

TM 11-344

WAR DEPARTMENT

TECHNICAL MANUAL

8

CONVERTER M-222

March 16, 1943

This Technical Manual published by Silman Manufacturing Corporation on Order No. 30859-Phila-43 is furnished for the information and guidance of all concerned.

DESTRUCTION NOTICE

Should it become necessary to abandon the converter in the combat zone, it should be destroyed by smashing with a hammer or other heavy object.

BOOKS AND PAPERS

Instruction books, circuit and wiring diagrams, records of all kinds for all types of Signal Corps equipment, and code books and registered documents should be destroyed by burning. Each cryptographic security officer will secure a five gallon can of gasoline to be kept within easy reach and reasonable proximity to the storage place of all registered documents. If possible, each document will be separated into individual sheets, each sheet crumpled; and all placed in a pile. The pile may then be saturated with gasoline and ignited; for safety, a lighted match may be thrown from a distance of at least six feet.

SAFETY NOTICE

Operation of this equipment involves the use of high voltages which are dangerous to human life. Operating personnel must at all times observe all safety regulations. Throw switch to OFF before removing cover.

KEEP AWAY FROM LIVE CIRCUITS

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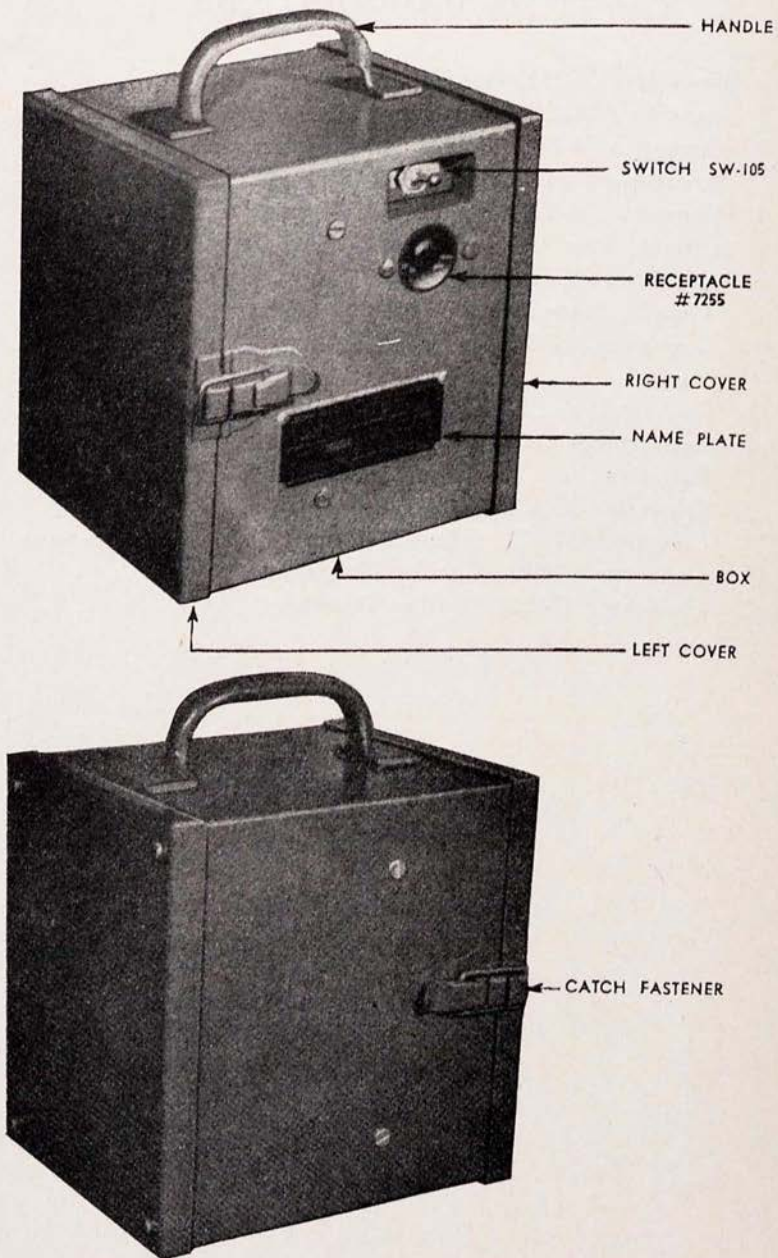


FIG. 1 CONVERTER M-22, OUTSIDE VIEWS

CONVERTER M-222

Prepared under direction
of the Chief Signal Officer

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SECTION I—DESCRIPTION

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1. General.—Converter M-222 is designed to supply emergency ringing current for telephone switchboards from two Signal Corps Batteries BA-23 in series, as a source of power. Converter M-222 is supplied without the batteries, which must be installed as described in paragraph 6, Battery Installation. The output voltage is 100 volts a.c. open circuit; 50 volts a.c. with a 5-watt load. The peak voltage does not exceed 250 volts a.c. The frequency of the output voltage is 24 cycles \pm 4 cycles.

2. Major components with weight and dimensions.—

a. 1 ea. Converter M-222

Height 8 $\frac{1}{4}$ " Max.

Width 6 $\frac{3}{4}$ " Max.

Depth 6 $\frac{5}{8}$ " Max.

Weight of Converter M-222 (without batteries)

11 pounds.

Weight (with batteries installed) 15 $\frac{1}{4}$ pounds.

b. Converter M-222 includes the following major components:

<i>Name</i>	<i>Weight</i>
1 ea. box	2.54 lbs.
1 ea. cover, right8 lbs.
1 ea. cover, left84 lbs.
1 ea. mounting shelf assembly.....	5.12 lbs.
1 ea. vibrator	1.19 lbs.
2 ea. Preliminary Instructions for Converter M-222	

3. Mechanical.—Converter M-222 consists essentially of the following assemblies:—a. *Mounting shelf assembly.*—The mounting shelf assembly consists of a shallow steel shelf with the following components mounted on it. On the top of the mounting shelf assembly are mounted one transformer (T-521A), one 0.25 μ f Capacitor CA-385,

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one 1- μ f Capacitor CA-234, and one vibrator (S-814-V). The vibrator is encased in a metal box and is held in place by two steel clips which are welded to the cover. The vibrator (S-814-V) plugs into a six prong socket (MIP6). A phenolic strip is mounted on the under side of the mounting shelf assembly directly under Capacitor CA-234. The mounting shelf assembly is fastened to the box by means of four No. 6-32 flat top, binding head screws. (See figure 7.)

b. *Box.*—The box (refer to figures 1 and 7) is a rectangular, steel box with two opposite sides removable. On the front is mounted one receptacle (No. 7255), one name plate, the lower section of one catch fastener, and one Switch SW-105. The switch is mounted in a recessed panel. The positions of the switch, ON and OFF are marked on this panel as shown in (figure 1.) A handle is welded to the top of the box, and the lower section of the other catch fastener is mounted on the back of the box. The mounting shelf assembly is fastened to this box in the position shown in (figure 7,) which leaves a space on the left hand side for installing batteries.

c. *Right cover.*—The cover to the right of the name plate, when the operator is facing the converter, is fastened to the box by means of four No. 8-32 round head screws, which fasten into 4 tapped angle brackets welded in the corners of the box. Two steel clips are welded on the back of this cover. When the cover is in place these clips fit over the vibrator and hold it securely in place. The circuit label is attached to the inside of the right cover.

d. *Left cover.*—The left cover has two spring clips mounted on the inside. These hold the batteries in place. The upper sections of the two catch fasteners used to fasten the cover to the box, are mounted on the sides of the left cover.

4. Electrical description.—Converter M-222 consists of two circuits, the input circuit and the output circuit.

a. *Input circuit.*—The input circuit consists of the vibrator, (S-814-V), the tapped transformer primary, the ON-OFF Switch SW-105, and the actuating point Capacitor CA-385. Its operation is as follows: The input current flows through Switch SW-105, the vibrator coil, the vibrator actuating point, the vibrator center reed, and back to the source of supply. (See figure 3.) This starts the vibrator, causing the center reed to make contact with one set of side reeds. The actuating point Capacitor CA-385 quenches the arc formed by the opening of the actuating point. With one set of side reeds closed, current flows through the center tap of the transformer, one-half of the transformer winding, one set of the vibrator side reeds, the vibrator center reed, and back to the source of supply. (See figure 4.) On the other half cycle of the vibrator, an exactly similar circuit is traced through the other half of the transformer and the other set of side

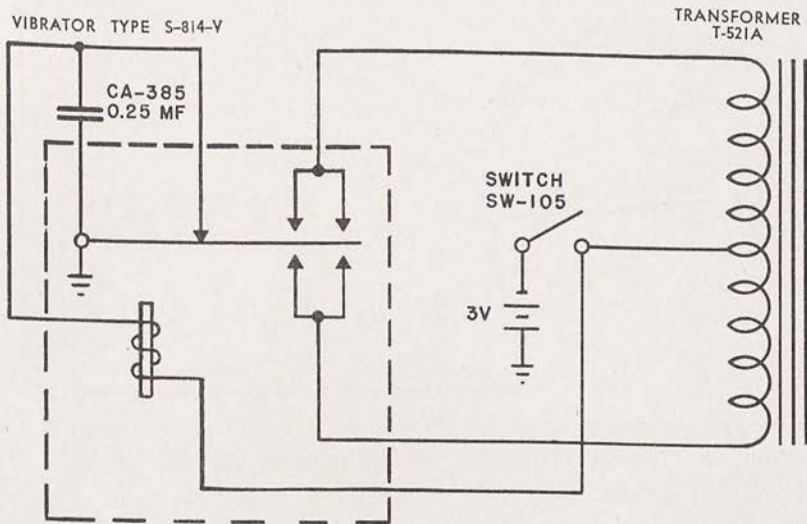


FIG. 2 CONVERTER M-222, FUNCTIONAL DIAGRAM OF INPUT CIRCUIT

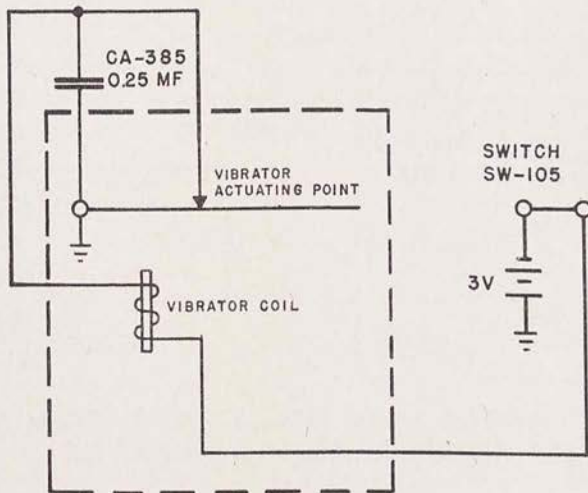


FIG. 3 CONVERTER M-222, FUNCTIONAL DIAGRAM OF VIBRATOR ACTUATING POINT CIRCUIT.

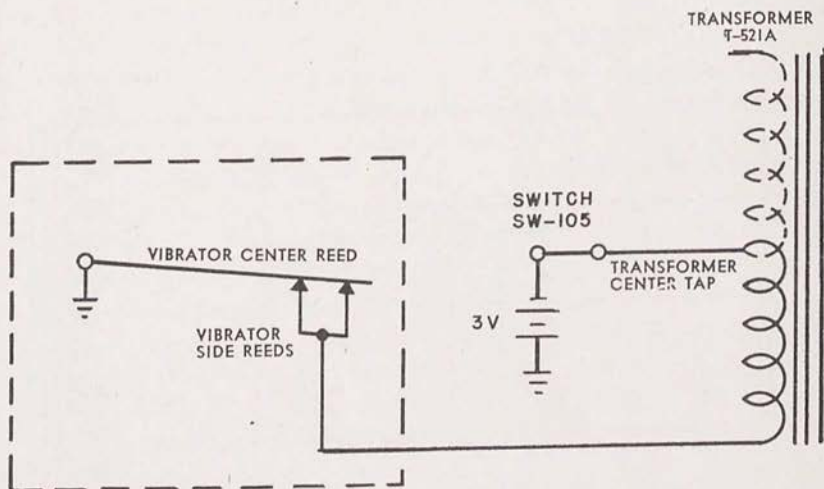


FIG. 4 CONVERTER M-222, FUNCTIONAL DIAGRAM OF VIBRATOR CIRCUIT, FIRST HALF CYCLE

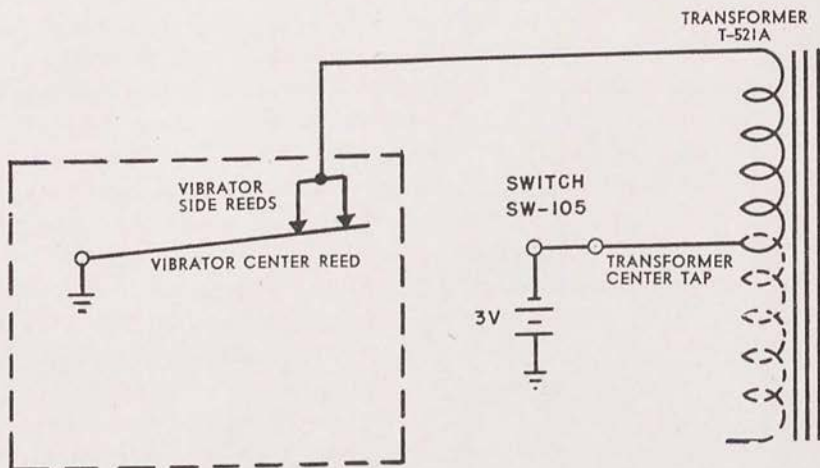


FIG. 5 CONVERTER M-222, FUNCTIONAL DIAGRAM OF VIBRATOR CIRCUIT, SECOND HALF CYCLE

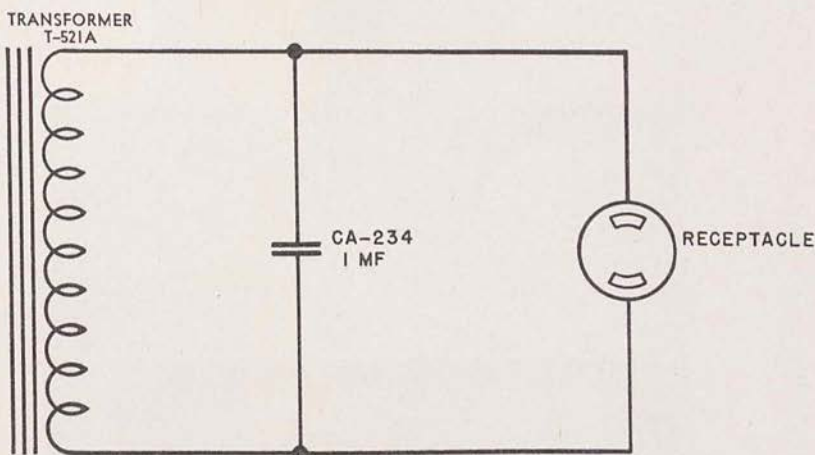


FIG. 6 CONVERTER M-222, FUNCTIONAL DIAGRAM OF OUTPUT CIRCUIT

reeds of the vibrator. (See figure 5.) The reversal of direction of current flow in the primary produces alternating flux in the iron core of the transformer.

b. Output circuit.—The output circuit consists of the transformer secondary, one buffer Capacitor CA-234, and the receptacle (No. 7255). The reversal of direction of flow in the primary produces alternating flux in the transformer core, thus producing alternating current in the secondary. The buffer Capacitor regulates the manner in which the flux decays in the transformer core during the off intervals of the vibrator. The receptacle (No. 7255) is connected across the output of the transformer. (See figure 6.)

SECTION II—INSTALLATION

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5. Unpacking.—Each Converter M-222 is packed in an individual cardboard carton. There are no special precautions while unpacking the converter.

6. Battery installation.—Converter M-222 is supplied without batteries. It requires two each Signal Corps Batteries BA-23 connected

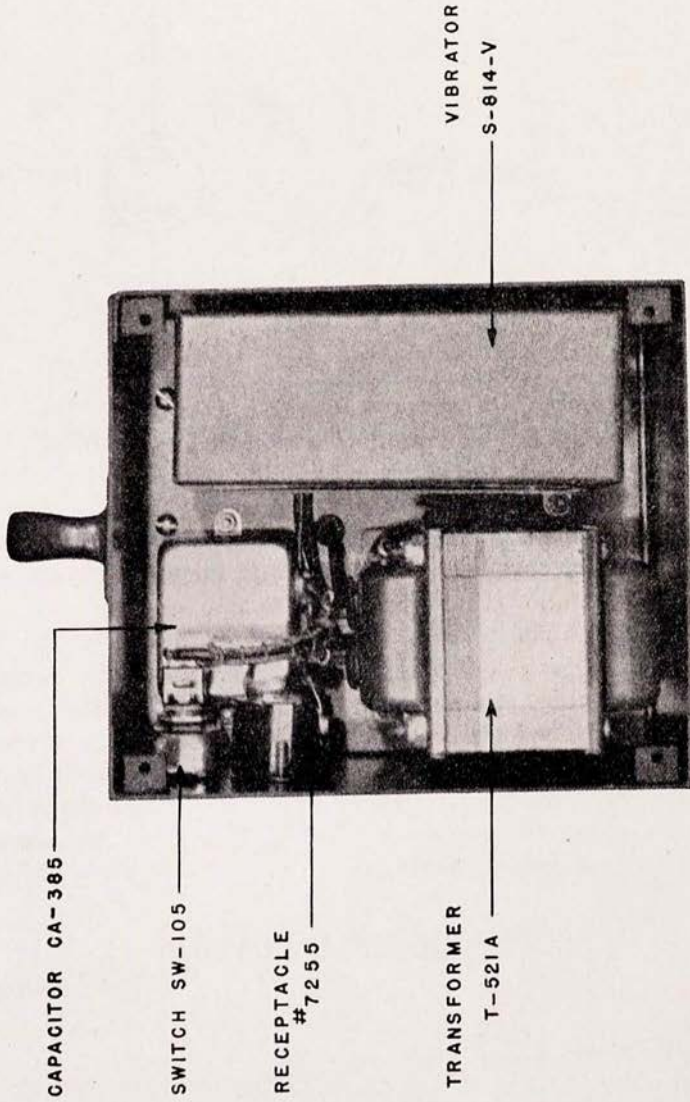


FIG. 7 CONVERTER M-222, INSIDE OF CHASSIS

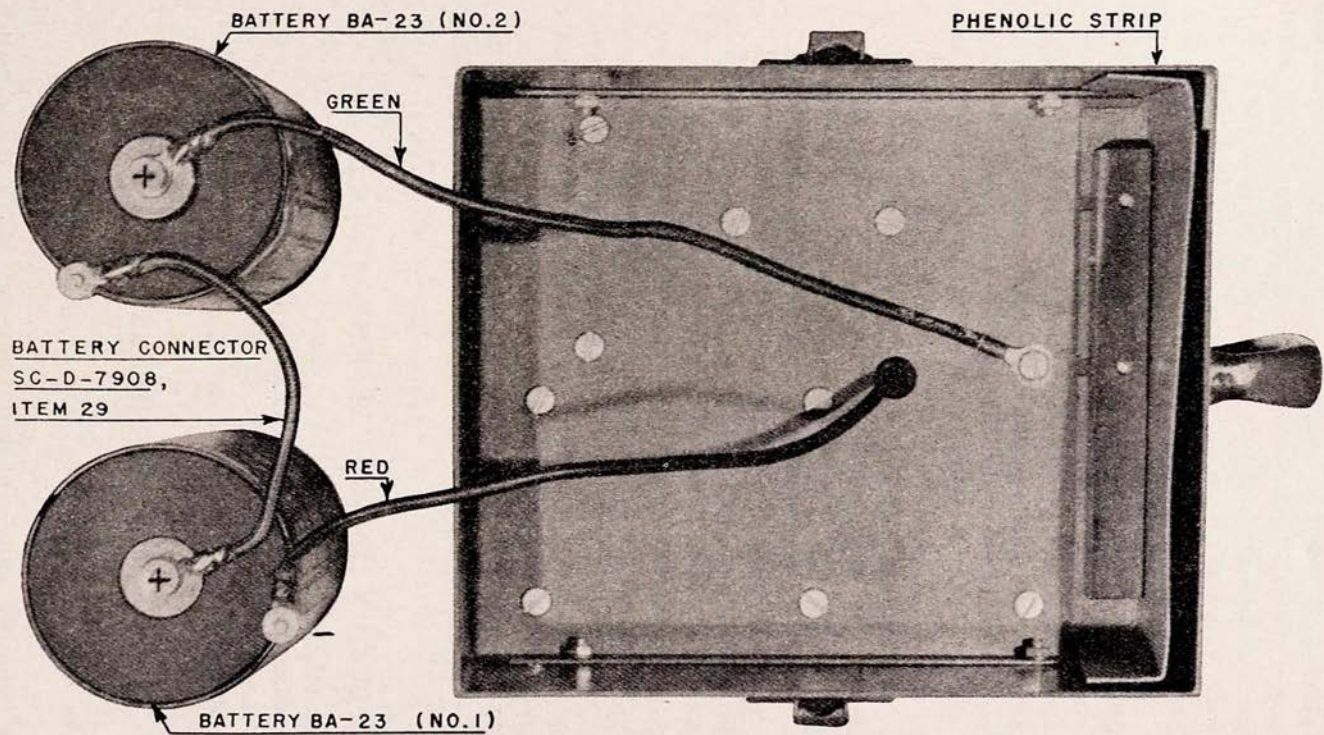


FIG. 8 CONVERTER M-222,
VIEW SHOWING INSTALLATION OF BATTERIES

CONVERTER M-222

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in series. These must be installed as follows. Unfasten the two catch fasteners which hold the left cover to box. Refer to (figures 8 and 11.) To connect the two batteries to Converter M-222, proceed as follows, using a standard dry cell battery connector, 9, which is a piece of green wire 5 inches long with a terminal lug on each end. The battery connector is packed inside the left cover and is fastened to the spring clips. Note the polarity of terminals on the battery. The *outside* terminal is negative. Unscrew the knurled nut on positive terminal (center) on battery No. 1 (as shown in figure 8) and place one connector terminal lug over the screw on the battery terminal. Replace the knurled nut and fasten securely. Connect the other connector terminal lug to the negative (outside) terminal on battery No. 2 (as shown in figure 8) in the same manner. Connect the green wire (which has one end grounded to the chassis) to the positive terminal on battery No. 2. Connect the red wire (which has one end connected to the switch) to the negative terminal on battery No. 1. Place the batteries in the box with the terminals toward the fibre insulator across the top. Push the batteries toward the bottom of the box, so that they fit below the phenolic strip which is mounted in front of the insulator. Replace the cover and fasten catch fasteners. The spring clips mounted on the cover will hold the batteries firmly in place.

7. Mechanical check.—Remove the four No. 8-32 round head steel screws which hold the right cover in place. Remove right cover. Inspect all wires and soldered joints for loose or broken connections. Check vibrator (S-814-V) to make sure it is seated firmly in socket. Replace cover and screws.

8. Electrical installation.—To prepare the converter for operation plug the line leading from the bell-ringing equipment into the receptacle (No. 7255).

SECTION III—PREPARATION FOR USE

9. Precautions.—

- a. Make sure that batteries are installed and connected correctly.
- b. Make sure that batteries are reasonably fresh.

SECTION IV—OPERATION

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Caution	11

10. Operation of unit.—To start Converter M-222 throw Switch SW-105 to ON. To stop Converter M-222 throw Switch SW-105 to OFF.

11. CAUTION.—WHEN CONVERTER IS NOT IN USE, ALWAYS THROW SWITCH TO OFF TO PREVENT BATTERIES FROM BEING DISCHARGED.

SECTION V—MAINTENANCE

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12. Inspection to determine proper operation.—*a.* Throw the switch to ON. Feel the box to determine whether or not Vibrator (S-814-V) is operating. If the vibrator is in operation, there will be a noticeable vibration of the box.

b. Refer to the instructions for operating the bell-ringing equipment. Check the bell-ringing equipment for proper operation.

c. The correct current output of Converter M-222 may be checked by following the instructions outlined in paragraph 15*b.*

13. Replacing parts.—*a.* Remove the four No. 8-32 round head steel screws which hold the right cover in place. Remove the right cover. Refer to (figures 1 and 7.)

(1) *Vibrator.*—Pull the Vibrator (S-814-V) directly away from the mounting shelf until the plugs in the base of the vibrator are disengaged from the socket. Before inserting a new vibrator, note the indexing of the vibrator socket. Place the vibrator into the socket, so that the two large prongs on the vibrator plug fit into the corresponding holes in the socket marked No. 1 and No. 6. Push the vibrator securely into the socket.

(2) *Other components.*—Components other than the vibrator will rarely have to be replaced. Should any components have to be replaced, make sure that all connections are clean and secure. Check the wiring with wiring diagram (figure 11) and schematic diagram (figure 10.) After changing any part, be sure the box, chassis, and wired parts are thoroughly cleaned and free from superfluous particles of solder.

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14. Field repairs.—*a.* If operation is not obtained and the vibrator does not operate, check the following probable sources of trouble:

<i>Trouble</i>	<i>Remedy</i>
(1) Vibrator not operating.	Replace with new vibrator.
(2) Vibrator loose from socket.	Replace vibrator firmly in socket.
(3) One or both batteries defective.	Replace with new Battery BA-23.
(4) Batteries incorrectly connected.	Correct connections. (See paragraph 6.)
(5) Broken connections.	Replace connections, making sure that new connections are clean and secure.
(6) Defective switch.	Replace with new switch.
(7) Damaged components.	Replace.

b. If the above checks do not correct the trouble, or if spare parts are not available, return Converter M-222 to the depot for repair.

15. Circuit test.—*a. Point to point check.*—A test of the circuit may be made by a point to point check. Refer to test schematic diagram (figure 9) for location of points. The meters necessary for the test are an a-c voltmeter, 0 to 150 volts, rectifier type, 2000 ohms per volt; an a-c voltmeter 0 to 10 volts; a d-c voltmeter, 0 to 5 volts; a low resistance range ohmmeter.

(1) *Voltage test.*—With the input voltage from the batteries 3.1 volts d.c., Switch SW-105 thrown to ON, and with no load, the readings should approximate the following:

<i>Points</i>	<i>Readings</i>	<i>Meter</i>
A to B	120 volts a.c.	0 to 150 a-c voltmeter
A to G	0.0	
C to D	5.7 volts a.c.	0 to 10 a-c voltmeter
C to E	2.85 volts a.c.	0 to 10 a-c voltmeter
D to E	2.85 volts a.c.	0 to 10 a-c voltmeter
E to G	3 volts d.c.	0 to 5 d-c voltmeter

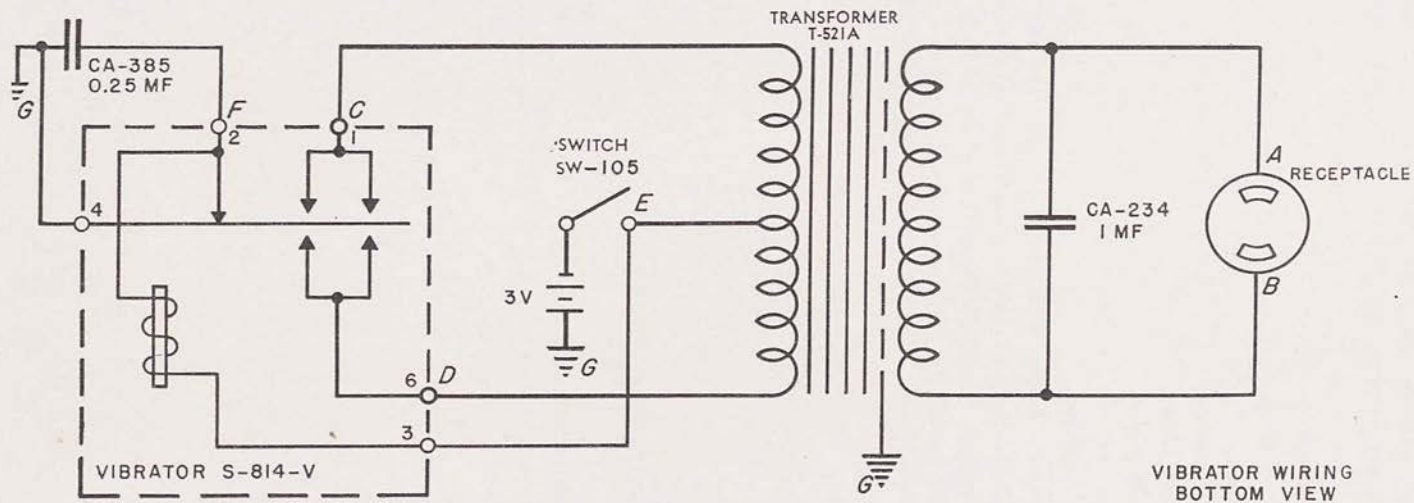
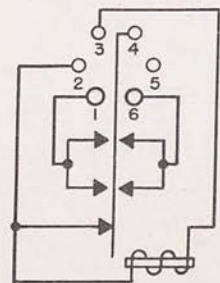
VIBRATOR WIRING
BOTTOM VIEW

FIG. 9 CONVERTER M-222, TEST CIRCUIT

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(2) *Resistance test.*—Throw the switch to OFF. Use a low resistance range ohmmeter. The following approximate readings should be obtained:

<i>Points</i>	<i>Resistance</i>
A to B	85 ohms
A to G	infinity
C to D	0.3 ohms
C to E	0.15 ohms
D to E	0.15 ohms
E to F	6 ohms
E to G	6 ohms

b. Current output test.—Using reasonably fresh Batteries BA-23, the output into a non-inductive circuit should be as shown below. The resistance of the output circuit includes that of the measuring instrument, which should be of the thermocouple or equivalent type to avoid errors due to waveform. Values listed in the following table are the minimum output.

<i>Resistance</i>	<i>Minimum Output</i>
200 ohms	110.0 milliamperes
1,000 ohms	52.0 milliamperes
10,000 ohms	8.5 milliamperes
100,000 ohms	0.9 milliamperes

SECTION VI—SUPPLEMENTARY DATA

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Components, weights and dimensions.....	16
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16. Components, Weights and Dimensions.

Stock No.	No. Req'd	Article	DIMENSIONS				Unit Weight	Signal Corps Drawing No.
			Height	Width	Depth	Diameter		
4F222/B2	1	Box Assembly:— 1 Box 4 Brackets 2 Catch fasteners 1 Handle 1 Switch mounting	8-1/4"	6-3/4"	6-5/8"		2.54	SC-D-7909 SC-D-7910, item 4
3E 4059-4	1	Connector battery						SC-D-7910, item 29
4F 222/C2	1	Cover Assembly, right:— 1 Cover 2 Clips	6-13/16"	5-13/16"	1/2"		.8	SC-D-7910, item 3 SC-D-7911, item 8
4F 222/C1	1	Cover Assembly, left:— 1 Cover 2 Clips	6-13/16"	5-13/16"	1/2"		.84	SC-D-7910, item 2 SC-D-7911, item 6
	2	Instructions, Preliminary, for Converter M-222	9"	6"				
4F 222/J1	1	Insulator	2-1/2"	5-21/32"	3/4"			SC-D-7911, item 9
4F 222/L1	1	Label, Circuit						SC-D-7914-B
4F 222/M1	1	Mounting Shelf Assembly:—	6-21/32"	3-5/8"	5-11/16"		5.12	SC-D-7912
3D 234		1 Capacitor CA-234						SC-D-7913, item 3
3D 385		1 Capacitor CA-385						SC-D-7913, item 1
6Z 4920		1 Grommet						
4F 222/J2		1 Insulator						
4F 222/M1/1		1 Mounting shelf						
2Z 8660-1		1 Socket, 6 prong						
6L 30555		2 Spacers						
3Z 12050-2	1 Terminal, brass, tinned		SC-D-7908, item 17					

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16. Components, Weights and Dimensions—Continued.

Stock No.	No. Req'd	Article	DIMENSIONS				Unit Weight	Signal Corps Drawing No.
			Height	Width	Depth	Diameter		
4F 222/T1 2Z 9625 4F 222/T1/1 4F 222/T1/2	1	Transformer Assembly:— 1 Transformer 1 Half shell 1 Half shell (with grommet holes) 2 Grommets, rubber						SC-D-7910, item 7
6Z 4920	1	Name Plate						
6Z 7788	1	Receptacle			1"	1-1/4"	.08	
	1 set	Rivets						
	1 set	Screws, nuts, and lockwashers						
4F 222/S1	1	Strip, phenolic	1/2"	4-3/8"	1/2"			
3Z 8105	1	Switch, toggle	1-5/8"	1"	1/2"		.06	SC-D-7910, item 5
3Z 12050-1	4	Terminals, brass, tinned						SC-D-7910, item 17
4F 222/V1	1	Vibrator	3-5/16"	5-3/8"	2-1/4"		1.18	
	Inches							
	13	Wire No. 18 A.W.G. Blue						
	13	Wire No. 18 A.W.G. Red						
	20	Wire No. 18 A.W.G. Green						
3G 2516	2	Sleeving, single, saturated, turbo 3mm.						

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SIGNAL CORPS

17. Table of Replaceable Parts.

Stock No.	Name	Description	Function	Mfgr's. Code	Drawing or Specification No.
2Z 8659-7	Socket	6 contact molded phenolic, Type MIP6.	Vibrator socket.	A	
3D 385	Capacitor CA-385	0.25 μ f. 200 volt d-c. oil.	Vibrator actuating point suppression.		SC-D-512
3D 234	Capacitor CA-234	1 μ f, 200 volt d-c. oil.	Output buffer.		Spec. 71-516
6Z 7788	Receptacle	2 contact molded phenolic, Type 7255.	Output voltage connection.	E	
32 8105	Switch SW-105	Toggle.	Input voltage ON-OFF switch.	C	SC-A-1042
2Z 9625	Transformer	3 volts d-c vibrator input, 100 volts a-c output. Type T-521-A.	Power.	D	
4F 222/V1	Vibrator	3 volt 24 cycles \pm 4 cycles. Type S-814-V.	To change input d-c voltage to a-c and apply it to the transformer.	E	
3A 23	Battery Connector	Green wire 5 inches long. No. 18 A.W.G. with a terminal lug on each end.	To connect two batteries.		SC-D-7908 (item 29)

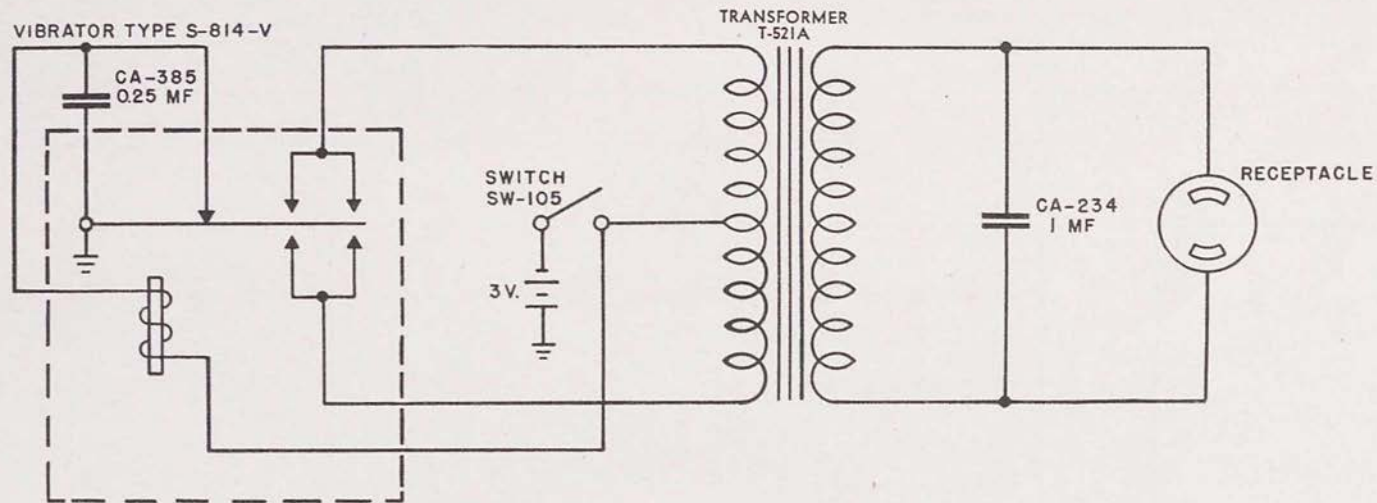
18. List of Manufacturers.

Code	Name	Address
A.	American Phenolic Co.	Chicago, Illinois
B.	Electronic Laboratories, Inc.	Indianapolis, Indiana
C.	Arrow Hart & Hageman Company	Hartford, Connecticut
D.	Silman Manufacturing Corp.	Pittsburgh, Penna.
E.	Harvey Hubbell, Inc.	Bridport, Connecticut

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INPUT VOLTAGE: TWO BATTERIES BA-23 IN SERIES
 OUTPUT VOLTAGE: 100 VOLTS A.C. OPEN CIRCUIT
 50 VOLTS A.C. AT 5 WATTS
 FREQUENCY: 24 CYCLES \pm 4 CYCLES

FIG. 10 CONVERTER M-222, SCHEMATIC DIAGRAM

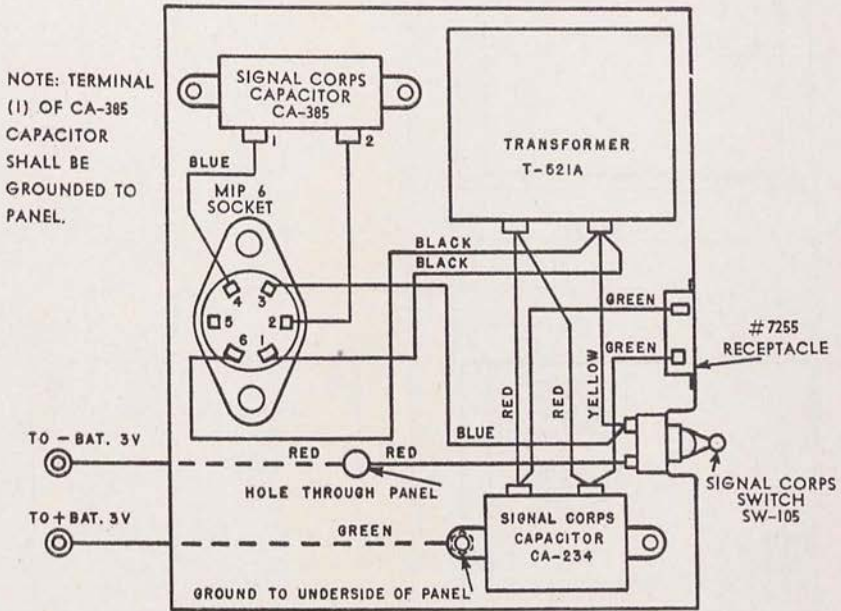


FIG. 11 CONVERTER M-222,
WIRING DIAGRAM

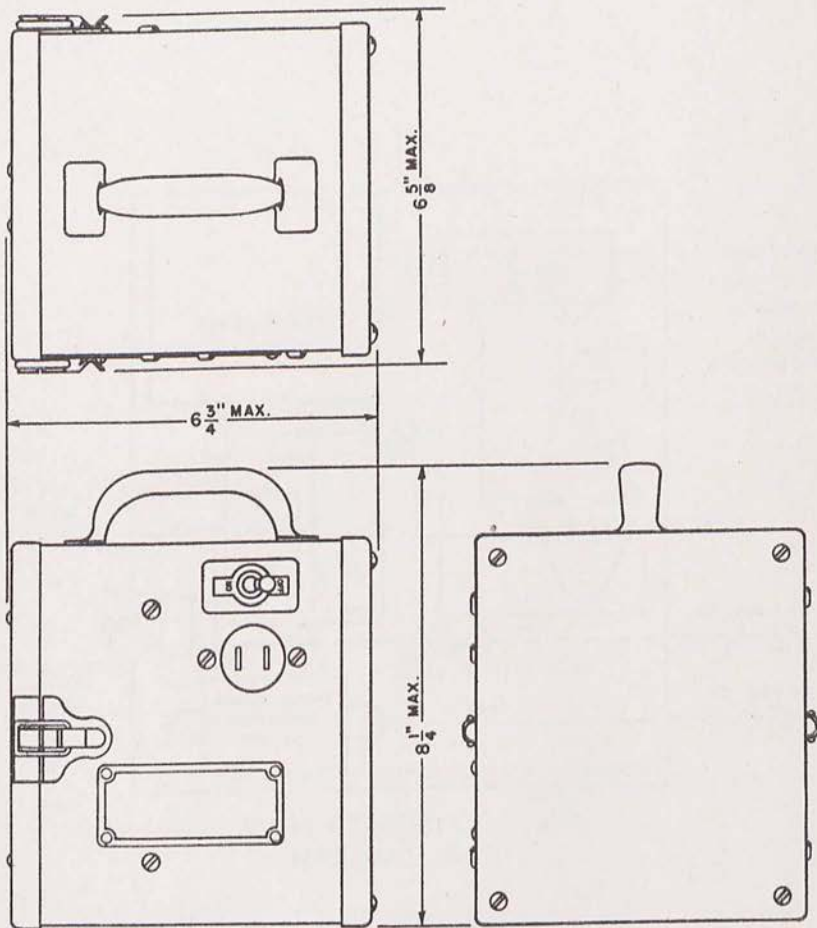


FIG. 12 CONVERTER M-222, OUTLINE DRAWING

[A.G. 062.11 (12-10-42)]

By Order of the Secretary of War:

G. C. MARSHALL,
Chief of Staff.

Official:

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

Distribution:

1 Bn and H1 (2); IC4, 11 (5)
(For explanation of symbols, see FM 21-6)