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BD-70-T1

Description and Operating Instructions  
for  
Switchboard, Type BD-70-T1 (Flash Ranging)

14 June 1933

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BD-70-T1

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SIGNAL CORPS LABORATORIES  
FORT MONMOUTH, NEW JERSEY

JJW:D

June 14, 1933.

DESCRIPTION AND OPERATING INSTRUCTIONS  
FOR  
SWITCHBOARD, TYPE ED-70-T1 (FLASH RANGING)

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I. REFERENCES:

- a. Letter from OCSigO, June 23, 1931 to O.I.C., Sig. C. Labs., file 413.42 Flash Ranging Switchboard, also 1st and 2nd indorsements thereon.
- b. Figures 1 to 6 incl., Photos 33-35-A, B,C,D,E,F, attached.
- c. Circuit Diagram, Switchboard, type ED-70-T1, ES-D-1053-A, attached.
- d. Schematic, Capacitor Unit, type BE-52-T1, ES-A-1228-A, attached.
- e. Wiring Diagram, Outpost Unit, type BE-51, ES-A-1404-A, attached.

II. GENERAL:

a. Switchboard, type ED-70-T1, is an improved flash ranging switchboard designed to replace Switchboard, type ED-47. The new switchboard will be a part of Flash Ranging Set, type GR-4.

b. A number of major improvements have been made in the Switchboard, type ED-70-T1, as compared to the type ED-47. These improvements are as follows:

1. A plywood case is provided, to which is attached folding angle-iron legs. This replaces the trunk feature and four separate legs, type M-100, as furnished with Switchboard, type ED-47.

2. The front of the new switchboard lowers to a horizontal position to form a large writing shelf, eliminating the necessity for the separate drawing board supplied as a part of the old switchboard.

3. The line fuses, arresters, and rheostats, are eliminated and modern type relays and keys are substituted for the old types used on Switchboard, type ED-47.

4. An operator's telephone circuit and ringing equipment are incorporated in the new switchboard.

5. Binding posts are provided for metallic lines (field wire), the common ground feature being eliminated.

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6. Testing circuits are provided for the line relays and associated lamps.

7. Two illuminating dash lamps, an inspection or "trouble" lamp socket on the panel, and two heater lamp sockets inside the case are provided.

8. A drawer is provided for carrying the operator's head and chest set, inspection lamp, tools, spare fuses and lamps and six Capacitor Units, type BE-59.

### III. DESCRIPTION:

a. Switchboard, type BD-70-T1, is an improved flash ranging switchboard with facilities for receiving flash ranging signals from six observers or outposts and for talking and ringing when the outpost lines are equipped with field telephones. The line relays are energized from a common 6-volt storage battery when the Outpost Units, type BE-51, are operated. Six line circuits are provided, and with the use of Capacitor Units, type BE-59, field telephones may be permanently connected to the outpost lines.

b. The equipment is permanently mounted in a plywood case with legs attached and weighs approximately 76 pounds. The weight of the operator's set, tools, six Capacitor Units, type BE-59, and other equipment carried in the drawer is approximately 9 pounds, making the total weight approximately 85 pounds.

c. The telescoping, folding legs may be locked in position on the bottom of the case as shown in Fig. 1. Fig. 2 shows a rear view with the door open, permitting access to the fuses and heater lamp sockets. Fig. 3 shows the switchboard in position with legs extended, front open and the operator's set connected ready for operation. Fig. 4 shows the drawer open and the tools and other loose equipment. Figs. 5 and 6 show close-up views of the front and rear of the panel and framework. The circuit diagram of the switchboard is shown on drawing ES-D-1053-A. A schematic diagram of the Capacitor Unit, type BE-59-T1, is shown on drawing ES-A-1228-A. The wiring diagram of the Outpost Unit, type BE-51, is shown on drawing ES-A-1404-A.

### IV. DETAILED DESCRIPTION:

#### a. Case.

The flash ranging switchboard is contained in a plywood case 21-1/2" long, 19" high and 9-3/4" deep. Telescoping angle-iron legs are hinged to the bottom of the case and open out to support the switchboard 23" above

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the ground. The legs may be folded and locked into position on the bottom of the case, adding 1" to the height. The front of the case hinges down to form a large writing shelf suitable for use as a plotting board. Substantial clasps are used for fastening the front cover. A door is provided in the back to expose the fuse mountings and heater lamp sockets and is fastened by means of a screw. A drawer is provided below the switchboard panel and is used to carry the operator's head and chest set and other accessory equipment.

b. Panel and Equipment.

A heavy bakelite panel 20" x 14" x 1/2" is used to mount the equipment on the face of the switchboard. Other equipment is mounted on the rear of this panel, some on metal mounting plates fastened to the panel with brackets. A welded metal framework supports the panel, so that the whole may be removed from the case and will be self-supporting for repairs or adjustment. A plate on the bottom of this framework serves as a cover for the drawer. The relays protrude thru the faces of the panel and are fitted with individual metal covers which may be removed for spring and contact adjustments. Moulded bakelite binding posts are mounted on the face of the panel for line and battery connections. W.E. 479 type keys (cam lever type) are used and mount flush with the panel.

c. Battery.

A 6-volt storage battery is required to supply line current for the outpost signaling circuits, transmitter current for the telephone circuit and current for the switchboard lamps, illuminating lamps, night alarm bell and inspection lamp. This battery should be of 90 ampere-hour capacity, but in emergencies a smaller battery or #6 dry cell batteries may be used for short periods of time. The battery should be connected to the "6 V. BAT." binding posts, with polarity as indicated. Three-ampere fuses and a "BAT." key are provided.

d. Outpost Signaling Circuits.

Each outpost signaling circuit consists of a W.E. 206 type polarized relay which operates a switchboard type lamp on the face of the panel. The relay has two 250-ohm windings and is fitted with an adjustable spring which opposes the operation of the armature. This spring serves to reduce armature chatter when alternating ringing current is received from a telephone connected to the outpost line. The relay contact closes a circuit thru a W. E. E-2 (or 2-H) lamp mounted in a W. E. 34 lamp socket and fitted with a W.E. 4-A lamp cap (white). The lamp caps of the six

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circuits are numbered ~~2x~~ 1 to 6 respectively. Operation of the "BUZ." key connects a special Western Electric 4-A buzzer per D-14992 in series with the common lamp lead, to give an audible signal when required. The lamps do not light when the buzzer is in series. Milliammeter keys are provided for connecting a milliammeter in the circuits in order to measure the line current.

e. Test Circuits.

A test circuit has been provided for each outpost signal circuit, whereby the operation of a "TEST" key disconnects the line and connects a 1200-ohm (W.E. 1B-BJ) resistance across the relay to simulate maximum line conditions, (approximately 5 miles of Wire, type W-110). The operation of the relay lights the associated switchboard lamp or operates the buzzer, depending upon the position of the "BUZ." key. With the "TEST" key operated, operation of the associated "MA" key connects the milliammeter in series with the line circuit to measure the current under test conditions. This current should be approximately 3.5 milliamperes. Adjustments may then be made upon the relay contacts and pole pieces to insure satisfactory operation.

f. Telephone Circuit.

The telephone circuit consists of talking and ringing facilities, and keys to connect either to any or all the lines. The telephone circuit consists of a Coil, type C-44, (W.E. 31 Induction Coil), two 2/uf capacitors (W.E. 139-A Condensers), a W.E. 12-M Retardation Coil, four W.E. 223-A Jacks, and the operator's head and chest set. The operator's set consists of a W.E. 375 Cord, W.E. 137 Plug, W.E. 528 Receiver, W.E. 396-A Transmitter and W.E. 3-A Transmitter Attachment (strap). The cord has 4 tinsel conductors 6 feet long, covered with a moisture-proofed cotton braid. The plug is a double, tip-sleeve plug, affording separate receiver and transmitter circuits. The receiver is of the watchcase type furnished with a wire headband (W.E. 11-A). The transmitter has a high resistance barrier type carbon button of approximately 175 ohms. A thin rubber membrane protects the carbon button from moisture. The curved, hard-rubber mouthpiece is readily removable. The transmitter housing is mounted on a triangular breastplate which is held in place by a web strap around the operator's neck. Jacks are provided for two operator's sets if desired.

The operation of a "TALK" key closes the transmitter circuit from battery thru the retardation coil, the transmitter "tip" springs of two adjacent jacks and the primary of the induction coil. A 2/uf capacitor is used to bypass the talking current around the battery and retardation coil. The secondary of the induction coil is connected thru a 2/uf capacitor and the receiver (jack sleeves) to the line by means of the "TALK" key. The keys are multiplied so the operator may talk to more than one outpost if desired.

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The ringing facilities consist of a Generator, type GN-38, Buzzer, type BZ-4, six signal drops (W.E. D-14281) and six 0.5/uf capacitors (W.E. 141-B). The operation of any "RING" key connects the generator in series with the buzzer to the associated line. Operation of the hand crank of the generator sends out ringing current of approximately 20-cycle frequency. The series buzzer indicates by its operation that the circuit is closed. The drop winding and 0.5/uf capacitor in series are bridged across the line relay. The capacitor prevents the drop winding from closing the relay circuit, thereby causing its operation, and aids in the operation of the drop when ringing current is received from a field telephone connected to the outpost line. Since the "RING" key is nearer the line than the "TALK" key, the former must be restored after each ring in order to listen on the line.

A night alarm contact is associated with each drop. The operation of the "BELL" key connects a W.E. 10-B Bell to the night alarm contacts, which are multiplied, and to battery. This gives a bell signal until the drops are restored by hand or the "BELL" key is returned to normal.

g. Meters.

The milliammeter is of the Weston 506 flush mounted type with a scale of 0 to 15 milliamperes. The milliammeter keys are non-locking and connect the meter into the various circuits. Only one key should be operated at a time as the meter will show the total current if more than one key is operated.

The voltmeter is also the Weston 506 flush type with a scale of 0 to 15 volts. The operation of the key marked "VOLTS" connects the voltmeter across the "BAT." key to measure the voltage of the battery.

h. Illuminating Lamps.

Two Ford dash lamp assemblies are supplied to illuminate the face of the switchboard. The lamps are equipped with Mazda 81, 6 c.p., 6-8 v., single-contact lamps, and nicked reflectors. The lamps are operated by pressing and turning the reflectors to the right.

i. Inspection Lamp.

A Presto 287DC inspection lamp is supplied in the drawer of the switchboard. This is supplied with a 6-foot cord and plug for connecting to the Presto 18-P flush mounted socket. The socket is connected to the live side of the LINE fuse block, so the lamp may be connected direct to the battery. This will allow "trouble shooting" after the fuses have blown. The lamp is fitted with a Mazda 82, 6 c.p., 6-8 v., double-contact lamp.

j. Heater Lamps.

Medium base sockets are provided for two heater lamps inside the case when required to dry out the switchboard. Three-ampere fuses are provided in the circuit between the sockets and the "HEATER" binding posts. Any available potential, usually 110 volts a.c., 110 volts d.c., or 32 volts d.c., may be connected to the heater circuit and corresponding lamps of as low a wattage as necessary to successfully dry out the switchboard shall be used.

k. Accessory Equipment. The following accessory equipment is furnished with the switchboard in addition to the operator's head and chest set and the inspection lamp previously described:

1. Tools.

A W.E. 116 Tool (lamp extractor) and W.E. 319-B Tool (lamp cap extractor) are furnished. Two relay adjusting tools (3" steel rod) are furnished for adjusting the line relays.

2. Spare Equipment.

The following spare equipment is furnished in the drawer of the switchboard:

10 Fuses, 3 amperes, Midget  
1 Lamp, Mazda 82  
2 Lamps, Mazda 81  
5 Lamps, W.E. E-2  
3 Lamp Caps, W.E. 4-A

3. Capacitor Units, type BE-59-T1.

The capacitor unit consists of a 1/uf capacitor mounted in an aluminum case approximately 4" x 3" x 1-1/4" with bakelite top fitted with 6 binding posts. Drawing ES-A-1228-A shows a schematic diagram of the unit. Space is provided in the drawer of the switchboard for carrying six Capacitor Units, type BE-59-T1, weighing 1.1 pounds each. The unit is used at outpost stations to connect the line, outpost unit and telephone to the three pairs of binding posts marked "LINE", "OUTPOST" and "TEL." respectively. The telephone is thus connected thru the 1/uf capacitor to the line, to prevent the ringer coil in the telephone from operating the line relay in the switchboard. The outpost unit is connected direct to the line. Slots are provided in the "LINE" and "TEL." binding posts to facilitate connection to stranded field wire.

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1. Outpost Units, type BE-51.

Six Outpost Units, type BE-51, are required for use on the six outpost lines, but no provision is made for carrying these in the switchboard. The unit consists of a milliammeter (0 to 5) in series with a 48,000-ohm resistance (W.E. 38-A) and a non-locking, push type key (W.E. 92-A) to short circuit the meter and resistance. The equipment is mounted on a bakelite base and inclosed in a leather case with shoulder strap. A Cord, type CC-327, is furnished as a part of the unit, and is used to connect to the center terminals of the Capacitor Unit, type BE-59. The Outpost Unit, type BE-51, is 7" x 3" x 2-1/2" and weighs approximately 2-1/2 pounds. One of these units is shown on top of the switchboard in Fig. 4. The wiring diagram is shown on drawing ES-A-1404-A.

The meter and series resistance contained in the outpost unit are normally across the outpost line and draw a current of approximately 0.12 milliampere. This is not sufficient current to operate the line relay, but operation of the key short circuits the meter and resistance, causing the relay to operate. The outpost operator may check the continuity of the outpost circuit by noting the meter drop to zero when the key is pressed.

V. OPERATING INSTRUCTIONS:

a. Installation.

1. The Flash Ranging Switchboard, type BD-70-T1, may be installed on a table or shelf in the Flash Ranging Truck, with the legs folded, or upon the floor or ground with the legs extended and firmly planted. The door in the back shall be opened to determine that the 3-ampere Midget fuses are in place. The front cover of the switchboard shall be lowered to a horizontal position.

2. The signal drops shall be released by lowering the locking springs to a horizontal position. The drops shall be tested to see that they fall freely and hold when restored to position. The relay covers, lamp caps, generator handle and other equipment shall be examined to see that they are in position and ready for operation. It will be noted that the position of the designations of each key on the wiring diagram are interchanged with those on the face of the panel, due to the key spring terminals being opposite to the operated position of the key handles.

3. A 6-volt, 90 ampere-hour battery shall be connected to the "6 V. BAT." binding posts, with polarity as indicated. The "BAT." key shall be operated to the "ON" position and the "VOLTS" key operated to measure the battery voltage.



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4. The Capacitor Units, type BE-59, and the operator's head and chest set shall be removed from the drawer. The outpost lines shall be connected to the line binding posts. The Capacitor Units shall be carried to the respective outpost stations and connected to the line, Outpost Unit, type BE-51, and field telephone. The operator's head and chest set shall be connected to one pair of "TEL." jacks.

b. Circuit Tests.

1. Line Circuit. With the "BAT." key "ON", each line circuit shall be tested by operating the "TEST" key, which should cause the line relay to operate and close the circuit thru the switchboard lamp and battery. The lamp should light if the "BUZ." key is normal or the buzzer should sound if the "BUZ." key is operated. If the lamp does not light, the relay cover shall be removed and the armature moved over against the left-hand contact. If the lamp still does not light it indicates the trouble is in the lamp circuit and not in the relay circuit. The "MA" key may be operated to check the relay test current, which should be approximately 3.5 milliamperes.

2. Generator Circuit. With the operation of any "RING" key and the associated "TEST" key, a few turns of the generator handle should operate the series buzzer. This buzzer serves as an audible indication that ringing current is flowing.

3. Telephone Circuit. With the two-line binding posts strapped with a short length of wire, the "TALK" key shall be operated and the operator should be able to distinctly hear himself gently blowing into the transmitter when the head and chest set is in position.

4. Night Alarm Circuit. The "BELL" key shall be operated and each drop lowered in turn to the horizontal and restored, to determine that the night alarm signal operates satisfactorily.

5. Illuminating Lamps. Each reflector of the dash lamps shall be turned to the right until it locks in the "ON" position. If the opening does not distribute the light downward, the reflector may be removed and replaced in the proper position. The illuminating lamps should be used only when required.

6. Inspection Lamp. The inspection lamp may be connected to the socket on the front of the panel to see that it is ready for emergency use.

c. Operation of Switchboard.

1. After all connections and tests described above have been made, the operator shall call each outpost station in turn. Operation of the "RING" key and the hand generator will show by the operation of the series buzzer that the line is complete. If the buzzer is heard, the "RING" key should be restored and the "TALK" key operated to await an answer from the outpost telephone. If a re-ring is required, the "TALK" key may be left operated while the "RING" key is operated and restored.

2. Upon establishing telephone communication with the outpost operator, the switchboard operator should instruct the outpost operator to ring back with the telephone generator. The "TALK" key should then be restored until the drop is operated, indicating the incoming call.

3. The switchboard operator should then instruct the outpost operator to operate the Outpost Unit, type BE-51, at certain intervals, and with the "TALK" key restored to normal, the switchboard lamp should flash in sequence.

4. The above operations may be reversed in part, where it is desired to have the outpost operator call in with his telephone as soon as he has made connections in the field. The switchboard operator may interrupt the flash signals at any time by ringing on the line.

d. Adjustments.

1. Very little adjustment should be required on the switchboard apparatus. The line relay may require minor adjustments from time to time, as follows:

(a) In case the lamp does not light under test conditions, the spring tension should be released slightly by turning the front thumb screw counter-clockwise a small amount. Sufficient tension should be maintained to just allow the relay operation under test conditions, and to keep the armature from excessive chattering when ringing current is received.

(b) The relay pole pieces are locked in position and should seldom require adjustment. They should be spaced with a slight air gap between the armature and the two pole pieces in the respective positions of the armature. The relay adjusting tools may be used for this adjustment.

(c) The contact points should also be adjusted when required to insure the armature making firm contacts in the non-operated (right) and operated (left) positions.

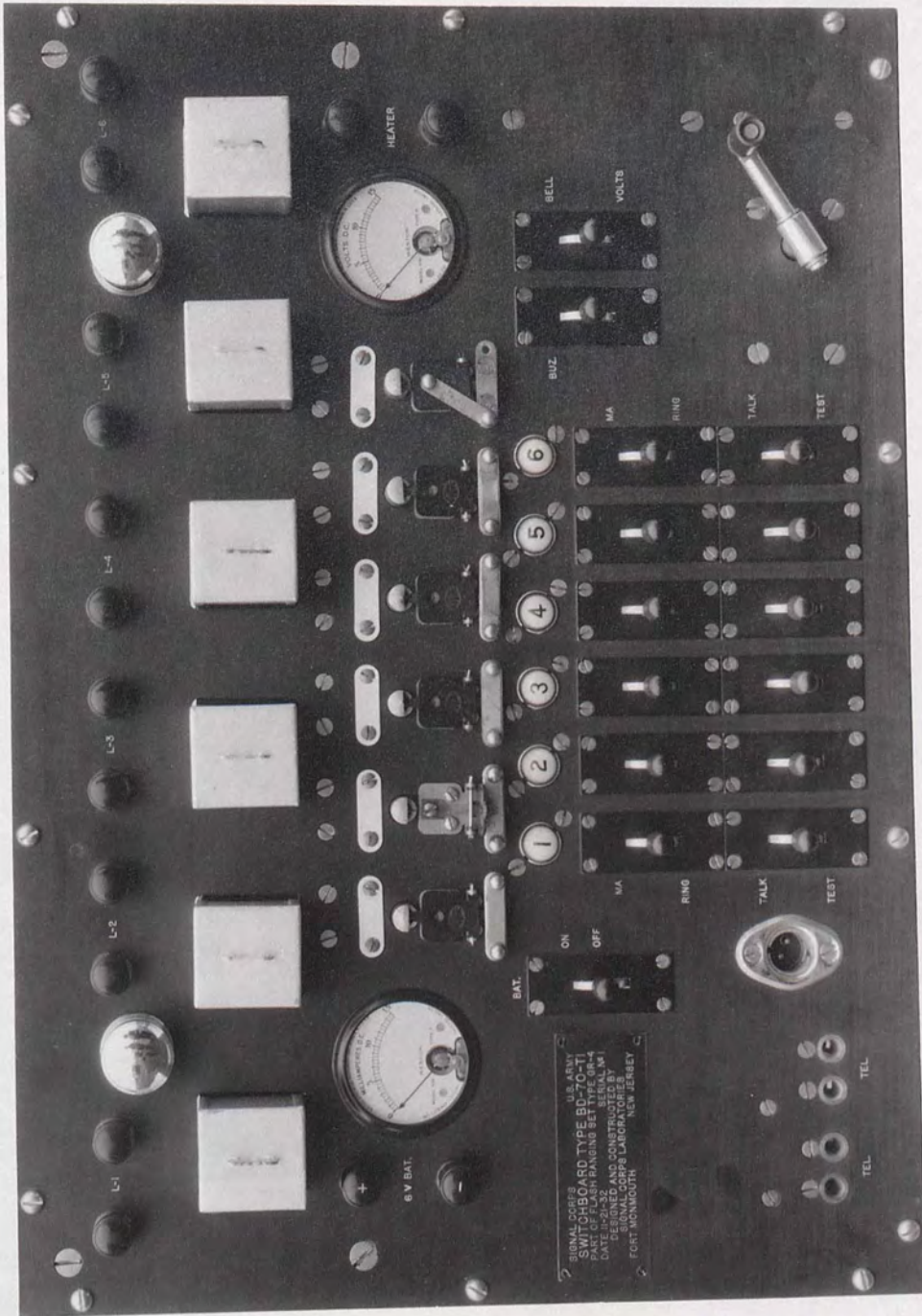
Description and Operating Instructions for Switchboard, type BD-70-T1  
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2. The drop shutters and night alarm contact springs may require certain adjustment from time to time. The springs are easily bent out of position when the shutters are forced down too far, and should be removed and straightened.

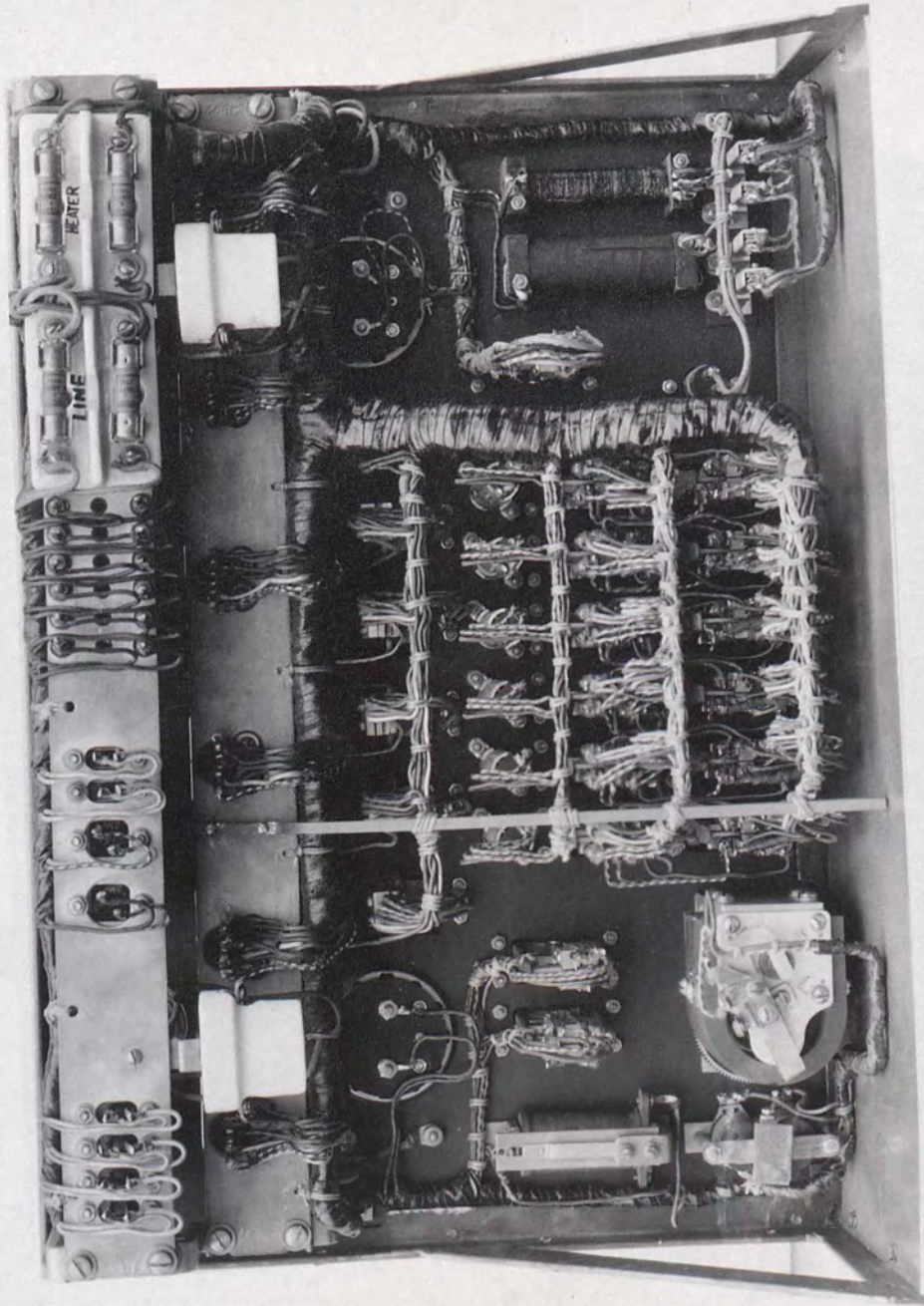
3. The lamp caps should be removed with the W.E. 319-B Tool and the lamps extracted with the W.E. 116 Tool. The latter may be forced over the end of the lamp with a slight pressure. If the lamp is burned out, a new one may be put in place in the lamp socket with the fingers.

4. Any adjustments required on the keys, jacks, buzzers or similar apparatus should be made in a general depot. The screws thru the plywood case holding the steel framework (not the screws on the face of the panel) should be removed and the frame and panel withdrawn. A copy of the circuit diagram is shellacked inside the case for use when the equipment is so removed.

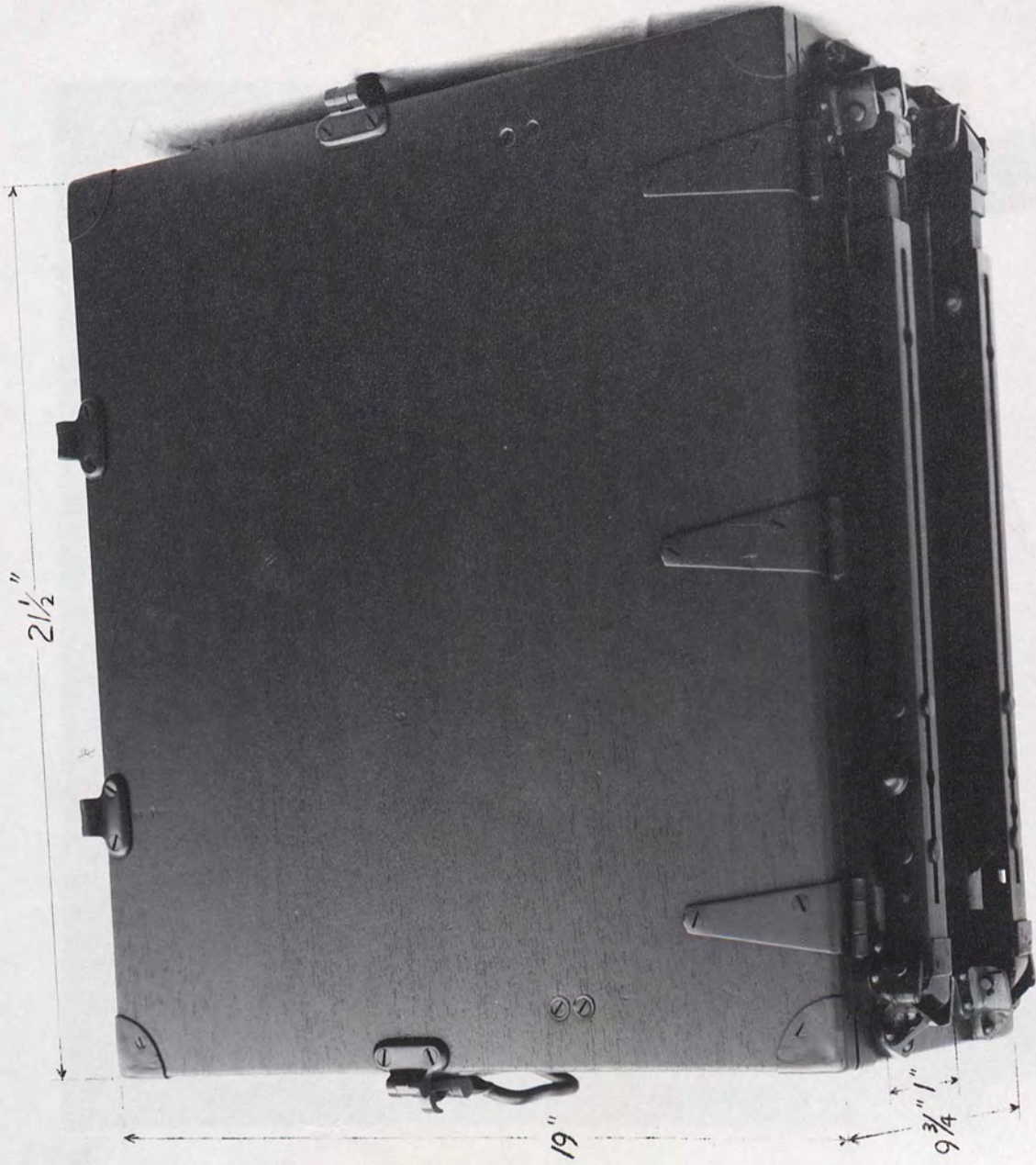
Incls.  
(See Section I, REFERENCES).



33-35-R



33-35-B



TOTAL WT. 85 LBS.

33-35-C

FLASH RANGING SWITCHBOARD, TYPE BD-70-T1

FIG. 1

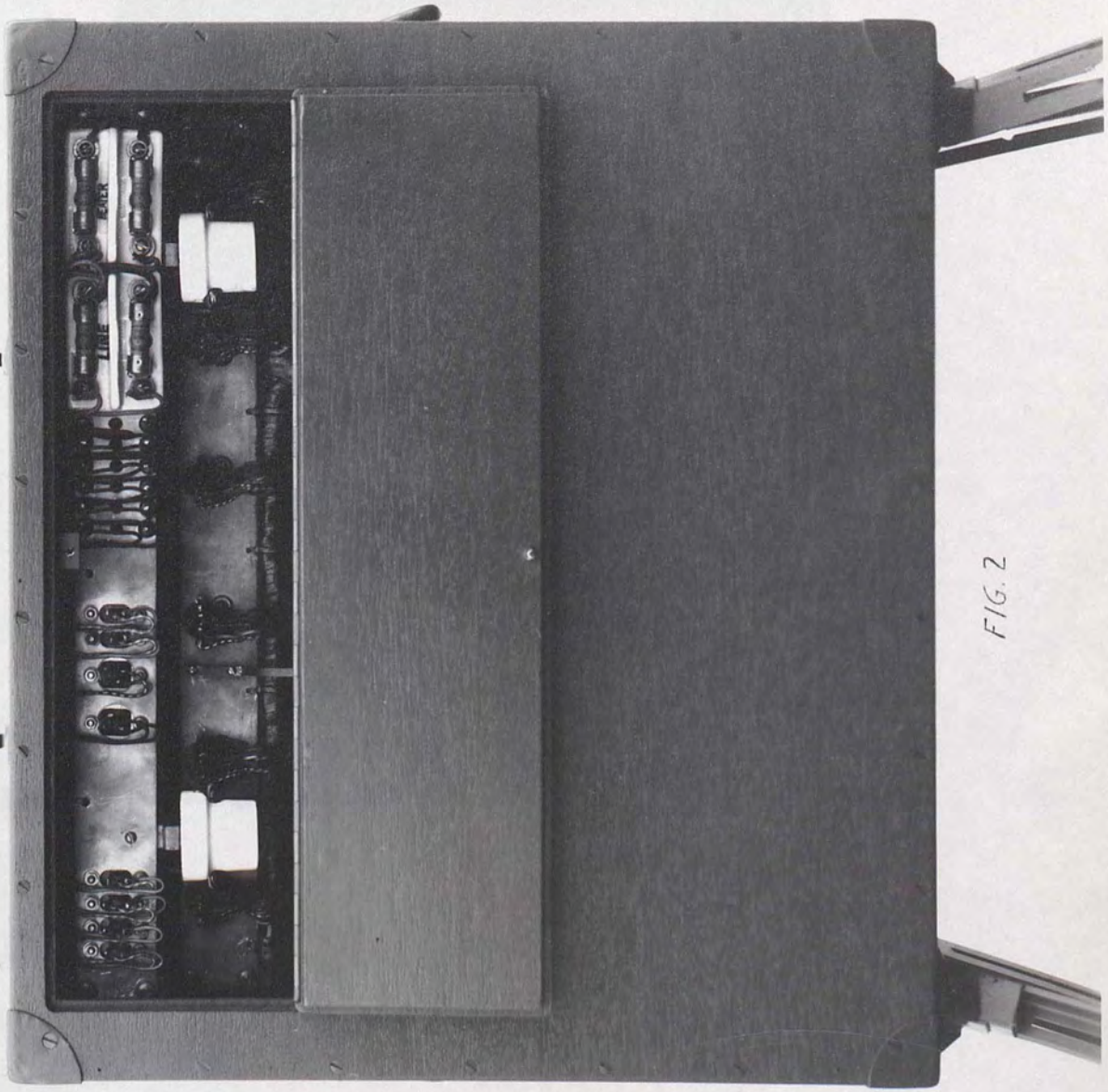


FIG. 2

33-35-D



FIG. 3

33-35-E



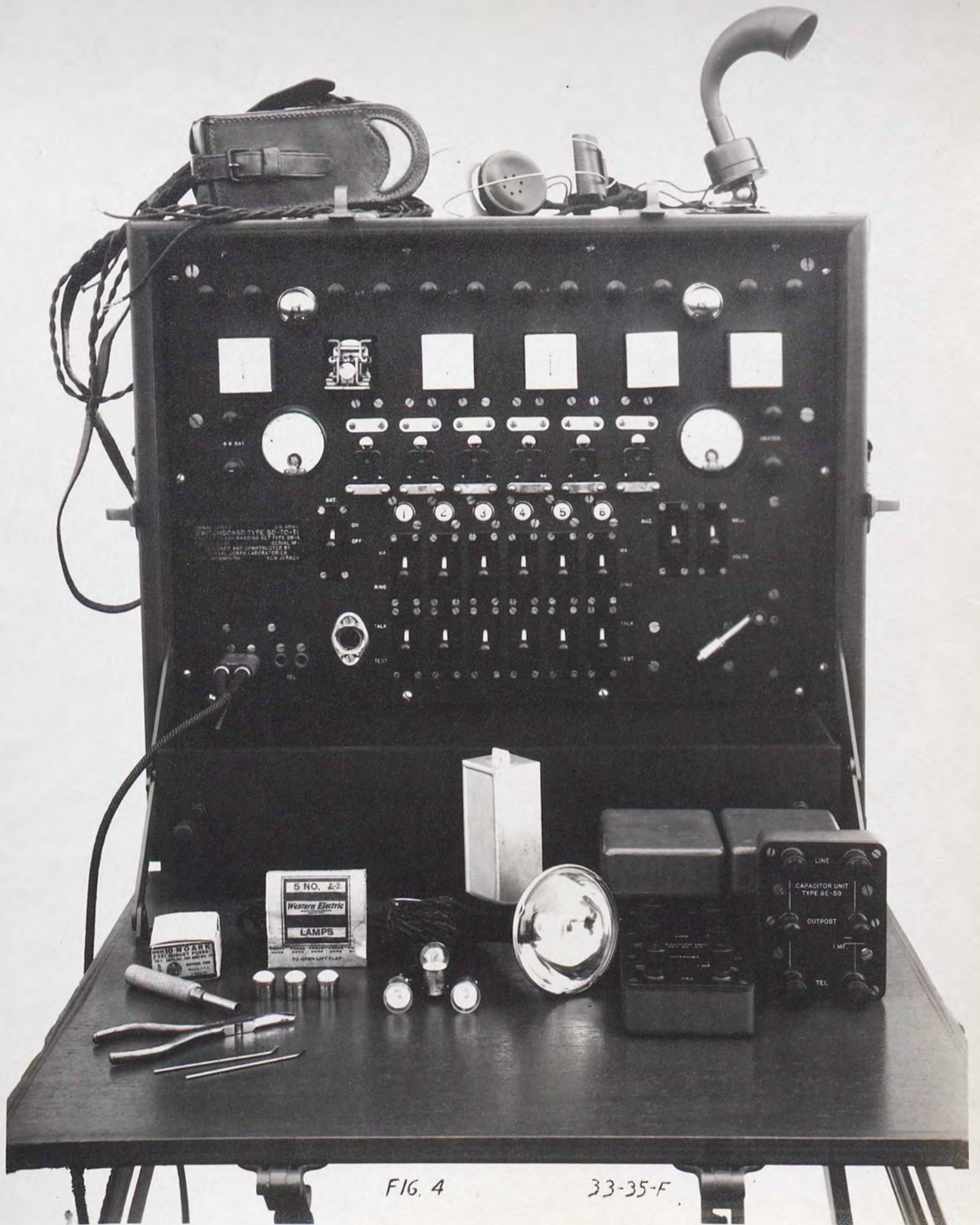
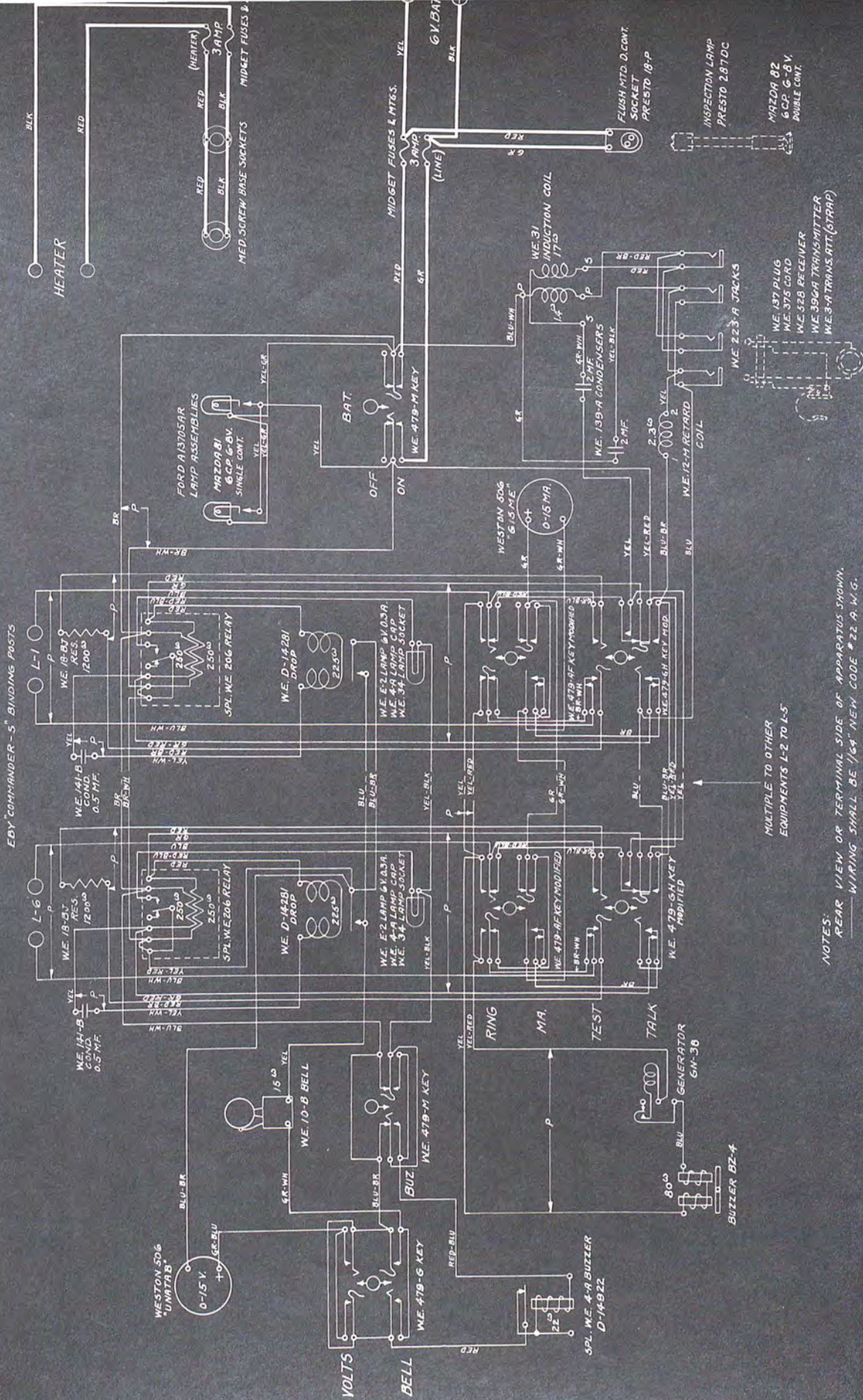


FIG. 4

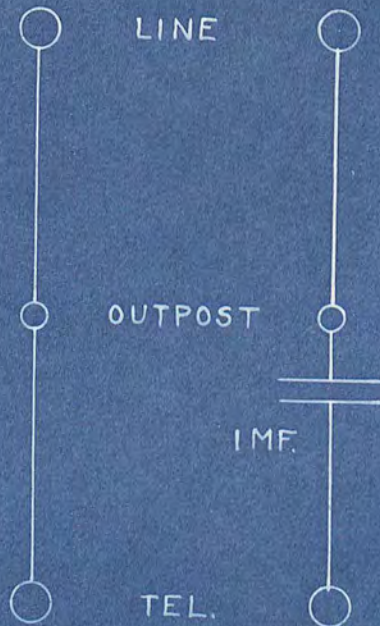
33-35-F

# CIRCUIT DIAGRAM FOR FLASH RANGING SWITCHBOARD TYPE BD-70-T1



- NOTES:
- REAR VIEW OR TERMINAL SIDE OF APPARATUS SHOWN.
  - WIRING SHALL BE 1/16" NEW CODE #22 A.W.G.
  - INSTRUMENT WIRE PER SPEC. 71-644.
  - WIRING SHALL BE #18 A.W.G. BELDEN "RAVINE" WIRE.

MULTIPLE TO OTHER EQUIPMENTS L-2 TO L-5



- BINDING POST, EBY "ENSIGN"
- BINDING POST, EBY "COMMANDER-S"

**SCHEMATIC  
CAPACITOR UNIT, TYPE BE-59-T1  
PART OF FLASH RANGING SET, TYPE GR-4, & SOUND RANGING SET, TYPE GR-3.**

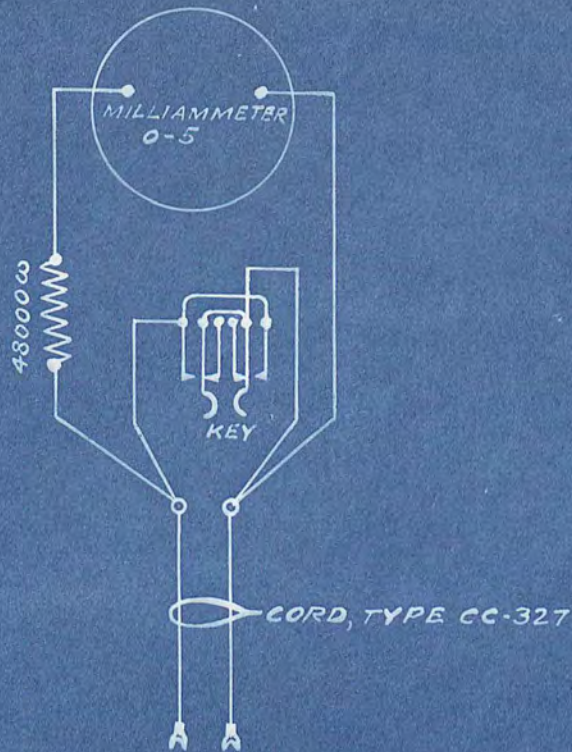
AUTHENTICATION

DRAWN: <i>J.J.W.</i>	VERIFIED:	ENGINEER: <i>J.J.W.</i>
TRACED:	APPROVED:	CH. OF SECT: <i>Z.A.G.</i>
CHECKED:	DATE: 1-3-33	APPROVED: <i>L.B.</i>
PROJ. OFFICER		

SIGNAL CORPS LABORATORIES  
U. S. ARMY  
FORT MONMOUTH NEW JERSEY

ISSUE-A-1-3-33

ES-A-1228-A



## WIRING DIAGRAM FOR OUTPOST UNIT, TYPE BE-51

AUTHENTICATION

DRAWN: **STALLINGS**

VERIFIED: *Peth*

ENGINEER: *J.F.W.*

TRACED: **STALLINGS**

APPROVED:

CH. OF SECT. *J.F.*

CHECKED:

DATE **6-6-33.**

APPROVED  
PROJ. OFFICER *J.F.*

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**ES-A-1404-A**

ISSUE-A      6-6-33.

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