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TM 11-435

WAR DEPARTMENT TECHNICAL MANUAL

U.S. Dept. of Army



PUBLIC ADDRESS EQUIPMENT PA-4-C

WAR DEPARTMENT • 31 JANUARY 1944

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WAR DEPARTMENT,

WASHINGTON, 25, D. C., 31 January 1944

TM 11-435, Public Address Equipment PA-4-C is published for the information and guidance of all concerned.

[A.G. 3]00.7 (13 Dec. 43).]

BY ORDER OF THE SECRETARY OF WAR:

G. C. MARSHALL,
Chief of Staff.

OFFICIAL:

J. A. ULIO,
Major General,
The Adjutant General

DISTRIBUTION: X

(For explanation of symbols see FM 21-6.)

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DESTRUCTION NOTICE

WHY —To prevent the enemy from using or salvaging this equipment for his benefit.

WHEN—When ordered by your commander.

HOW —1. Smash—Use sledges, axes, handaxes, pickaxes, hammers, crowbars, heavy tools, etc.

2. Cut—Use axes, handaxes, machete, etc.

3. Burn—Use gasoline, kerosene, oil, flamethrowers, incendiary grenades, etc.

4. Explosives—Use fire arms, grenades, TNT, etc.

5. Disposal—Bury in slit trenches, foxholes, other holes. Throw in streams. Scatter.

USE ANYTHING IMMEDIATELY AVAILABLE FOR DESTRUCTION OF THIS EQUIPMENT.

WHAT —1. Smash—Tubes, amplifier, loudspeaker, microphone, batteries and case.

2. Cut—Cords and shoulder harness.

3. Bend and/or Break—Tripod.

4. Burn—Instruction books, shoulder harness and wire.

5. Bury or scatter—Any or all of the above pieces after breaking.

DESTROY EVERYTHING

SAFETY NOTICE

Plate potential of 135 volts is available in Public Address Equipment PA-4-C. Be careful, when installing "B" batteries, or adjusting or repairing this equipment, to avoid shocks which are always unpleasant and can be dangerous.

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Section I
Description

1. GENERAL Public Address Equipment PA-4-C is a light-weight, portable public address system, to be used for the purpose of speech amplification in limited areas for mobile or stationary use. It has an undistorted output of two watts.

2. COMPONENTS

a. The components that make up Public Address Equipment PA-4-C are:

Item	*Quantity*	*Article*	*Dimensions in inches*	*Weight in lbs.*
*1	1	Amplifier BC-641-C	8⅞x8¼x3 3/16 Overall dimensions	7.0
*2	12	Battery BA-30; 4 installed; 8 spare		
*3	4	Battery BA-51 for Amplifier BC-641-C; 2 installed, 2 spare		
*4	2 Sets	Tubes, vacuum; complete, for Amplifier BC-641-C 1 Set (consisting of 1—1H4G and 1—1J6G) installed; 1 Set spare		
5	1	Case CS-91-C	19¾x10¾x8¾	11.0
6	2	Technical Manual for Public Address Equipment PA-4-C		
*7	1	Loudspeaker LS-6-C	14½ long; 10⅝ bell	6.0
*8	1	Microphone T-36-C		.5
*9	1	Shoulder Harness ST-39		.75
*10	1	Tripod M-230-C	15 long (extended 53½)	1.75

*NOTE: Items 1, 2, 3, 4, 7 and 9 assembled, form a portable public address equipment.
Items 1, 2, 3, 4, 7, 8 and 10 assembled, form a public address equipment for classroom or assembly room use, using Tripod M-230-C for Loudspeaker LS-6-C and Microphone T-36-C. Either one or both microphones may be operated at the same time.

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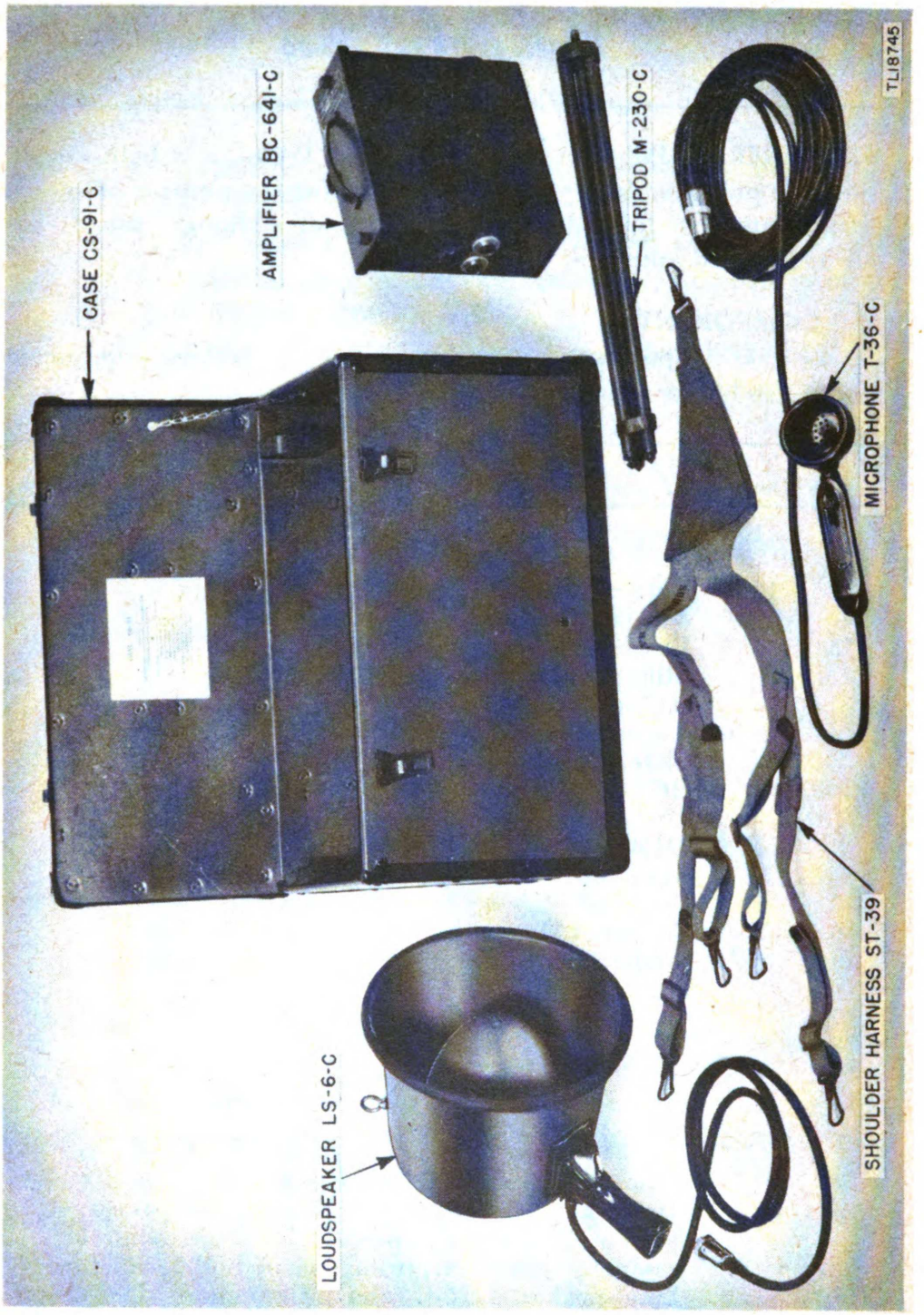


Figure 1. Public Address Equipment PA-4-C, components

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b. Amplifier BC-641-C.

(1) Amplifier BC-641-C is a two tube amplifier employing a type 1H4G tube as a preamplifier for the microphone and also to drive the type 1J6G tube which is used as a push-pull, class B power-output stage. It uses a filament supply of 2 to 3 volts and a plate supply of 100 to 135 volts. Output impedance is approximately 3.5 ohms, and the input impedance is approximately 250 ohms for carbon microphone operation.

(2) The amplifier is set at fixed minimum gain, which is sufficiently low to prevent microphone feedback by means of a 2,500 ohm resistor (27) across terminals 8 and 5 of the first stage (see fig. 8). Adjust the volume control on the outside of the case to increase amplifier gain.

(3) No capacitors are used in this circuit. The microphone coupling resistor and the volume control are the only resistors used.

(4) The amplifier employs one tube type 1H4G and one tube type 1J6G.

(5) The volume control can be turned to full volume when using Microphone T-36-C with the amplifier and speaker as shown in (figs. 4 and 5.)

c. Loudspeaker LS-6-C.

Loudspeaker LS-6-C is a combination unit consisting of exponential reflex baffle, permanent magnet dynamic loudspeaker unit, carbon type microphone unit, pistol handle with trigger switch and necessary cable with connector attached. The dynamic loudspeaker unit is of the permanent-magnet moving coil type. The microphone is a waterproof, carbon granule type of special construction. Loudspeaker LS-6-C is operated by pressing the trigger switch (55) and speaking into the microphone (61). The switch (55) is non-locking and the system is inoperative when the switch trigger is released (fig. 3).
A six-foot 4-conductor cord with connector (58) is attached to the handle of Loudspeaker LS-6-C for connecting this unit to Amplifier BC-641-C.

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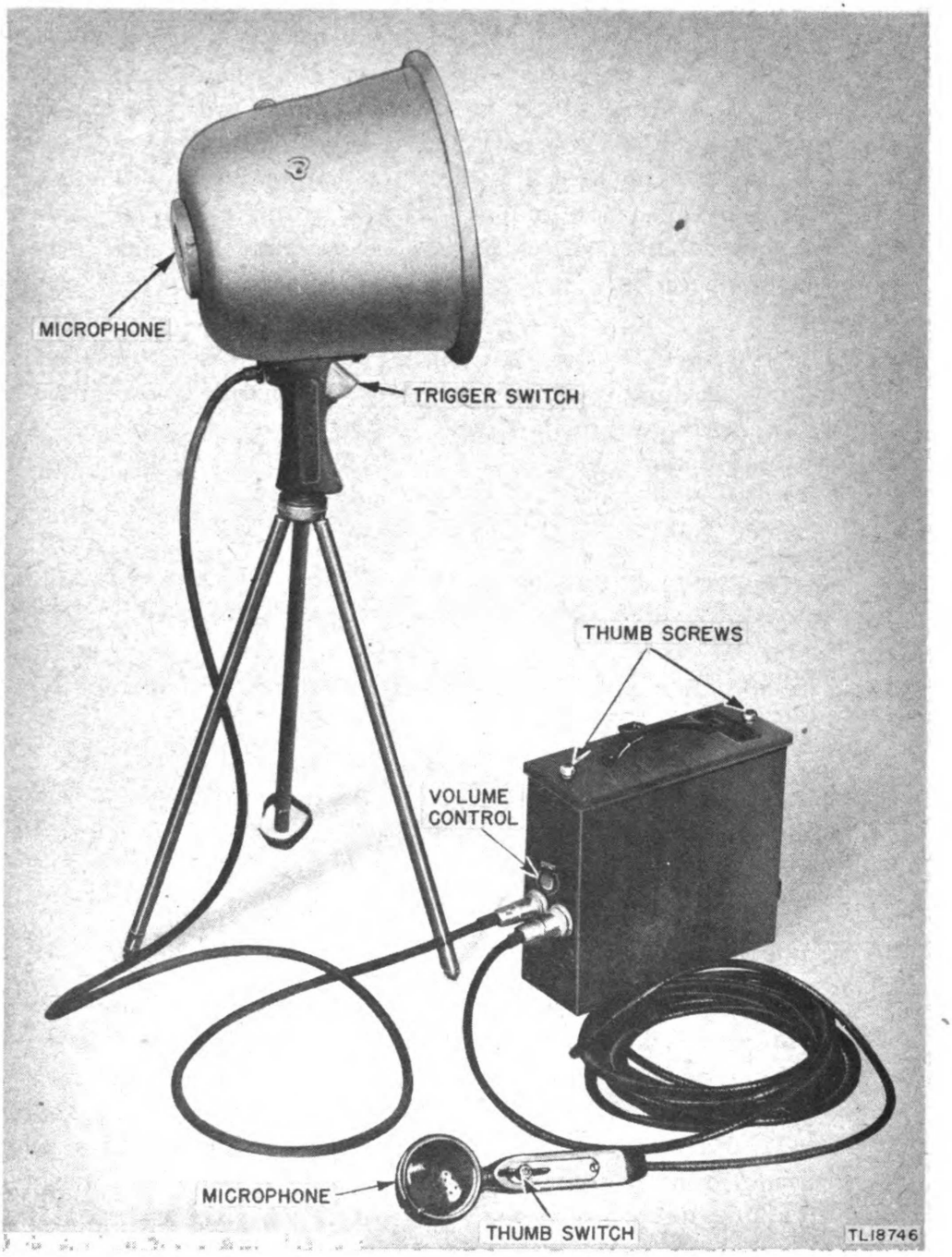


Figure 2. Public Address Equipment PA-4-C, assembled with Tripod M-230 and Microphone T-36-C

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d. Microphone T-36-C.

Microphone T-36-C consists of a carbon type microphone unit (same as used in Loudspeaker LS-6-C) assembled in a hand housing fitted with a thumb operated switch (86) (figs. 2 and 4). The operation of Microphone T-36-C is accomplished by moving the switch arm to either the left or the right with the thumb. The system is non-operative when this switch is released. A 24-foot 3-conductor cord with connector (89) is attached to the handle of Microphone T-36-C for connecting this unit to Amplifier BC-641-C.

e. Shoulder Harness ST-39.

Shoulder Harness ST-39 is made of web and duck and can be adjusted to fit the wearer.

The harness is used as shown in Figures 3 and 5 with Amplifier BC-641-C slung on the back of the user and Loudspeaker LS-6-C slung for easy carrying.

f. Tripod M-230-C.

Tripod M-230-C is of the telescope type and can be used at a height of fifteen and ⅞ inches or extended to fifty-three inches.

This tripod is used as a mounting for Loudspeaker LS-6-C by screwing the tripod into the drilled and tapped hole at the bottom of the handle on Loudspeaker LS-6-C (figs. 2 and 4).

Section II
Installation and Operation

3. PREPARATION FOR USE

a. Amplifier BC-641-C is shipped with tubes but less "B" batteries and "A" batteries. The "A" battery component consists of four Batteries BA-30 (flashlight cells). The "B" battery component consists of two Batteries BA-51. Tubes are installed in Amplifier BC-641-C when issued; "A" and "B" batteries are issued separately.

b. To install Batteries:

(1) Remove the cover from Amplifier BC-641-C by unscrewing the two knurled thumb screws, (it is not necessary to remove the knurled thumb screws entirely). (See fig. 2.)

(2) Insert four Batteries BA-30 in the "A" battery compartment as shown in figure 6.

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Figure 3. Public Address Equipment PA-4-C, in use as portable equipment

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(3) Install two Batteries BA-51 using the connectors (see fig. 6). These connectors are of the polarized type and installation cannot be made incorrectly.
(4) Place the two Batteries BA-51 with connectors attached, on top of the "A" battery compartment.
(5) Place the cover over the amplifier case using the knurled thumb screws to fasten it securely.
(6) Attach connector on the end of the cable of Loudspeaker LS-6-C to the socket on the case of Amplifier BC-641-C (fig. 2) fastening the plug securely with the locking nut on connector.
(7) Shoulder Harness ST-39 is worn as in figures 3 and 5, and is used to carry Amplifier BC-641-C and Loudspeaker LS-6-C.

4. OPERATION

a. Operation is instantaneous. Press the trigger switch (55) (see fig. 2) on the handle of Loudspeaker LS-6-C, and speak into the microphone (61) mounted on the back of Loudspeaker LS-6-C. Best results will be obtained by speaking close to the microphone.

b. To operate Microphone T-36-C attach the connector (see fig. 2) of Microphone T-36-C to the socket on the case of Amplifier BC-641-C. Operation of Microphone T-36-C is instantaneous upon throwing the thumb switch. Both microphones can be used at the same time, or either of them can be used alone.

c. For stationary use, Tripod M-230-C can be attached to Loudspeaker LS-6-C by screwing the tripod into the threaded hole at the bottom of the handle of Loudspeaker LS-6-C. Extend the telescopic leg sections to elevate the loudspeaker. It is generally better to use Microphone T-36-C when the loudspeaker is on tripod.

Section III
Functioning of Parts

5. GENERAL

a. Sound waves created by the voice of the operator strike the diaphragm of Microphone T-36-C (87) or the microphone (61) located on Loudspeaker LS-6-C (fig. 8). The vibration of the diaphragm actuates the carbon granules in the button causing its resistance to fluctuate. A fixed voltage of approximately 3 volts d-c is impressed upon this carbon button through the primary of the input transformer (24). The vibrations from the voice thus create

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Figure 4. Public Address Equipment PA-4-C, showing Microphone T-36-C in use (auditorium)

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a fluctuating direct current in the primary of the input transformer (24). The primary has an impedance of 100 ohms and is correctly designed to match the input impedance.

b. The fluctuating current induces a stepped up a-c voltage in the secondary of the input transformer. The secondary impedance of this transformer is 58,500 ohms and is designed to match the grid impedance of the 1H4G tube. The signal voltage generated is then impressed on the grid (5) of the 1H4G tube.

c. The amount of signal voltage impressed on the grid of this tube is governed by the 2,500 ohms fixed resistor (27) and the 25,000-ohm volume control resistor (36). Rotating this control in a clockwise direction (to the right) increases the power. Rotating the control in a counter-clockwise direction (to the left) decreases the output.

d. The signal voltage impressed on the grid (5) of the 1H4G tube is amplified through the tube and this amplified signal voltage is impressed on the primary of the driver transformer (25). The primary impedance of this transformer is 2,000 ohms and matches the plate impedance of the 1H4G tube.

e. This voltage is transferred by induction to the push-pull secondary of the driver transformer (25). The secondary impedance is 1,750 ohms each side of center tap to correctly match the grid impedance of the 1J6G tube. This voltage is impressed on the two grids (4-5) of the 1J6G (double triode type) tube. The voltage is again amplified in this tube (3-6) and transferred to the push-pull primary of the output transformer (26). The impedance of this primary is 10,000 ohms, plate to plate, to match the plate impedance of the two sections of the tube.

f. This primary voltage is induced into the secondary of the transformer and then impressed (through connectors 32 and 58) across the voice coil of the permanent magnet speaker mounted in Loudspeaker LS-6-C. The output impedance of output transformer (26) is 3½ ohms to correctly match the impedance of the voice coil.

g. The two Batteries BA-51 (67½ volts) connected in series (135 volts) provide the plate voltage for the proper operation of the amplifier. The four Batteries BA-30 (1½ volt flashlight cell) connected in series—parallel (3 volts) provide the proper filament

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Figure 5. Public Address Equipment PA-4-C, showing Microphone T-36-C in use (field)

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voltage for the 1H4G tube and the 1J6G tube and the current to actuate the carbon microphones. The negative side of both battery supplies is wired through connectors (32 and 58) to trigger switch (55) located on handle of Loudspeaker LS-6-C and through connectors (31 and 89) to thumb switch (86) mounted on Microphone T-36-C. Depressing either or both of these two switches completes the negative circuit thereby placing the amplifier in operation.

Section IV
Maintenance

6. GENERAL

a. Test the equipment after each use, by checking both microphones with the loudspeaker connected to Amplifier BC-641-C.

b. Disassemble the equipment and replace it in Case CS-91-C.

c. Batteries should be removed when the equipment will not be used for five days or more.

7. TO REMOVE THE AMPLIFIER CHASSIS

a. Remove the cover.

b. Unfasten "B" battery terminals and remove batteries.

c. Unscrew the four corner screws of the internal dividing plate. The complete chassis with "A" battery compartment can then be removed as a complete unit (fig. 6).

8. TESTS

If equipment does not operate satisfactorily, make the following tests and replace defective parts.

a. Test the "A" Batteries with Microphone T-36-C and Loudspeaker LS-6-C connected and the switch (55) closed. The terminal voltage reading should be 1.8 volts minimum (3 volts normal).

b. Test the "B" Batteries with the microphone and loudspeaker connected, with switches closed. The terminal voltage reading should be 100 volts minimum (135 volts normal).

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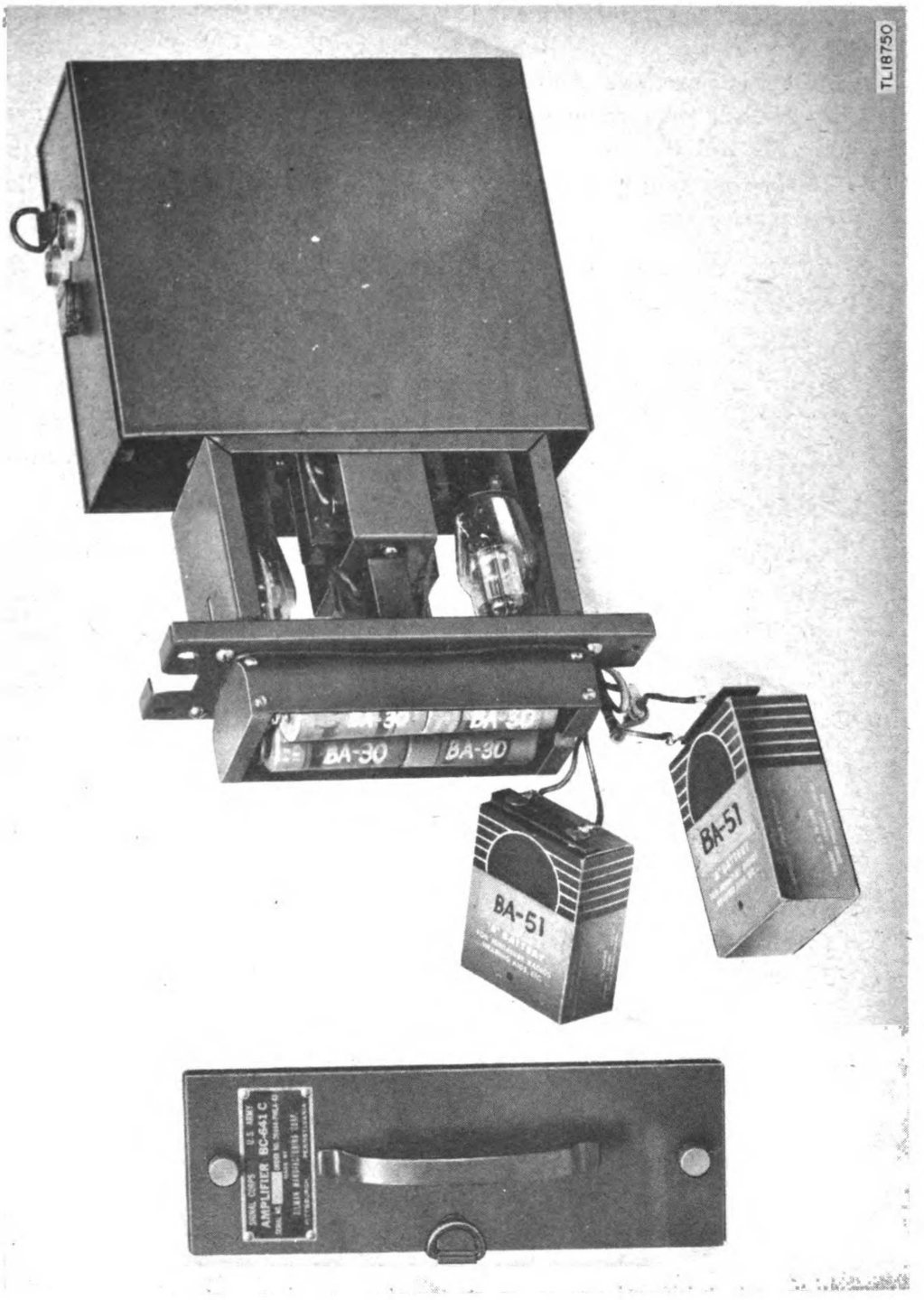


Figure 6. Amplifier BC-641-C, showing chassis and method of connecting Batteries

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c. Check the tubes in accordance with the instructions accompanying Test Set I-56-( ) to determine the tube efficiency. Replace poor tubes.

d. To test Amplifier BC-641-C, put a resistance of 30 ohms across the input and a 1-watt 4-ohm resistor across the output. Apply 1,000 c.p.s. at 0.18 volts across the input and measure the output across the 4-ohm load. The output should be at least 1.0 volts with the volume control turned all the way to the right (clockwise).

e. Test the voice coil of Loudspeaker LS-6-C for an open circuit.

f. Test the switch (55) and connections of Loudspeaker LS-6-C.

g. Test the terminals of the connector (58).

h. Test the terminal of the microphone (61) and check the resistance of the buttons (250 ohms normal).

i. Test Microphone T-36-C (see *f*, *g* and *h* above).

j. Test all cables for open, or short circuits.

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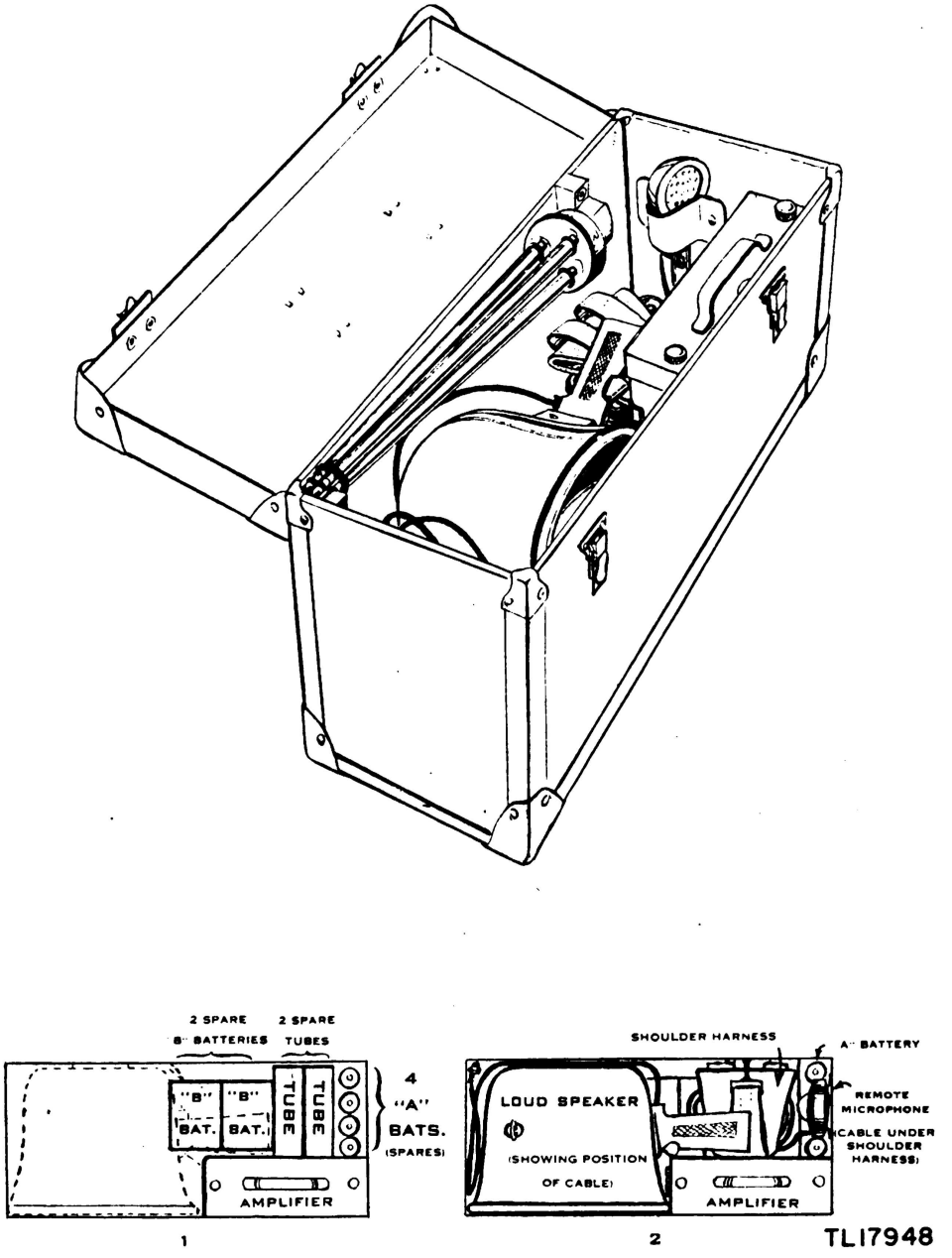


Figure 7. Public Address Equipment PA-4-C in Case CS-91-C

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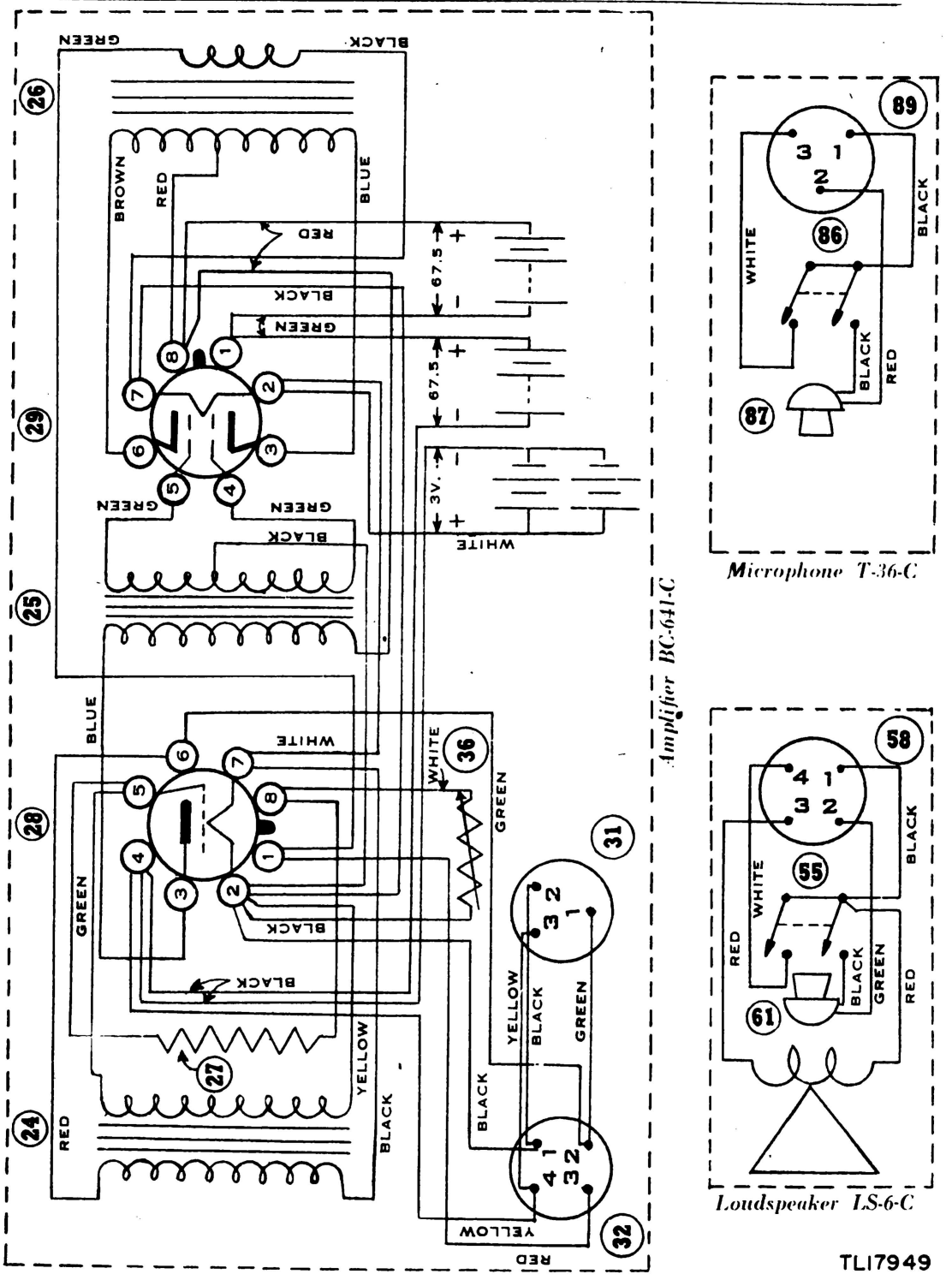


Figure 8. Public Address Equipment PA-4-C, schematic diagram

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Section V. Supplementary Data

9. TABLE OF REPLACEABLE PARTS.

NOTE: Order parts by Signal Corps Stock No., name and description.

a. Amplifier BC-641-C. Stock No. 2C241C.

Ref. Symbol	*Total Quantity In Equip.*	*Signal C. Stock No.*	*Name of Part and Description*	*Function*	*Mfr's Code*	*Contr's Dwg. or Part No.*
10	1		Case for amplifier BC-641-C	Housing for amplifier	A	A1509
11	1		Cover for amplifier case	Lid for 10	A	A1509
12	#2	2C241C/S1	Screw, knurled top	Secure lid to case (10)	A	1508
13	1		Dividing Plate	Separate amp. and batts.	A	A1508
14	1		Chassis U frame	Amplifier chassis	A	A1508
15	1		Pad, rubber	Insulates batteries	A	
16	#1	2C241C/C2	Compartment	Holds "A" batteries	A	*ES-D-9223-A
17	2		Side plate, laminated	(+) Section of 16	A	*ES-D-9223-A
18	1		Side plate, laminated	(—) Section of 16	A	*ES-D-9223-A
19	2		Spring, contact, coiled	(—) Contact of 16	A	*ES-D-9223-A
20	1		Retainer plate, nickel-silver	To hold 19	A	*ES-D-9223-A
21	2		Stud, contact, nickel-silver	(+) Contact for 17	A	*ES-D-9223-A
22	1		Plate, bottom of compartment	Bottom of 16	A	*ES-D-9223-A
23	#2	2C241C/C5	Connector, 2 contact, flat fiber	"B" battery connector	A	
24	#1	2Z9969	Transformer, 250 ohms to grid, input	Input stage of amp.	A	A7903
25	#1	2Z9969-1	Transformer, driver, 2000 to 3500 ohms	Driver stage of amp.	A	A6236
26	#1	2Z9969-2	Transformer, output, 10000 to 3½ ohms CT	Output stage of amp.	A	A6235
27	#1	3Z6250-30	Resistor, fixed, 2500 ohms, ½ watt composition	Microphone coupling	C	*SC-D-970
28	1		Tube, Type 1H4G	Input tube	G	
29	1		Tube, Type 1J6G	Output tube	G	
30	#2	2Z8795-12	Socket, 8 prong, type MIP-8	For 28 and 29	B	
31	#1	2Z8799-33	Connector, 3 contact female	Connector for T-36-C	A	
32	#1	2Z8799-220	Connector, 4 contact female	Connector for LS-6-C	A	
33	1		Clamp, steel	Fasten to 10	A	
34	1		Clamp, steel	Fasten to 14	A	
35	#1	2C241C/G1	Grommet, ½" hole	Insulator for 14	A	
36	#1	2Z7262-25M2	Resistor, variable, 25000 ohms Composition, LM type	Microphone control	C	

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9. TABLE OF REPLACEABLE PARTS—Continued

Ref. Symbol	*Total Quantity In Equip.*	*Signal C. Stock No.*	*Name of Part and Description*	*Function*	*Mfr's Code*	*Contr's Dwg. or Part No.*
37	1		Cover, steel	To cover 36	A	
38	1		Base, steel	Bottom of 37	A	
39	1		Pin, steel	To connect 37 and 38	A	
40	1		Spring, steel coiled	For 39	A	
41	#1	6Z4049	Gasket, rubber, ⅝" diam.	Insulator for 37	A	
42	2		Gasket, rubber, 1⅛" diam.	Insulator for 31 and 32	A	
43	2		Gasket, thiokol, ½" diam.	Insulator for 12 lid screws	A	

b. Loudspeaker LS-6-C. Stock No. 6C46C.

50	1		Horn, steel	Projector	A	1506
51	1		Baffle, steel	Mounting for 53	A	1504
52	1		Cone, steel	Housing for 53	A	1504
53	1		Speaker assembly unit	Loudspeaker unit	A	
54	1		Handle, bakelite	Attached to 50	A	A1505
55	#1	6C46C/S4	Switch, trigger type, D.P.S.T.	To operate LS-6-C	D	80605
56	1		Strap, steel	Attached to 54 and 55	A	
57	#6 ft.	3E2146	Cordage, 4 conductor, type CO-146	Attached to 54	E	CO-146
58	#1	2Z3096.1	Connector, 4 contact male	Attached to 57	A	
59	1		Clamp, steel	Attached to 54	A	
60	1		Plate, steel	Reenforce 54 mounting	A	
61	#1	6C46C/M1	Transmitter, carbon, single button	Voice operation	F	9811-AS
62	1		Screen, bakelite	Cover for 61	F	9188-AS
63	1		Housing, steel	Housing for 61	A	
64	1		Cover, steel	Cover for 63	A	
65	#1	6C46C/P1	Pad, sponge rubber, 1⅝" diam.	Insulator for 61	A	
66	#1	6C46C/R1	Cushion, sponge rubber, 3⅛" diam.	Insulator for 61	A	
67	#1	6C46C/R2	Ring, sponge rubber, 3⅛" diam.	Insulator for 61	A	
68	#7	6C46C/G1	Grommet, ⅜" hole	Attached to 63	A	
69	1		Lug, terminal	Contact to 61	A	
70	1		Protector, rubber	Attached to 50	A	

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9. TABLE OF REPLACEABLE PARTS—Continued

c. Microphone T-36-C. Stock No. 2B1636C.

Ref. Symbol	*Total Quantity In Equip.*	*Signal C. Stock No.*	*Name of Part and Description*	*Function*	*Mfr's Code*	*Contr's Dwg. or Part No.*
80	1		Handle, bakelite	Handle for T-36-C	F	1516
81	1		Housing, bakelite	Housing for 87	F	1516
82	1		Ring, brass	Lock ring for 87	F	1517
83	1		Lock nut, brass	To lock 80	F	
84	1		Spring, contact, copper	(+) Contact to 87	F	1519
85	1		Spring, contact, copper	(—) Contact to 87	F	1519
86	#1	2B1636A/S2	Switch, thumb type, D.P.S.T.	Operate T-36-C	F	SC-D-1055-M
87	#1	2B1109E/3	Transmitter, carbon type, contact terminals	Voice operation	F	9818A
88	#24 ft.	3E2145	Cordage, 3 conductor type CO-145	Attached to 80	E	CO-145
89	#1	2Z3096	Connector, 3 contact male	Attached to 88	A	
90	1		Screen, bakelite	Cover for 87	F	9188-AS
d. Shoulder Harness ST-39. Stock No. 2Z8539.						SC-D-5685-B
95	4		Buckle, brass	To adjust 39	H	*SC-D-5685-B
96	5		Snap, bronze	Attached to 39	H	*SC-D-5685-B
97	4		End clip, brass	Attached to 39	H	*SC-D-5685-B
e. Tripod M-230-C. Stock No. 6C330B.						
98	1		Strap assembly, leather with fasteners attached	Attached to leg of M-230-C	A	1514
f. Case CS-91-C. Stock No. 6C11C.						SC-D-7945-A

Furnished by the contractor as part of maintenance parts groups.

* Indicates Signal Corps drawing.

10. MANUFACTURERS NAMES AND ADDRESSES.

A. Silman Manufacturing Corporation, Pittsburgh, Pa.
B. American Phenolic Corporation, Chicago, Ill.
C. Stackpole Carbon Company, St. Marys, Pa.
D. Arrow-Hart & Hageman Co., Hartford, Conn.
E. Diamond Wire & Cable Co., Chicago, Ill.
F. Connecticut Tel. & Elec. Co., Meriden, Conn.
G. RCA Manufacturing Co., Camden, N. J.
H. North and Judd Manufacturing Company, New Britain, Conn.

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