

# 152

INSTRUCTION BOOK  
FOR  
TIME INTERVAL APPARATUS EE-85-T6  
LINE CONNECTOR UNIT EE-87-T4  
FIRING SIGNAL BE-65-T2

R E S T R I C T E D

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FORT MONMOUTH, NEW JERSEY

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30 April 1937



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FORT MONMOUTH, NEW JERSEY

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# INSTRUCTION BOOK

FOR

## TIME INTERVAL APPARATUS EE-85-T6 LINE CONNECTOR UNIT EE-87-T4 FIRING SIGNAL BE-65-T2

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10 Circuit Label Time Interval Apparatus EE-85-T6 . . . . .	SC-A-2594-A
11 Circuit Label Line Connector Unit EE-87-T4 . . . . .	SC-A-2595-A
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INSTRUCTION BOOK  
FOR  
TIME INTERVAL APPARATUS EE-85-T6  
LINE CONNECTOR UNIT EE-87-T4  
FIRING SIGNAL BE-65-T2

SECTION I

GENERAL DESCRIPTION

1. The time-interval apparatus and associated equipment described in this instruction book are designed for mobile coast artillery. The equipment consists of three principal pieces of apparatus as follows:

Time Interval Apparatus EE-85-T6  
Line Connector Unit EE-87-T4  
Firing Signal BE-65-T2

2. Time Interval Apparatus EE-85-T6 consists of an accurate clock and time-interval mechanism which are operated from a 6-volt battery and provide time intervals of 1, 5, 10, 15, 20, 30 and 45 seconds. Each of these intervals, with the exception of the 1- and 5-second intervals, is preceded by two 1-second intervals. The duration of each time interval, or the time the signal contact is closed, is approximately 0.4 second. Also, a preliminary warning interval is provided for the 20-, 30- and 45-second series, occurring 3 seconds ahead of the series of intervals. On the 20-second circuit, the contacts are therefore closed at 15, 18, 19, 20, 35, 38, 39, 40; etc., seconds.

3. Line Connector Unit EE-87-T4 is designed to superimpose tone time-interval signals on one to six telephone lines. A multicontact relay is operated by the time-interval apparatus to control a 1000-cycle tone source and connect each output transformer to the respective line. Alternate microphone hummers are provided for the tone source and a key connects one or the other to the circuit. Another key controls the output volume by connecting resistors in series with the hummer-output winding and the series primaries of the transformers.

4. Firing Signal BE 65-T2 is a local-battery howler which supplies a loud tone at the gun position for each interval desired. The time-interval apparatus operates a sensitive relay to close a 3-volt battery circuit thru a vibrator operating on a heavy diaphragm and resonator. Six firing signals are provided, and may be connected to the same or different terminals of the time-interval apparatus.

5. The nomenclature, dimensions and weights of the various units are listed below:

<u>Nomenclature</u>	<u>Dimensions (Ins.)</u>	<u>Weight (Lbs.)</u>
Time Interval Apparatus EE-85-T6	7 x 11-1/4 x 14-1/2	14
Line Connector Unit EE-87-T4	7 x 11 x 14-1/2	25
Firing Signal BE-65-T2	6-1/2 x 9-1/2 x 10-1/2	18



## SECTION II

### DETAILED DESCRIPTION

#### 6. Time Interval Apparatus EE-85-T6.

a. This equipment is housed in a mahogany case with hinged cover and carrying strap. A hinged section on the left side of the cover provides entrance for field wire and battery leads. Two bakelite panels are mounted in the case, one providing an opening for the clock and the other containing binding posts and Switch SW-105 on top, and the time-interval mechanism mounted on the under side. A rubber-gasketed, bakelite case is mounted in the proper position for housing the clock. Four common Binding Posts TM-175, two each for the 1-, 5-, 10-, 15-, 20-, 30- and 45-second intervals, one for the spare contact on the 90-second arbor and one for the spare contact on the 120-second arbor are provided. Two Binding Posts TM-109 are provided for the battery connection and three Binding Posts TM-152 for the straps to connect to the clock.

b. The clock is the resonance type, electromagnetically driven from the 6-volt battery, and has a center vertical axle upon which is mounted a heavy cylindrical weight, a contact-operating mechanism and a magnetic bar suspended between the windings of an electromagnet. In the stopped position the mechanism holds the motor contact closed so that when battery is applied, the circuit is completed through the electromagnet, giving an impulse to the bar. The contact-operating mechanism is so arranged that the contact is closed once for each complete oscillation of the bar and weight. At the bottom of the axle a heavy spiral spring is connected to a contact arm which closes a heavy auxiliary contact. The time of oscillation of the clock is one second and the auxiliary contact remains closed approximately 0.4 second. The spiral spring has a very low-temperature coefficient so that the accuracy of the clock is better than 2.88 minutes in 24 hours when operating with a voltage from 4-1/2 to 6 volts.

c. A driving magnet operates from the auxiliary contact of the clock to move a ratchet bar which turns the 90-second arbor. Geared to this is the 120-second arbor. Four bakelite discs on each arbor are removable and may be replaced by other discs cut for time intervals within the scope of the respective arbors. Heavy wiping contacts are operated by the raised sections on the circumference of each disc. The 1-second interval is taken direct from the auxiliary contact of the clock. A 1-mu f capacitor and 250-ohm resistor in series are bridged across the auxiliary contact to reduce arcing and prevent radio interference. A similar capacitor and resistor are bridged across the motor contact of the clock.

d. On the 90-second arbor next to the gear is the 5-second disc, with raised sections around the circumference which hold the corresponding contact closed one second out of each five. The next disc is the 15-second disc, with raised sections around the circumference which hold the corresponding contact closed for the 13th, 14th and 15th second, etc. The third disc is the 45-second disc, and the raised sections hold the corresponding contact closed for the 40th, 43rd, 44th and 45th second, etc. The three discs listed above are synchronized, so that the last second of each series comes at the same time as the 5-second interval for two positions on the arbor.



The arbor-pin holes in the discs are therefore marked S 5, S 15, and S 45, respectively. The fourth disc operates the contact connected to the binding post marked SPARE 90" ARBOR, and the disc furnished is a 45-second disc with three arbor-pin holes. One is marked S 45 for the synchronized position and the others are marked D 5 and D 15, indicating 5- and 15-second delays in the time intervals from the synchronized position. The discs are separated by spacers and are easily removable by loosening the large arbor nut. The contact closed by each disc is in series with the battery, corresponding interval binding post and the auxiliary contact of the clock.

e. On the 120-second arbor next to the gear is the 10-second disc, with raised sections which hold the corresponding contact closed for the 8th, 9th and 10th second, etc. The second disc is the 20-second disc, with raised sections which hold the corresponding contact closed for the 15th, 18th, 19th and 20th second, etc. The third disc is the 30-second disc, with raised sections which hold the corresponding contact closed for the 25th, 28th, 29th, and 30th second, etc. These three discs are synchronized and are marked S 10, S 20 and S 30, respectively. The fourth disc operates the contact connected to the binding post marked SPARE 120" ARBOR. Two spare discs are furnished, with arbor-pin holes marked as follows:

(1)	S 20	D 5	D 10
(2)	S 30	D 10	D 15

These discs provide delayed 20- and 30- second intervals as indicated. One of these discs is carried on the 120-second arbor, and the other is mounted on a stud, within the case, with several blank 90- and 120-second discs which may be cut for any desired intervals.

#### 7. Line Connector Unit EE-87-T4

a. The EE-87-T4 equipment is housed in a mahogany case similar to the time-interval apparatus. Provision is made for connection to six telephone lines. Duplicade General Radio 572B microphone hummers are used as tone sources. The bakelite panel contains two Western Electric 479-type keys for switching the hummers into the circuit and for controlling the tone on the telephone lines, and 16 Binding Posts TM-175.

b. Inside the case are mounted six transformers, one North Electric Company relay, and six 0.1-mu f capacitors. The tone for the telephone lines, approximately 1000 cycles, is obtained from one or the other hummer. A key connects one or the other to the transformer primary windings and two resistors in series, under the control of the multicontact relay. The transformer secondary windings are connected through individual relay contacts and 0.1-mu f capacitors to the line binding posts, so that the telephone lines will not be inductively coupled except for the 0.4-second periods that tone is actually being superimposed on the lines. The 0.1-mu f capacitors prevent battery drain when connected to common-battery lines.

c. One key is marked INT. 1, OFF and INT. 2 for the three positions of the key lever and is used to connect one or the other hummer to the circuit. The other key is marked LOUD, MED., and LOW; and in the LOUD position shorts out the two resistors, in the MED. position shorts out the 50000-ohm resistor and in the LOW position does not short out any resistor.



## 8. Firing Signal Be-65-T2.

a. The firing signals are designed for use at each gun position. Each is housed in a heavy metal case with carrying handle. A screen grill on the front covers a resonator chamber and heavy, blast-proof diaphragm. The back cover is hinged at the bottom and held in place by two knurled-head screws. A heavy waterproof gasket is provided around the edge of the cover and at an opening for the line wires to enter.

b. Inside the case is a Relay BK-7, a heavy vibrator operating on the diaphragm, a terminal panel and a battery compartment for two Batteries BA-23 or equal. The relay is mounted at the top and supported on a shock-absorbing base made of 3/8" Keldur. The relay winding has a resistance of 150 ohms and is connected to two Binding Posts TM-175, designated LINE, mounted on the terminal panel. The relay may be adjusted by means of the SPRING and GAP levers to operate on a current of four milliamperes or less. The relay contact closes a local circuit thru the 3-volt battery and the vibrator contact and winding. The vibrator is adjustable. The current required for operation is approximately 0.7 ampere, but since the vibrator is on only for a short period of 0.4 second for each time-interval, the battery should have a fairly long life. The battery compartment consists of a metal slide held in place when the cover is closed, upon which the two dry cells are clamped in wooden cradles by means of metal straps and thumb screws. Leads are provided for connecting the batteries in series and to the Binding Posts TM-152 on the terminal panel.

## SECTION III

### INSTALLATION

9. Figure 13, drawing ES-A-2931-P, shows a typical example of installation of the time-interval apparatus and associated equipment. A 6-volt storage battery will be required for the EE-85-T6 and EE-87-T4 units. Care should be taken to use a fully charged battery to insure proper operation.

10. Time Interval Apparatus EE-85-T6 should be connected to the 6-volt storage battery. One marked binding post of the time-interval desired and one COMMON binding post should be connected to the RELAY binding posts of the line-connector unit. The firing signals at each gun position should be similarly connected direct to the desired time-interval and common binding posts.

11. Line Connector Unit EE-87-T4 should also be connected to the 6-volt storage battery. The connections to the time-interval apparatus should be made as described in the preceding paragraph. Tone signals may be superimposed on six telephone lines by bridging the lines to the binding posts marked "11" to "16" respectively. A 0.1-mu f capacitor is in series with each transformer secondary winding to prevent battery drain when connected to common-battery lines.



12. The firing signals at each gun position may be connected to the same or different time-intervals as desired. If staggered firing is desired, the proper disc should be put on the arbor and connection made to the spare binding post for that arbor. Several firing signals on the same time-interval may be bridged together or individual lines run to the time-interval apparatus, whichever is shorter.

## SECTION IV

### OPERATION

13. Time-Interval Apparatus EE-85-T6 should be put in operation by pushing the switch to the ON position. The apparatus is self-starting and should require no adjustment of the clock mechanism.

14. Line Connector Unit EE-87-T4 should be put in operation by operating the key to the position for INT. 1 or INT. 2. The multicontact relay is adjusted to operate under the control of the time-interval apparatus to connect the 1000-cycle tone to the telephone lines. The tone key should be operated to the proper position to give the desired volume.

15. The relay of each firing signal should be adjusted for the best operation. Since the 150-ohm relay will operate on a current of four milliamperes or less, the spring tension and armature gap should be adjusted for the current obtained over the line. With the time-interval apparatus in operation (5-second intervals suggested), the SPRING and GAP levers on the relay should be adjusted as follows:

a. With the SPRING lever at position 5, the GAP lever should be moved out until signals stop, then returned about half way on the graduated GAP scale. Minor adjustments may be made with the SPRING lever to obtain the best signals. The SPRING lever should be out far enough to prevent the armature from dropping against the "make" contact for low-current adjustments, and the GAP lever out far enough to prevent the armature from touching the movable core and preventing the contact from closing.

b. Assuming a line resistance of 1000 ohms, the current thru the relay would be  $6 \times 1000 \div 1150 = 5.2$  milliamperes. This would require careful adjustment of the SPRING and GAP levers to secure satisfactory operation. Little spring tension is required and the air gap should be small so that the contact does not vibrate and cause a ragged tone.

c. The loudness of the tone cannot be materially changed by adjustment of the vibrator in the firing signal; this would require rewinding the 3-volt circuit. However the vibrator contacts should be adjusted for best tone and operation, and the locknuts kept tight.



SECTION V  
MAINTENANCE

16. Extreme care should be used in adjusting the time-interval mechanism. Set screws control the spring adjustment of the time-interval contacts and these may be adjusted when required, by removing the large panel from the time-interval case. Only rough paper (not sandpaper) or a burnishing tool should be used in cleaning the contacts. The clock mechanism of the EE-85-T6 apparatus should not be opened but should be removed and sent to the manufacturer for repairs. Additional W. & T. SK-3917 clocks may be obtained and placed in the apparatus.

17. The keys and relay of the line-connector unit should be cleaned and adjusted when required. Since the relay has wiping contacts under spring tension, very little trouble from dirty contacts is expected. The contact springs may be adjusted by bending the top springs up or down with a pair of long-nose pliers.

18. The firing signal relays should be kept clean and in adjustment. Very little adjustment is required for the vibrator mechanism. The batteries should be removed from the lower compartment, except when in use, to prevent corrosion.

19. **PRECAUTION** - When the firing signals are handled with the batteries in place, the spring tension should be increased to the maximum to prevent the contact closing, due to vibration in handling, and the resulting tone from the vibrator.



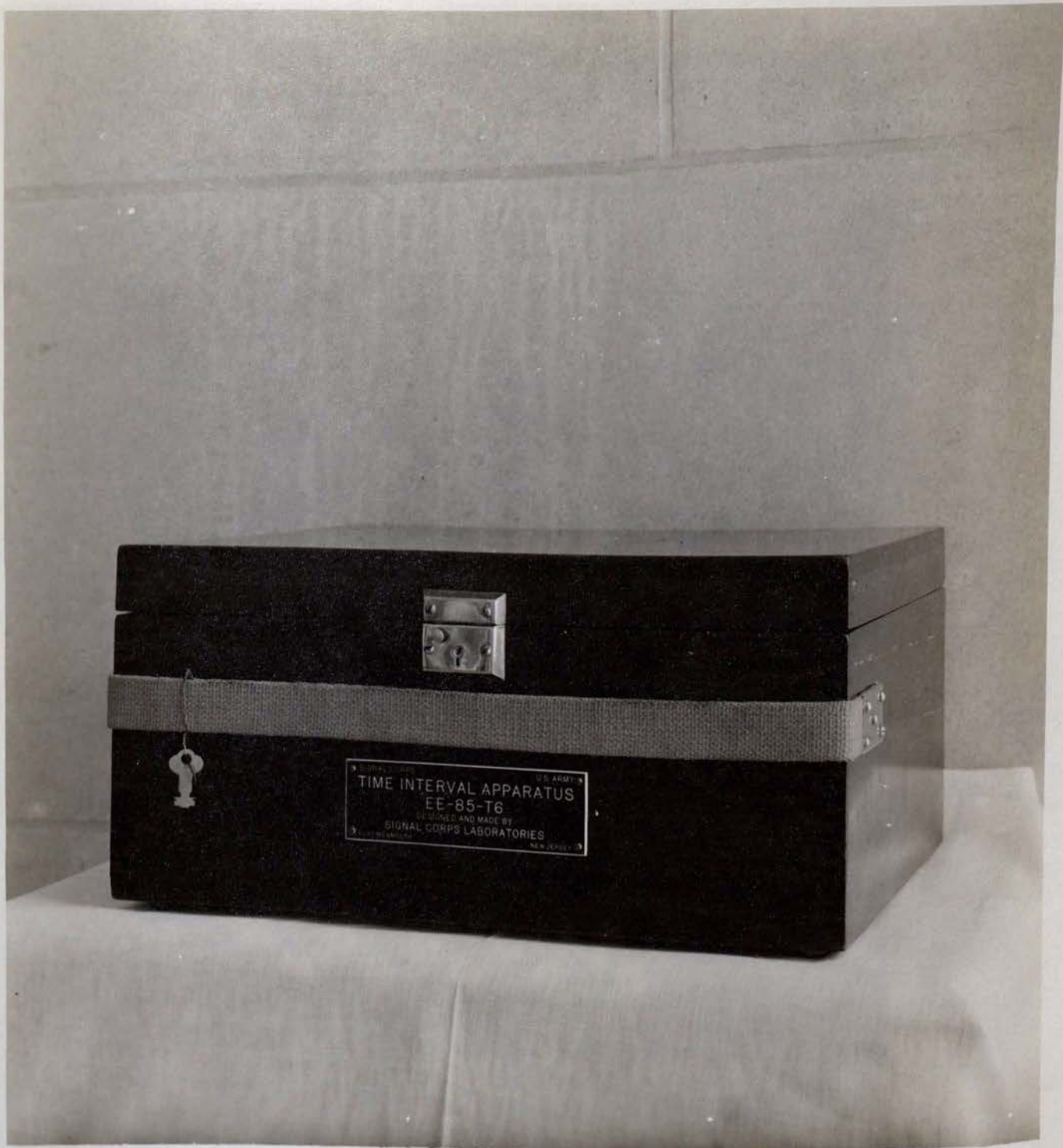


Fig. 1

SIGNAL CORPS LABORATORIES, FORT MONMOUTH, NEW JERSEY		
DATE 4-20-37	NO. 37-41	TITLE: TIME INTERVAL APPARATUS EE-85-T6, CLOSED



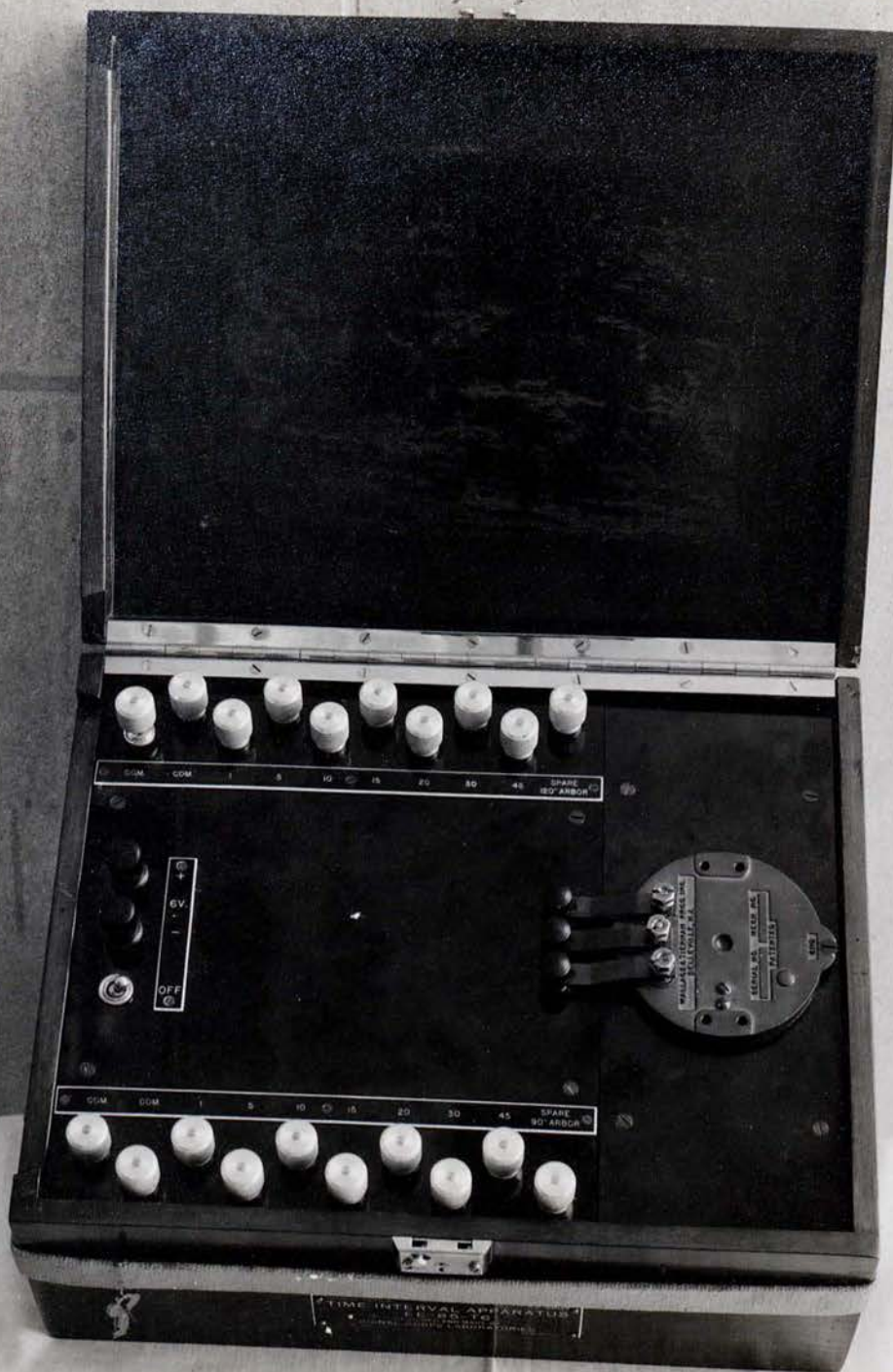


Fig. 2

SIGNAL CORPS LABORATORIES, FORT MONMOUTH, NEW JERSEY

DATE 4-20-37

NO. 37-41-A

TITLE: TIME INTERVAL APPARATUS  
EE-85-T6, OPEN





Fig. 3

SIGNAL CORPS LABORATORIES, FORT MONMOUTH, NEW JERSEY

DATE 4-20-37

NO. 37-41-B

TITLE: TIME INTERVAL APPARATUS  
EE-85-T6, INSIDE VIEW





Fig. 4

SIGNAL CORPS LABORATORIES, FORT MONMOUTH, NEW JERSEY

DATE 4-20-37

NO. 37-42

TITLE: LINE CONNECTOR UNIT  
EE-87-T4, CLOSED





Fig. 5

SIGNAL CORPS LABORATORIES, FORT MONMOUTH, NEW JERSEY

DATE 4-20-37

NO. 37-42-A

TITLE: LINE CONNECTOR UNIT  
EE-87-T4, OPEN



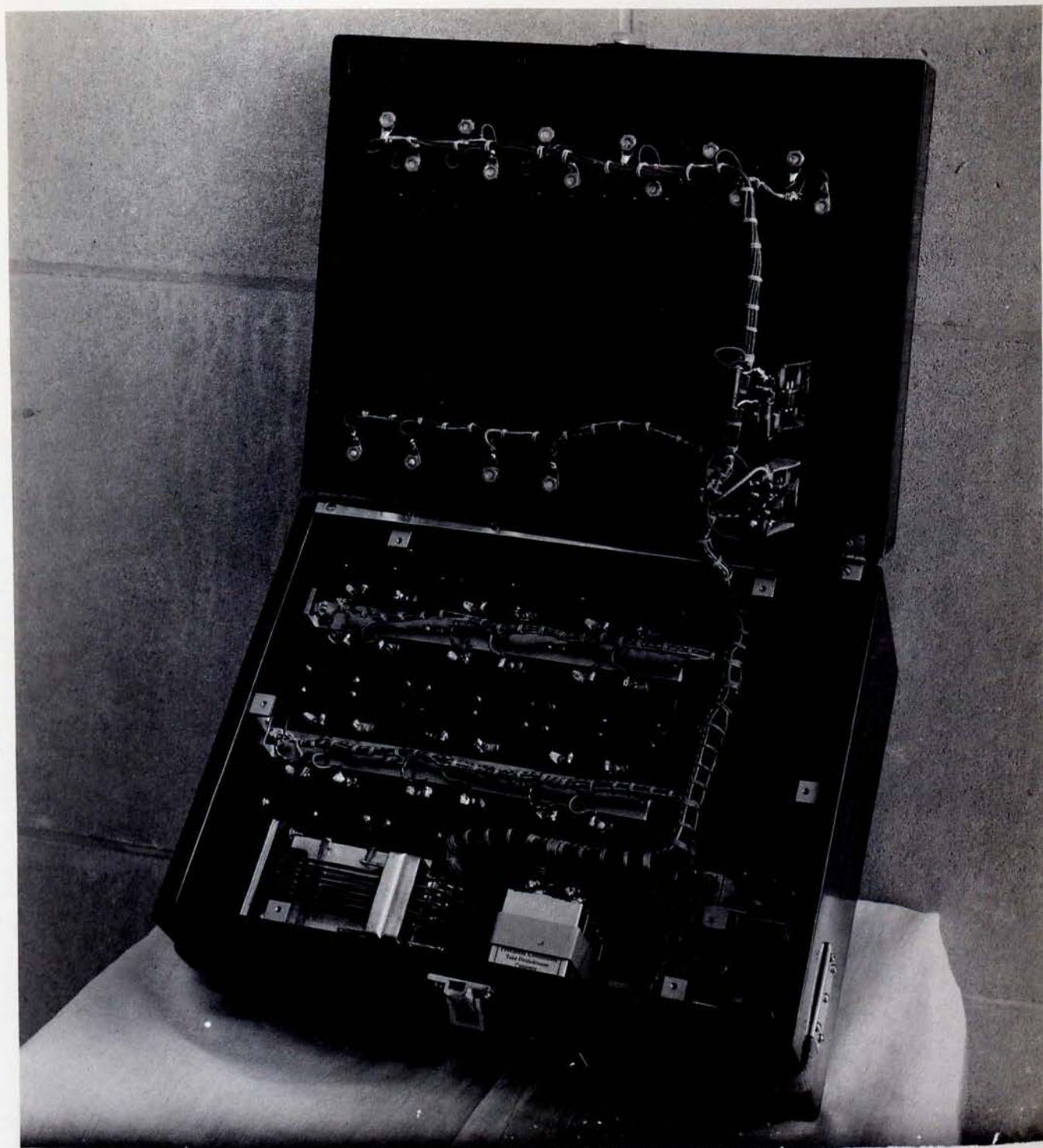


Fig. 6

SIGNAL CORPS LABORATORIES, FORT MONMOUTH, NEW JERSEY

DATE 4-20-37

NO. 37-42-B

TITLE: LINE CONNECTOR UNIT  
EE-87-T4, INSIDE VIEW



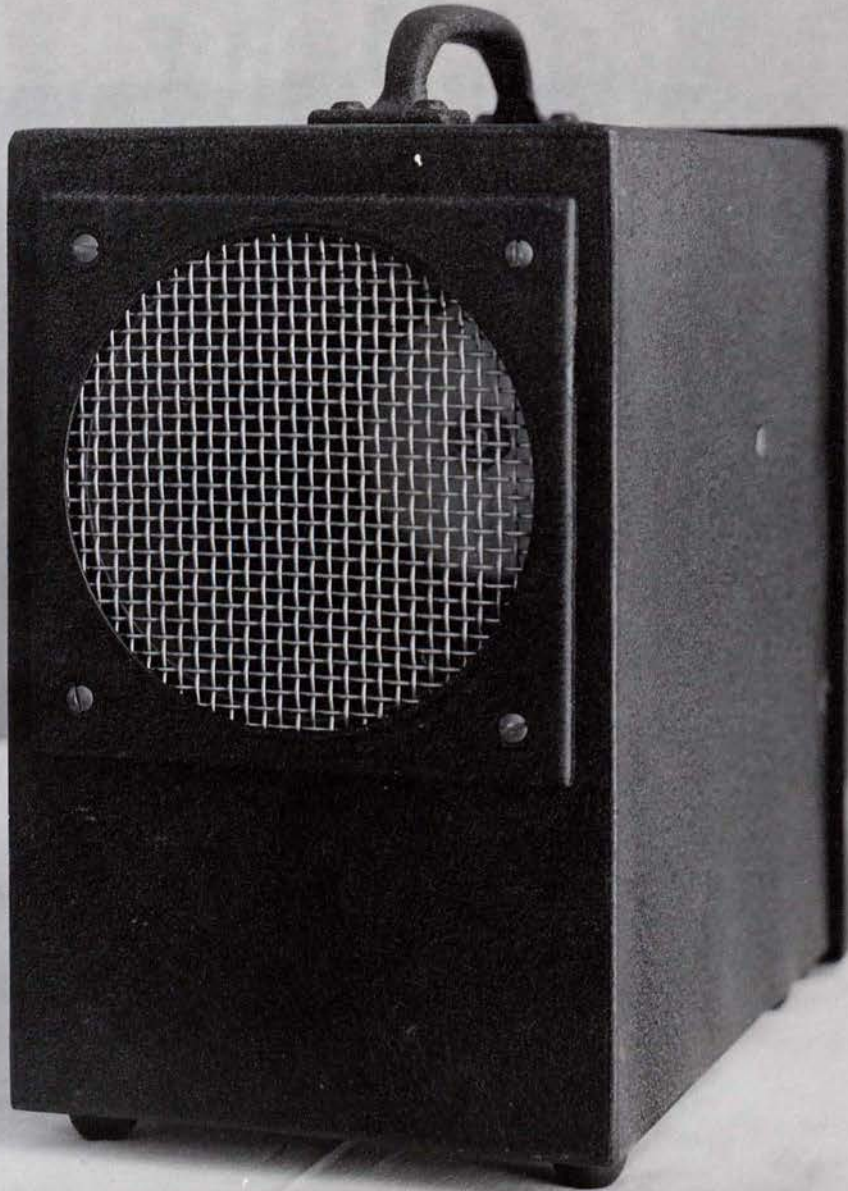


Fig. 7

SIGNAL CORPS LABORATORIES, FORT MONMOUTH, NEW JERSEY

DATE 4-20-37

NO. 37-43

TITLE: FIRING SIGNAL BE-65-T2,  
FRONT VIEW



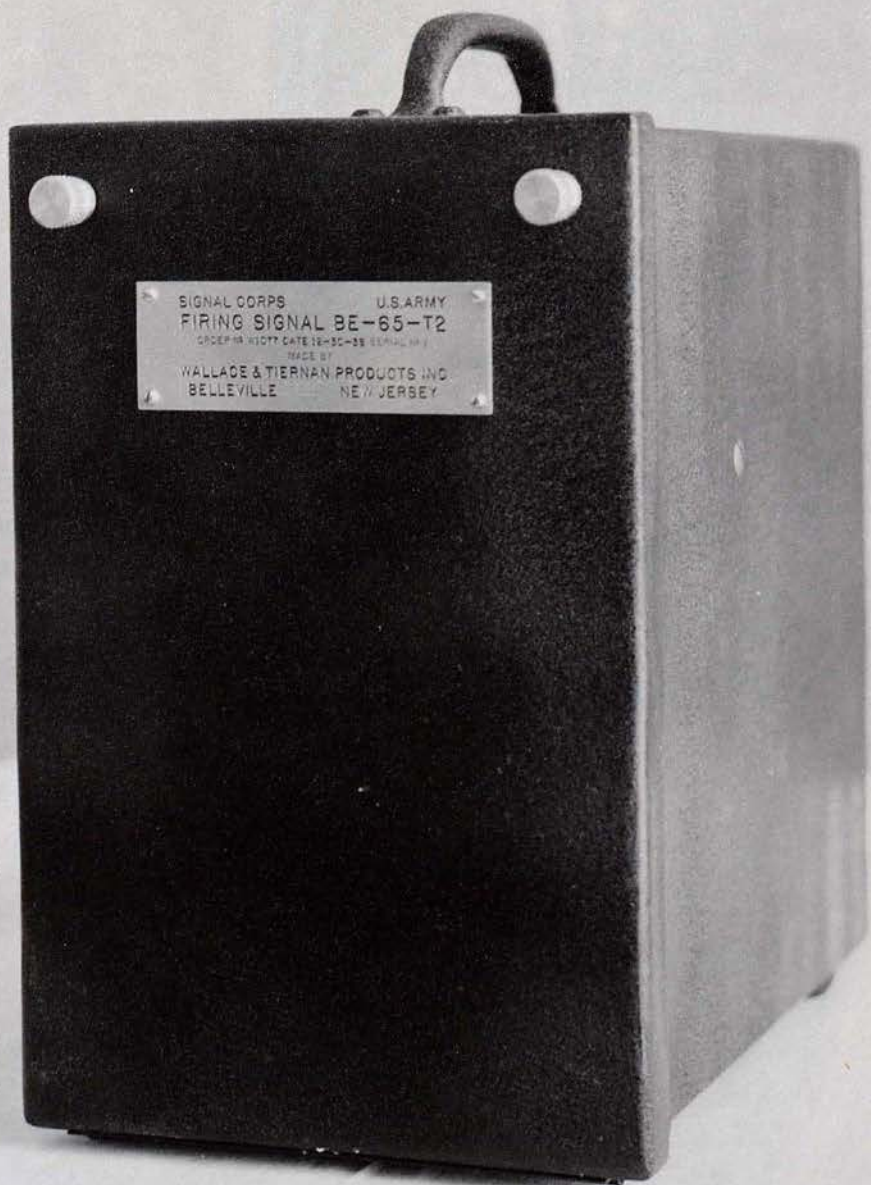


Fig. 8

SIGNAL CORPS LABORATORIES, FORT MONMOUTH, NEW JERSEY

DATE 4-20-37

NO. 37-43-A

TITLE: FIRING SIGNAL BE-65-T2  
REAR VIEW



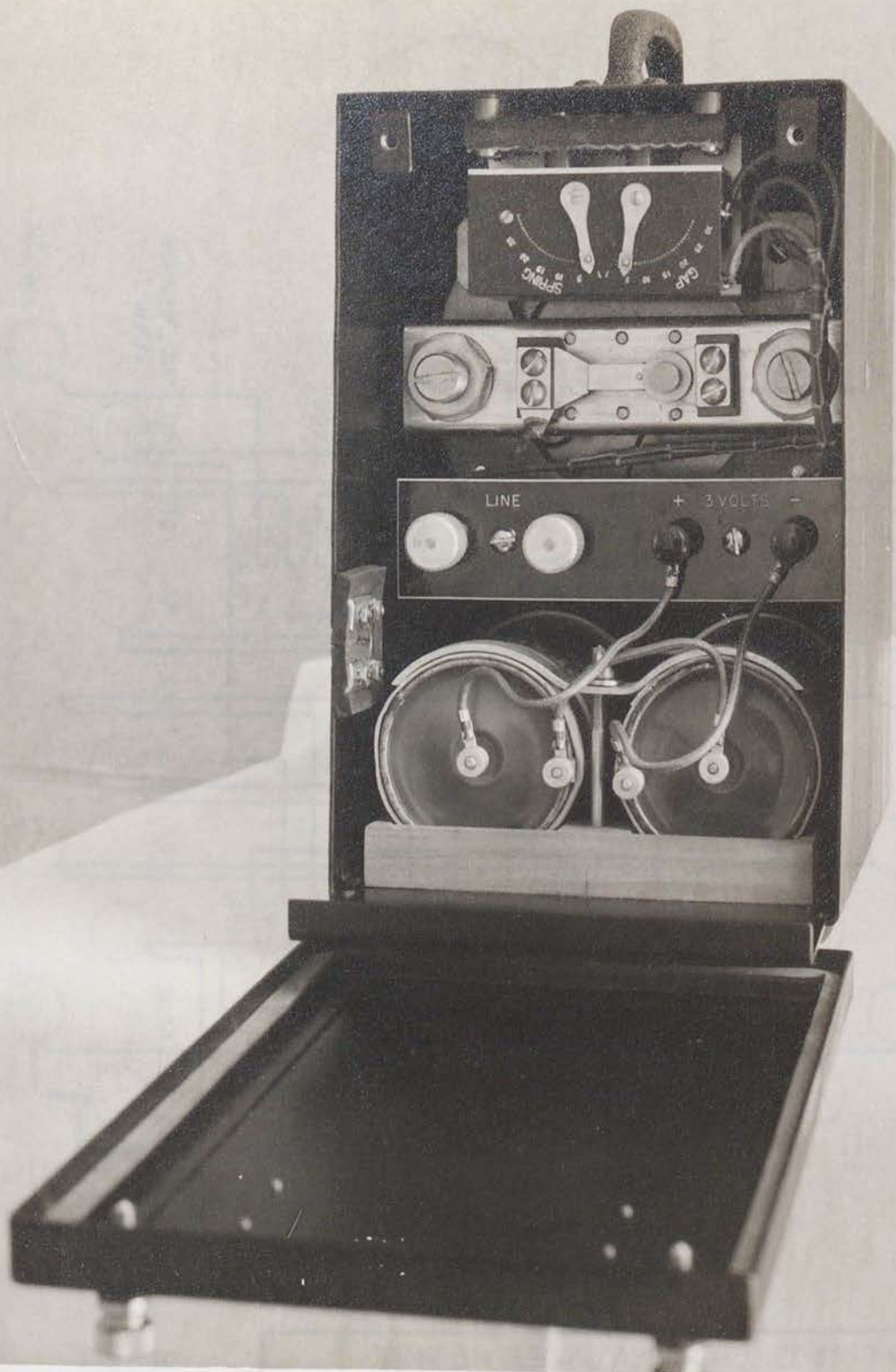


Fig. 9

SIGNAL CORPS LABORATORIES, FORT MONMOUTH, NEW JERSEY

DATE 4-20-37

NO. 37-43-B

TITLE: FIRING SIGNAL BE-65-T2,  
INSIDE VIEW



TIME INTERVAL APPARATUS EE-85-T6  
CIRCUIT LABEL

Fig. 10

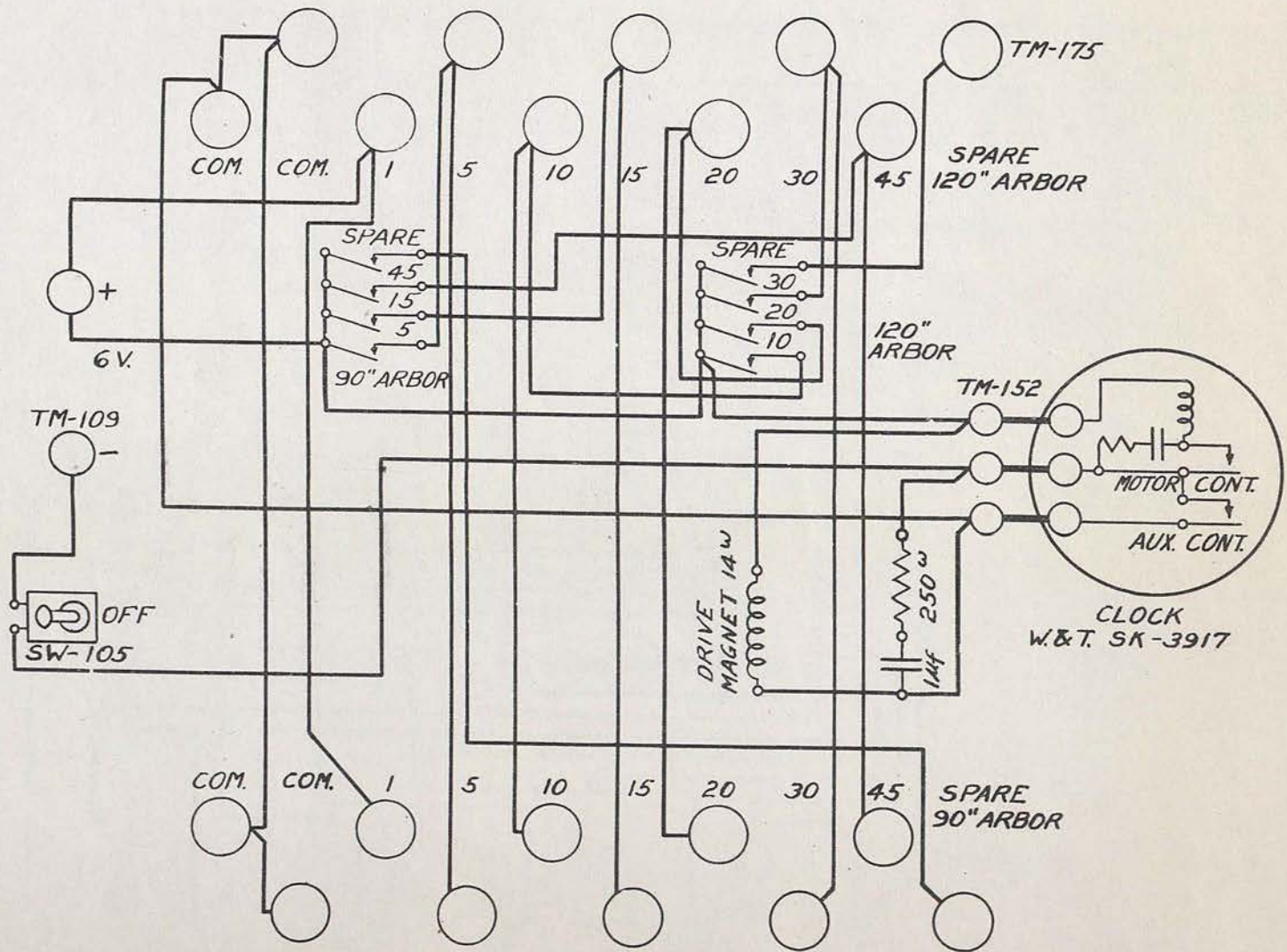
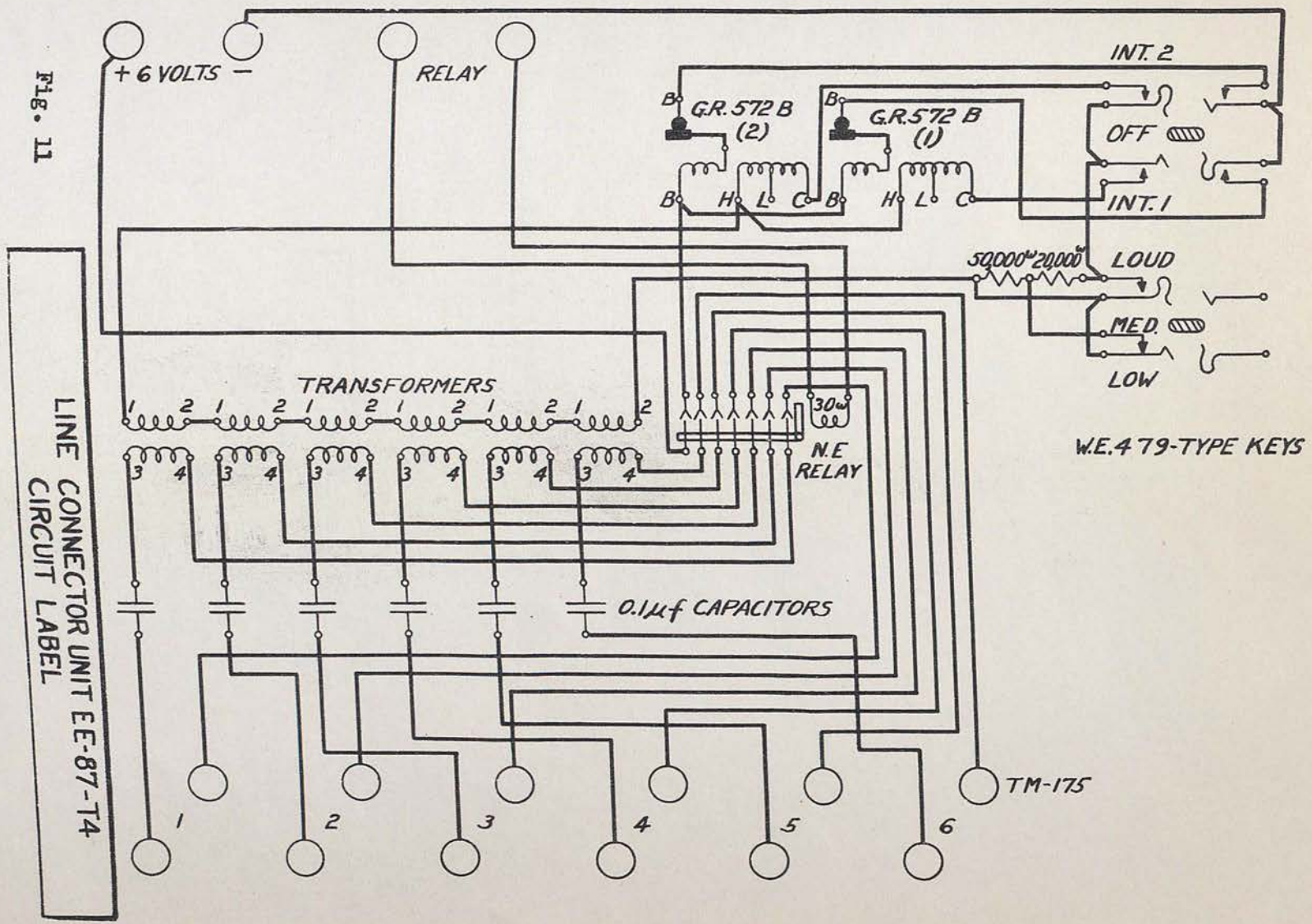




Fig. 11



LINE CONNECTOR UNIT EE-87-T4  
CIRCUIT LABEL

WE.479-TYPE KEYS

TM-175



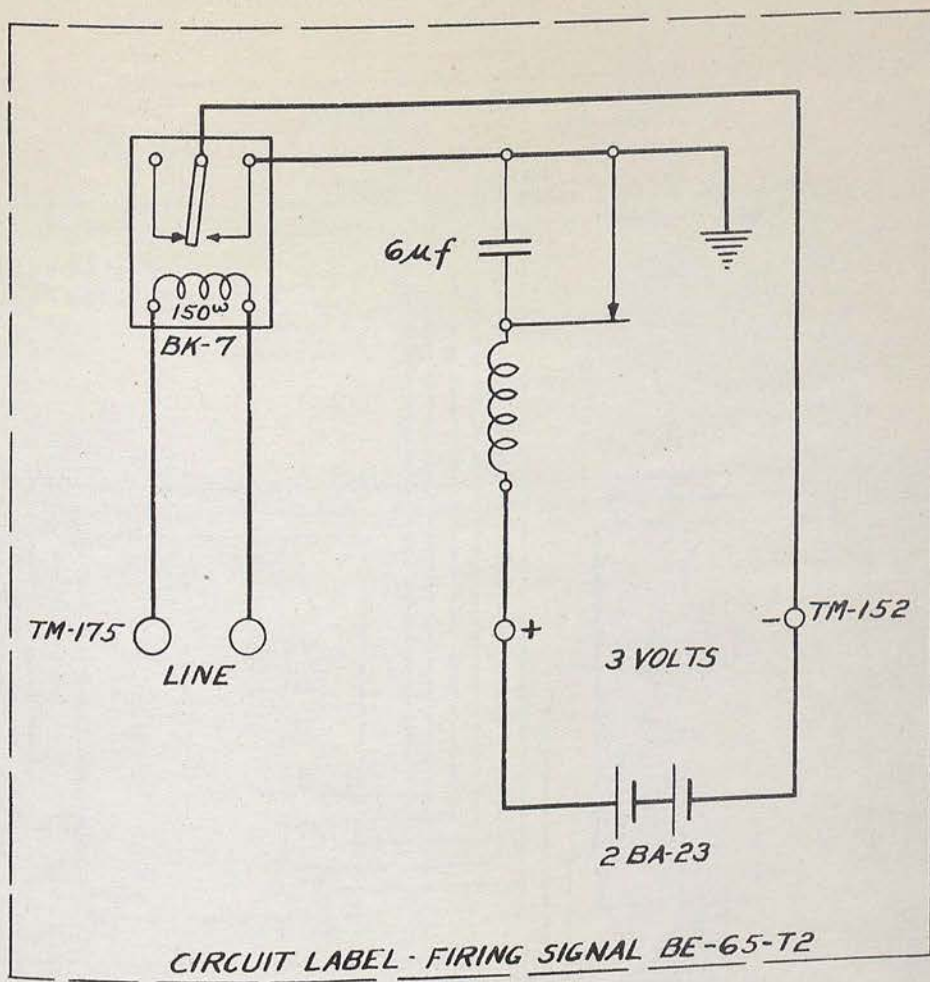


Fig. 12

FIRING SIGNAL BE-65-T2  
CIRCUIT LABEL

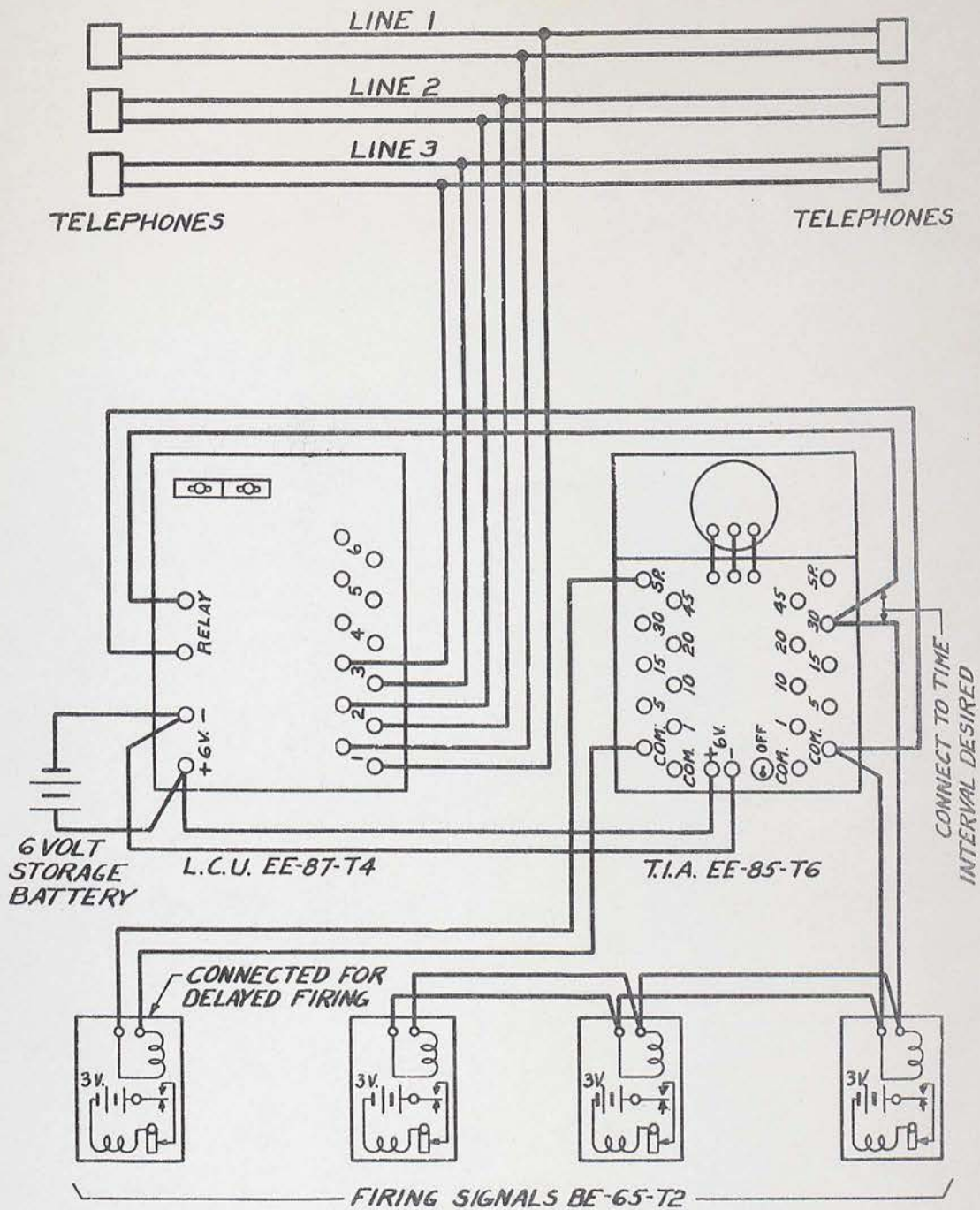


Fig. 13

**EXAMPLE OF INSTALLATION**  
 T.I. APPR. EE-85-T6; L.C. UNIT EE-87-T4 & FIRING SIG. BE-65-T2



