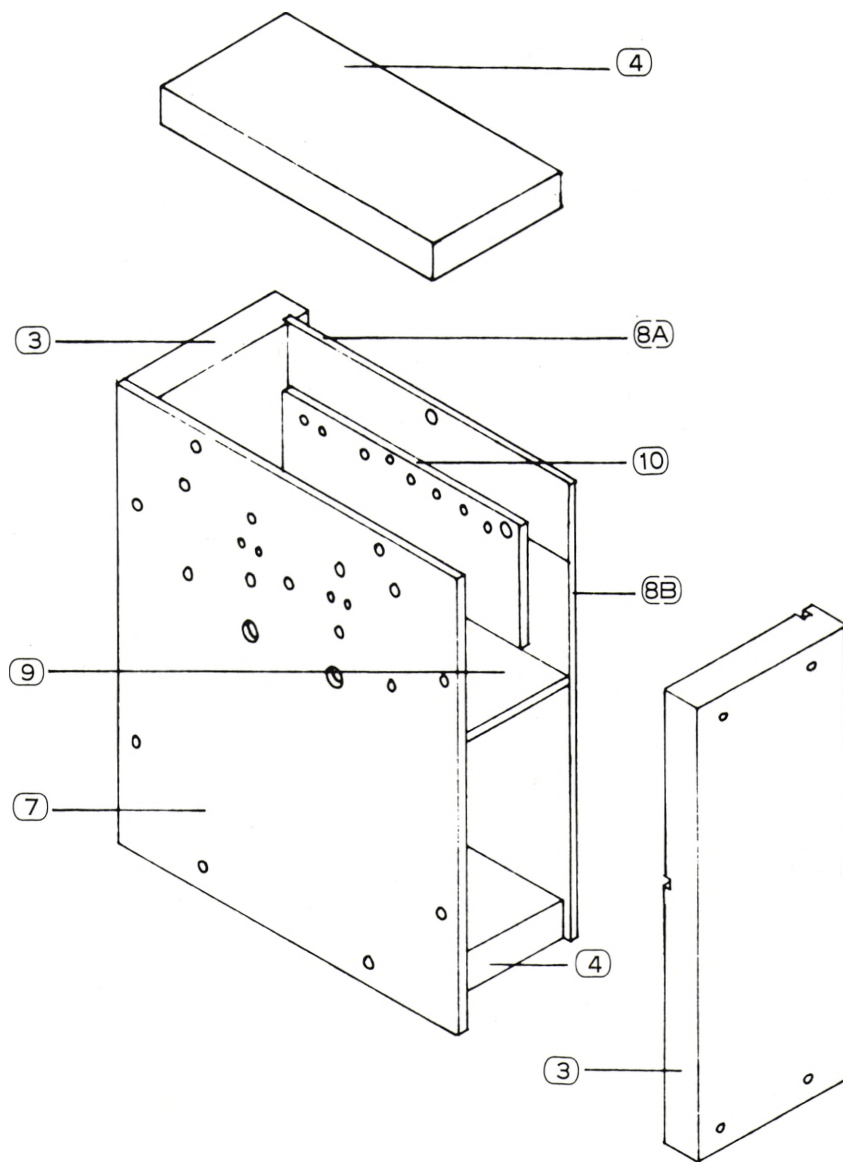


Battery Holder, Part 9



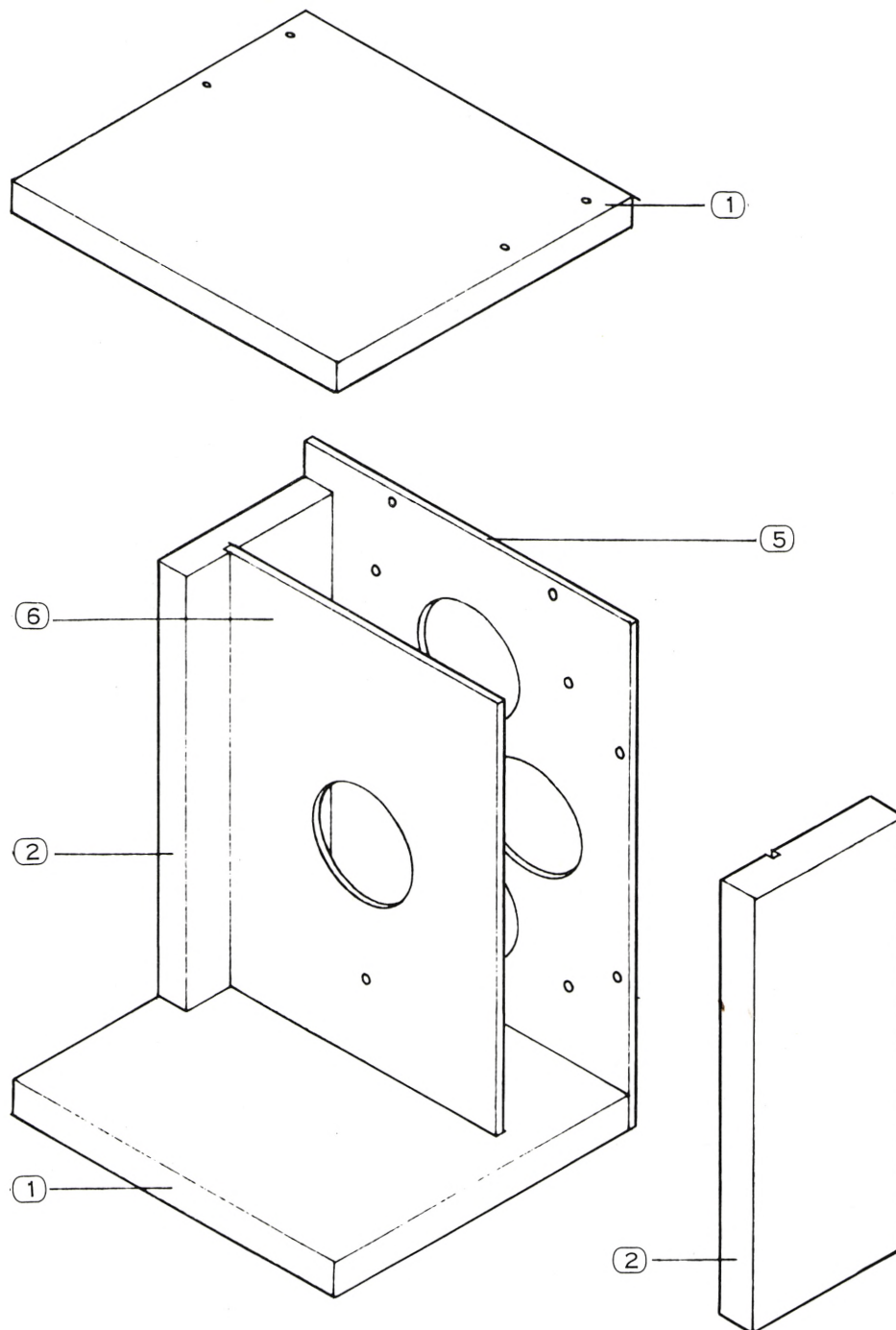
Circuit Board, Part 10

P. A. System



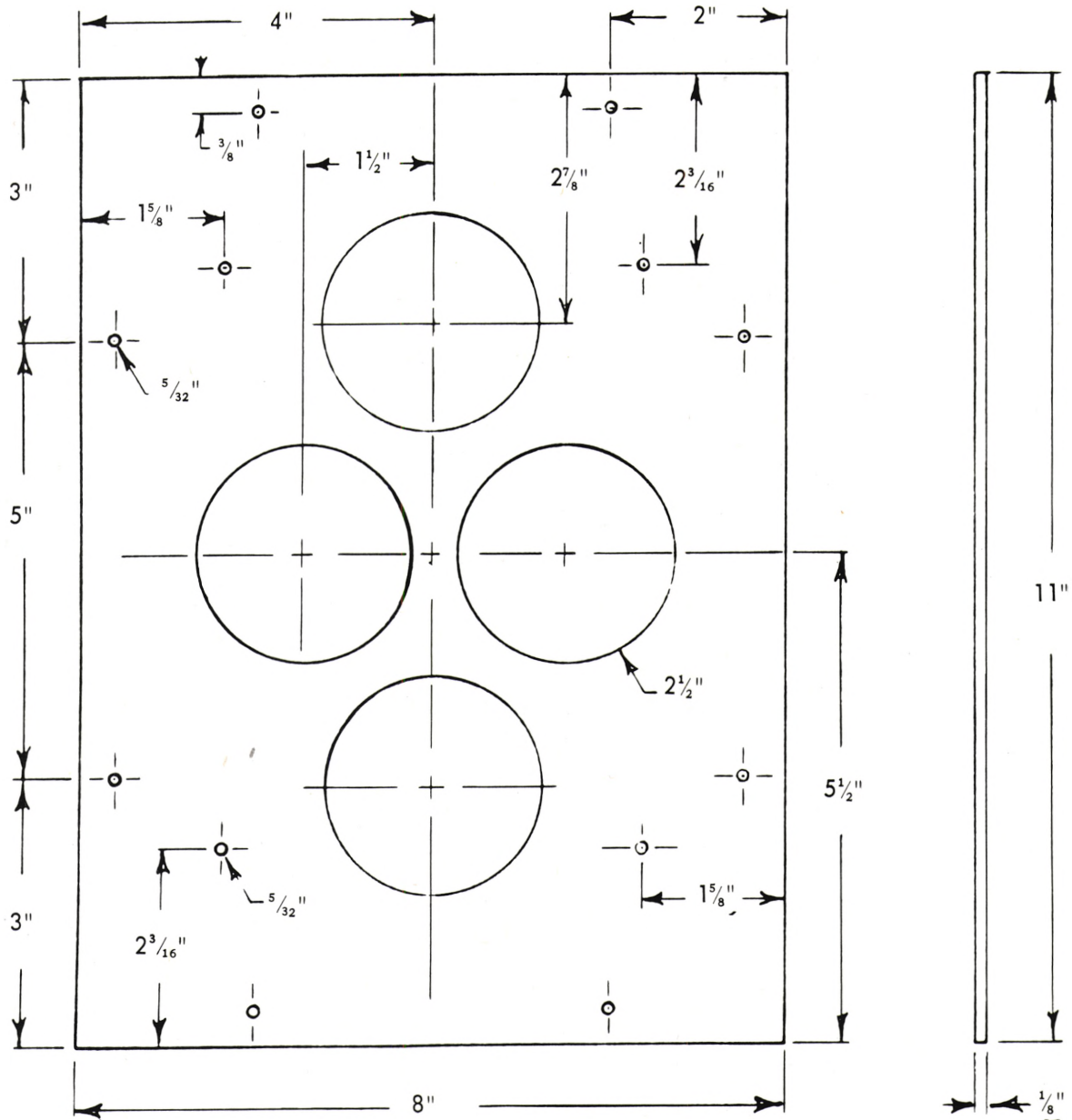
Amplifier Case

P. A. System

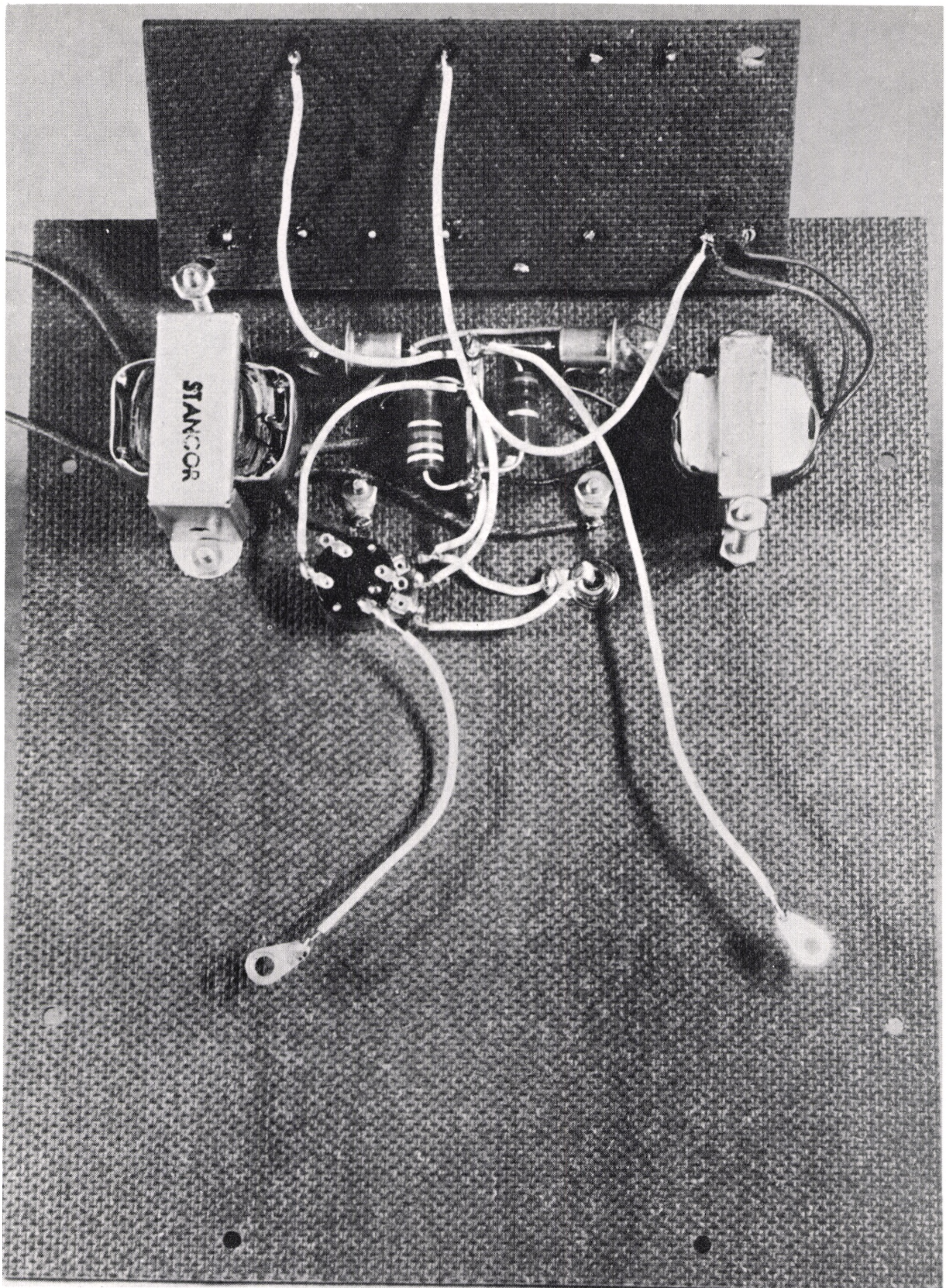


Speaker Case

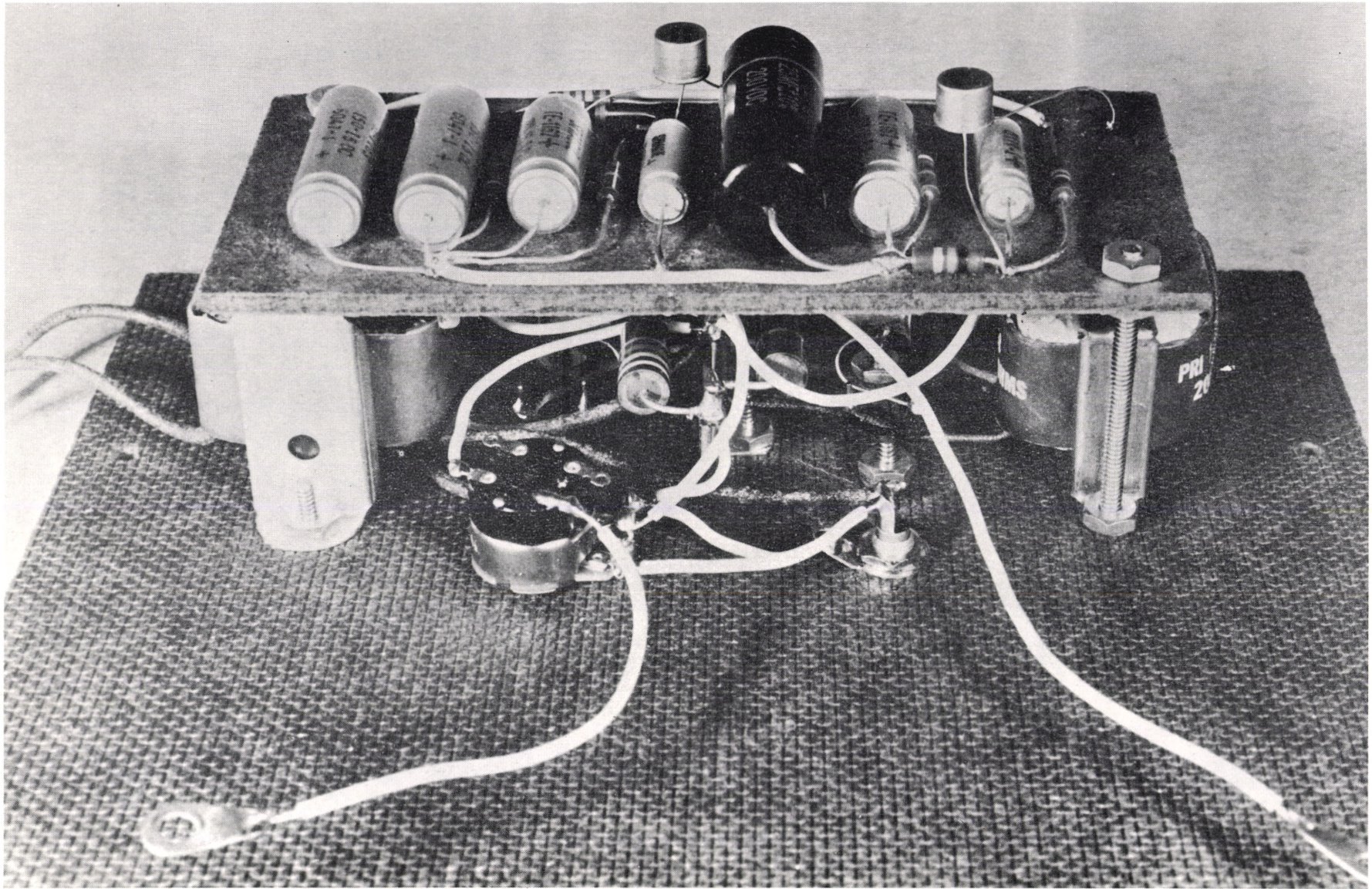
P. A. System



Speaker Front, Part 5

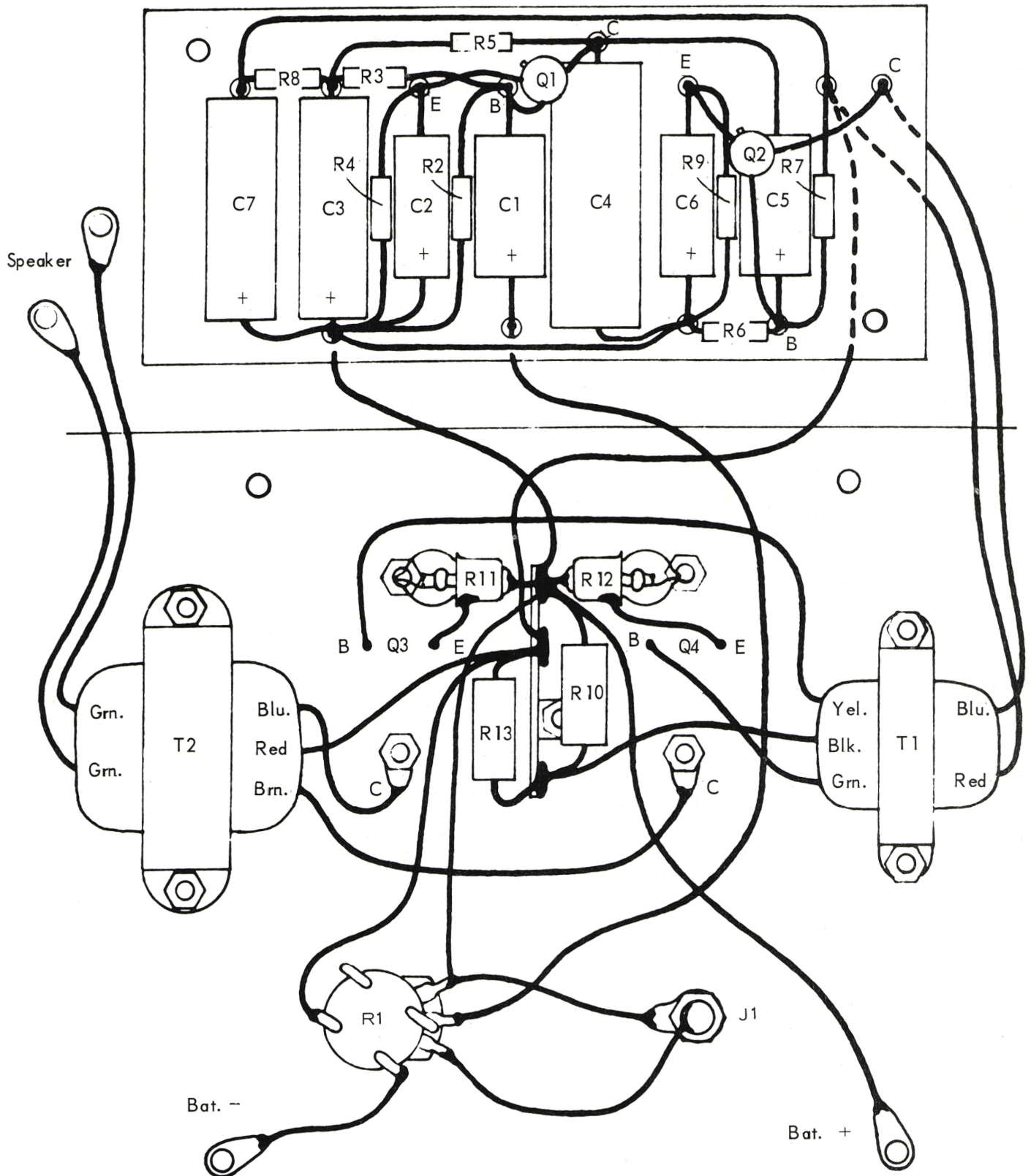


Amplifier Panel Parts Placement and Wiring (Part 7)



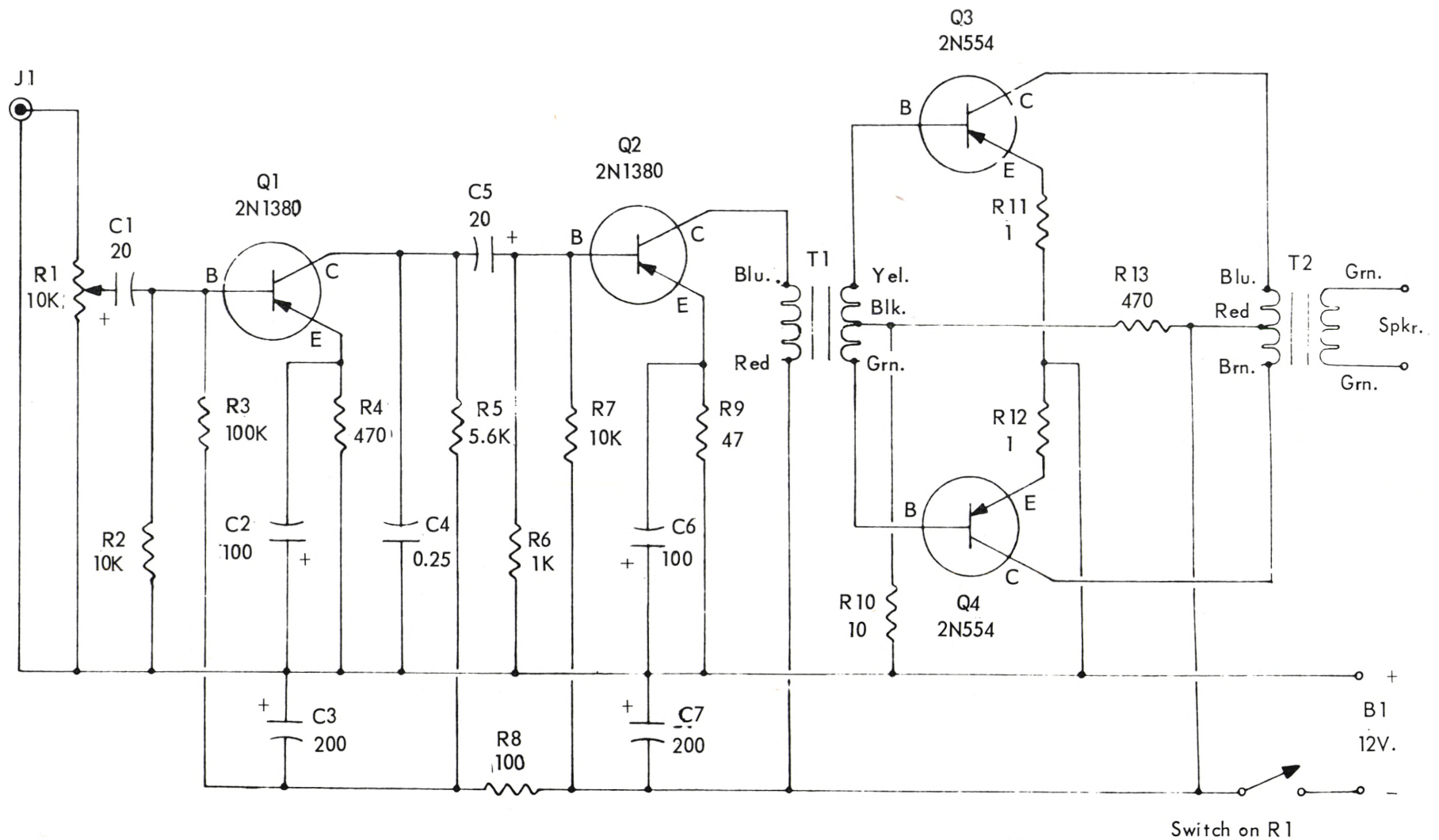
Circuit Board Mounting and Wiring (Part 7)

P. A. System



Amplifier (Pictorial)

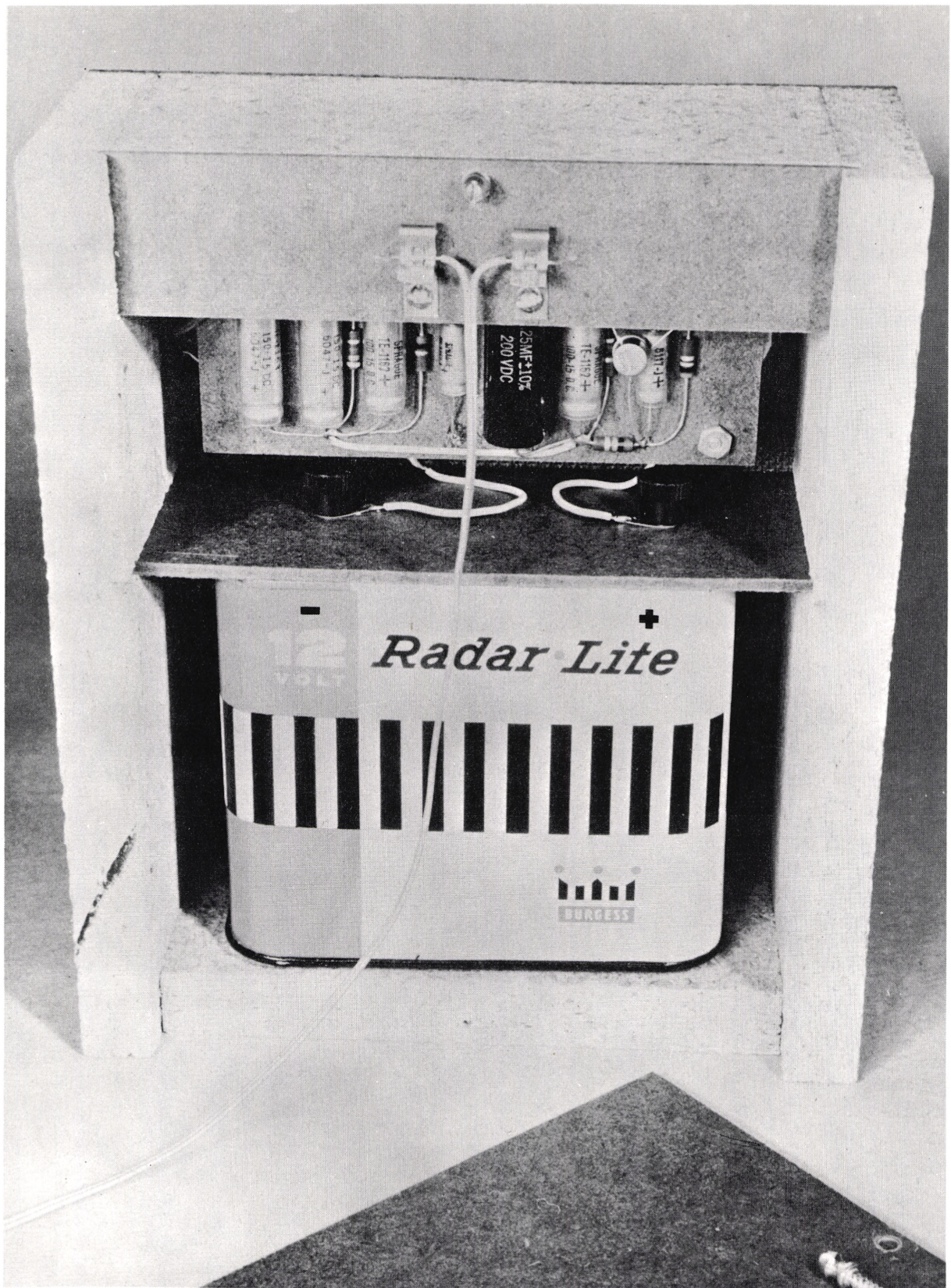
P. A. System



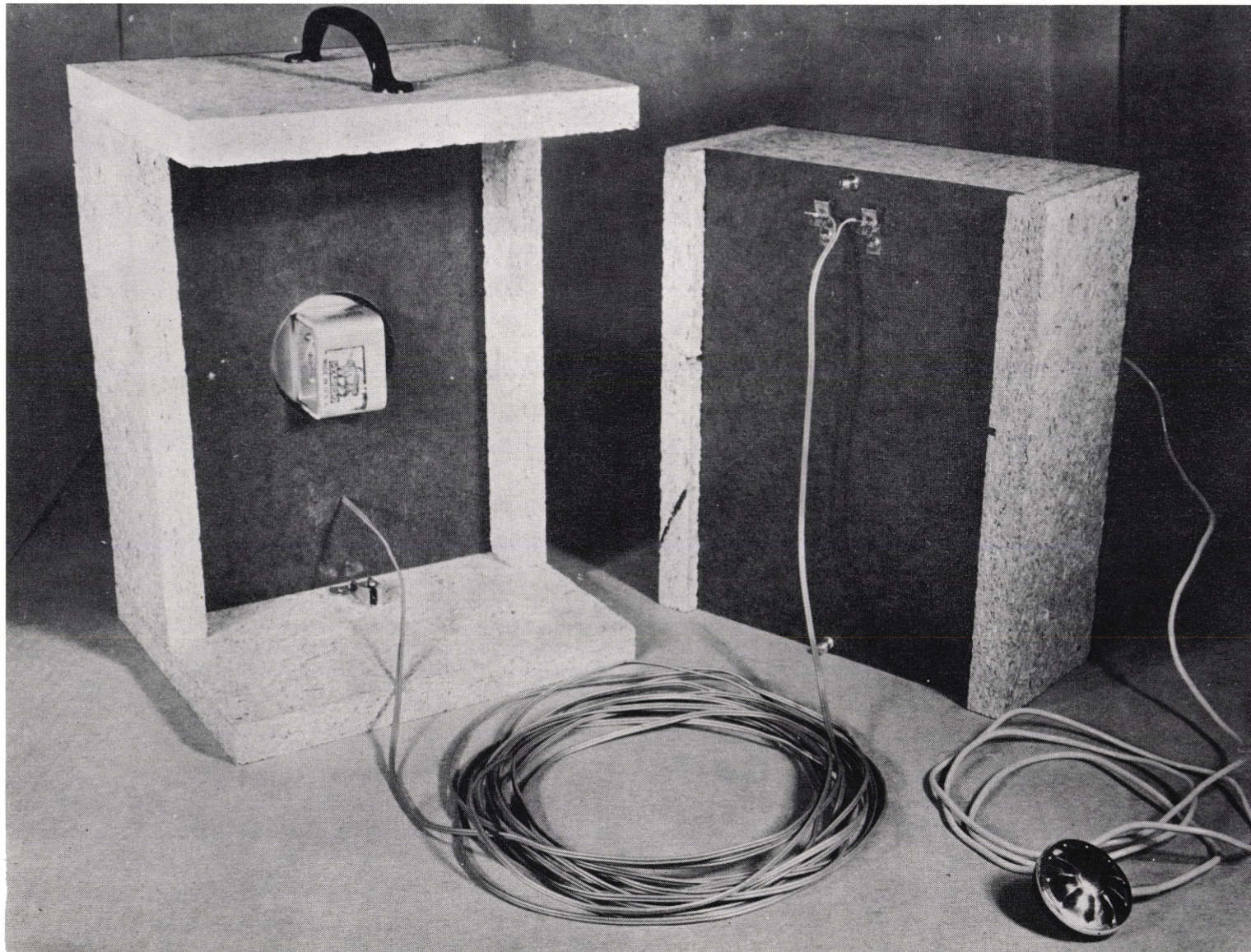
C in mfd

R in ohms (K = 1000)

Amplifier (Schematic)



Battery Placement in Amplifier Unit



Back View of Speaker Enclosure and Amplifier Unit

