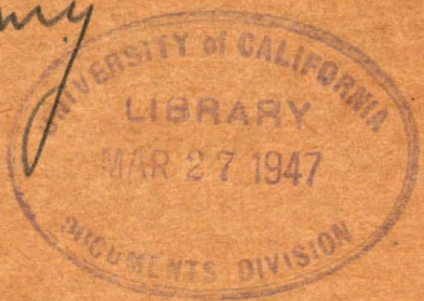


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WAR DEPARTMENT, TECHNICAL MANUAL

U.S. Dept. of Army



TIMING AND TELEPHONE SET ML-110

WAR DEPARTMENT

JUNE 1946

WAR DEPARTMENT TECHNICAL MANUAL

TM 11-334

This manual supersedes TM 11-334, 20 August 1943, and TB 11-334-1, January 1945.

**TIMING AND
TELEPHONE SET
ML-110**



WAR DEPARTMENT

JUNE 1946

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The Adjutant General

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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.

2. Cut—Use axes, handaxes, machetes.

3. Burn—Use gasoline, kerosene, oil, flame throwers, incendiary grenades.

4. Explosives—Use firearms, grenades, TNT.

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

USE ANYTHING IMMEDIATELY AVAILABLE FOR DESTRUCTION OF THIS EQUIPMENT

WHAT—1. Smash—Clock mechanism, battery box, time interval unit case, transmitter, receiver, headband, chest plate, reel, axle.

2. Cut—Cords, straps, wires.

3. Burn—Cords, straps, wires, Technical Manuals.

4. Bury or scatter—All parts that have been smashed, cut, and burned.

DESTROY EVERYTHING

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CONTENTS

Paragraph Page

PART ONE. INTRODUCTION.

Section I. Description of Timing and Telephone Set ML-110.

General	1	1
Table of major components	2	2
Time Interval Unit ML-138	3	2
Head and Chest Set HS-25- (*)	4	4
Jack JK-54	5	6
Plug PL-57	6	6
Reel RL-39- (*)	7	7
Strap ST-42	8	7
Wire W-130-A	9	8
Shipping weights and dimensions of packed timing and telephone set	10	8
Differences in models of Timing and Telephone Set ML-110	11	9

II. Installation and assembly.

Siting	12	9
Unpacking and uncrating	13	10
Assembly of Reel RL-39- (*)	14	12
Checking equipment	15	12
Installation of batteries	16	12
Laying wire with Reel RL-39- (*)	17	13
Connection of Time Interval Unit ML-138 to communication line	18	13
Preliminary tests	19	14
Removing Time Interval Unit ML-138 from service	20	15
Recovering wire with Reel RL-39- (*) or re- loading	21	15

III. Initial adjustments.

Toggle switches	22	15
Clock	23	16
TONE VOLUME control	24	16

PART TWO. OPERATING INSTRUCTIONS.

Section IV. Procedure for operation.

Operation	25	17
Emergency use of receiver as transmitter	26	17
Emergency use of Time Interval Unit ML-138 with Telephone EE-8- ()	27	17
Precautions during operation	28	17

V

Considerations for operation in extremes of temperature and humidity.....	29	18
V. Equipment performance check sheet.		
Purpose and use of equipment performance check sheet.....	30	18
Equipment performance check sheet.....	31	20

PART THREE. MAINTENANCE.

<i>Section VI.</i> Preventive maintenance techniques.		
Meaning of preventive maintenance.....	32	22
Description of preventive maintenance techniques.....	33	22
Preventive maintenance tools and materials.....	34	24
Exterior of Time Interval Unit ML-138 and face of control panel.....	35	24
Head and Chest Sets HS-25-(*).	36	25
Interior of Time Interval Unit ML-138 and back of control panel.....	37	26
Jack JK-54 and Plug PL-57.....	38	27
Reel RL-39-(*).	39	27
VII. Preventive maintenance check list.		
Preventive maintenance check list.....	40	28
VIII. Lubrication.		
Reel RL-39-(*).	41	29
IX. Moistureproofing and fungiproofing.		
General.....	42	29
Reducing failures.....	43	30
Treating Time Interval Unit ML-138.....	44	30
Treating equipment after repairs.....	45	31

PART FOUR. AUXILIARY EQUIPMENT. (Not used.)

PART FIVE. REPAIR INSTRUCTIONS.

<i>Section X.</i> Theory of equipment.		
Time Interval Unit ML-138.....	46	33
Interrupter BZ-7-G.....	47	35
Timing and switching mechanism.....	48	36
Head and Chest Set HS-25-(*).	49	37
Transmitting.....	50	38
Receiving.....	51	39
XI. Test equipment.		
Test equipment.....	52	40
XII. Trouble shooting.		
General.....	53	41
Procedures.....	54	41
Trouble-shooting chart.....	55	42
XIII. Adjustments.		
Clock-operated contacts and switching mechanism.....	56	44
Signal time.....	57	46
XIV. Removal and replacement of parts.		
Capacitor CA-243.....	58	48

	<i>Paragraph</i>	<i>Page</i>
Interrupter BZ-7-G-----	59	48
Clock -----	60	50
Switches SW-105 and SW-106-----	61	52
TONE VOLUME rheostat-----	62	52
Battery Box-----	63	52
Head and Chest Set HS-25- (*)-----	64	53
Reel RL-39- (*)-----	65	53
Unsatisfactory Equipment Report-----	66	54
APPENDIX I. MAINTENANCE PARTS FOR TIMING AND TELEPHONE		
SET ML-110-----		57
II. REFERENCES AND ABBREVIATIONS-----		59

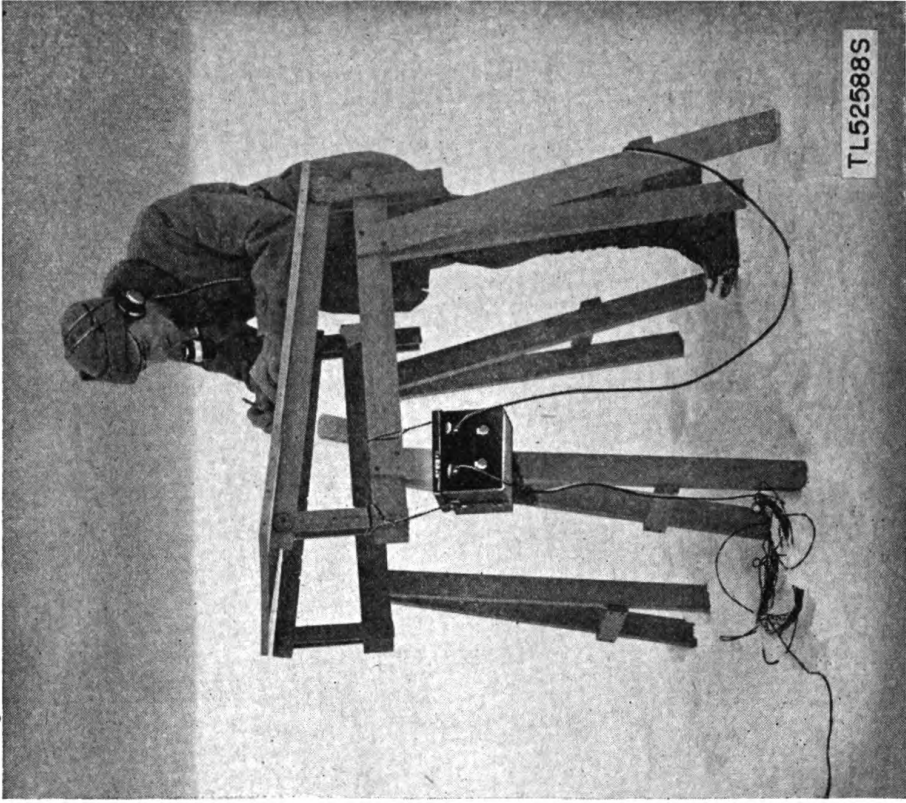
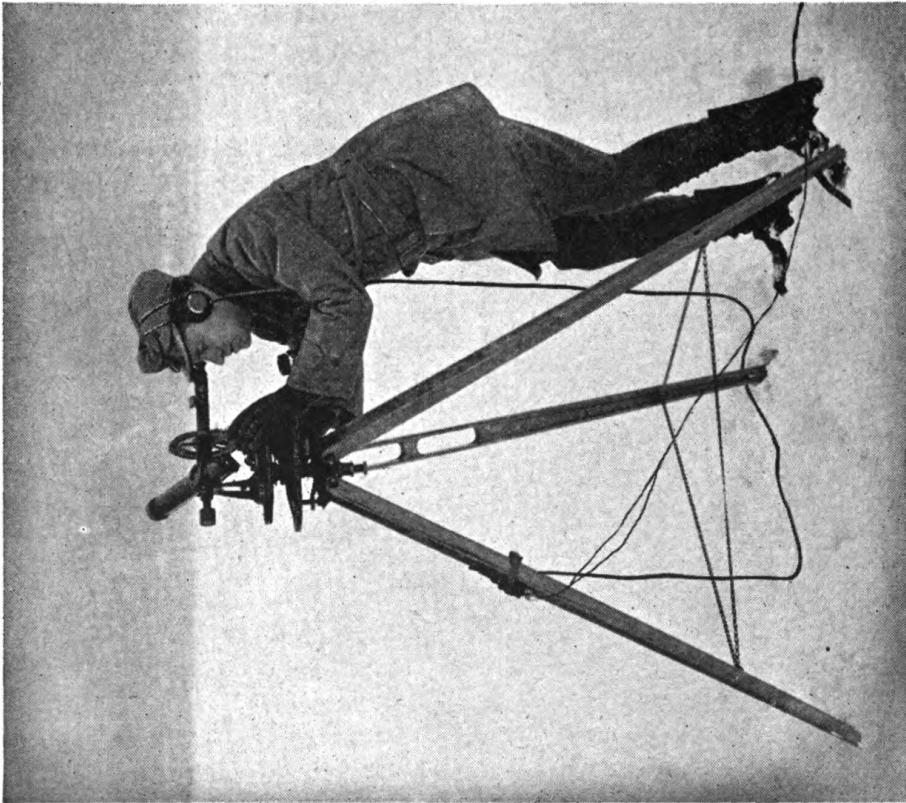


Figure 1. Timing and Telephone Set ML-110 in use with theodolite and plotting station equipment.

This manual supersedes TM 11-334, 20 August 1943, and TB 11-334-1, January 1945

PART ONE

INTRODUCTION

Section I. DESCRIPTION OF TIMING AND TELEPHONE SET ML-110

1. General

a. Timing and Telephone Set ML-110 consists of Time Interval Unit ML-138 and associated equipment. The timing and telephone set is designed as an aid in making theodolite observations of pilot balloons. It provides two services: telephonic communication between a plotting station and one or two theodolite observers, and superimposed timing signals on the telephone communication line to aid the observer in making periodic observations of balloon positions.

Note. All timing and telephone sets procured in the ML-110 or ML-210 series have been converted so that all have like components. The sets formerly designated as Timing and Telephone Sets ML-110-A, B, C, ML-210-A, and B varied in that sets were supplied with different types of wire or cable or in that none were furnished. All of these sets are operationally identical.

b. Timing and Telephone Set ML-110 is usually used for single theodolite observations where the distance between the observer and the plotter is much less than the greatest range of the equipment, but it may be used over relatively long base lines for double theodolite observations. (For information regarding these applications, see TM 11-1158A and TM 1-235.)

c. Time Interval Unit ML-138 continuously generates a tone of about 1,000 cycles per second. This tone is transmitted intermittently to the line by a timer which is based on a modified 8-day clock. A special interrupter, operating from two Batteries BA-30, serves as the tone generator.

d. Battery power is required only for operating the tone generator unit. The tone unit will operate with a battery potential, under load, as low as $1\frac{1}{2}$ volts.

e. The timing and telephone set uses sound-powered telephone equipment requiring no battery power. The operating range of the equipment is limited to about 3 miles of Wire W-130-A or its equivalent.

2. Table of Major Components

The items listed below are the major components of Timing and Telephone Set ML-110:

Package No.	Component	Quantity	Dimensions (in.)			Weight (lb.)
			Height	Length	Depth	
1	Time Interval Unit ML-138.	1	6 $\frac{7}{32}$	7 $1\frac{1}{16}$	5 $\frac{7}{16}$	10.6
	Head and Chest Set HS-25, HS-25-A, or B.	2		Cord 120		2.6 (each)
	Jack JK-54 (one in use, one spare).	2		2 $\frac{1}{4}$	$\frac{7}{8}$ OD	0.1 (each)
	Plug PL-57 (one in use, one spare).	2		3 $\frac{5}{8}$ over-all, shank	$\frac{7}{8}$ OD	0.3 (each)
	Strap ST-42	1		1 $3\frac{1}{16}$		
	Reel RL-39 or RL-39-A.	1		65	2 wd	0.7
	Wire W-130-A	1		14	10 diam	7.0
	Wire W-130-A	$\frac{1}{4}$ mi				10.0

Note. This list is for general information only. See appropriate publications for information pertaining to requisition of spare parts.

3. Time Interval Unit ML-138

a. Time Interval Unit ML-138 (fig. 2) consists of a metal box assembly with a hinged cover and detachable bracket for mounting. All the metal box parts are black enamel finish. There are four circular openings in the front of the case. The two upper openings provide access to Jacks JK-44 on the chassis of the unit. The two lower openings are used when winding the clock in the unit. Each of the four circular openings is weatherproofed with a hinged cover under spring tension and a sponge rubber or felt seal. The box cover is fastened with a sliding catch. A D-shaped ring on either side of the case is for attaching Strap ST-42 for carrying the unit.

b. A detachable mounting bracket fits over the back of the case and is fastened to the case by fitting the openings along the edges of the mounting bracket over the two screws on each side of the unit. (See fig. 3.) The bracket has four holes for screwing or bolting the unit to walls of a building or vehicle or other support.

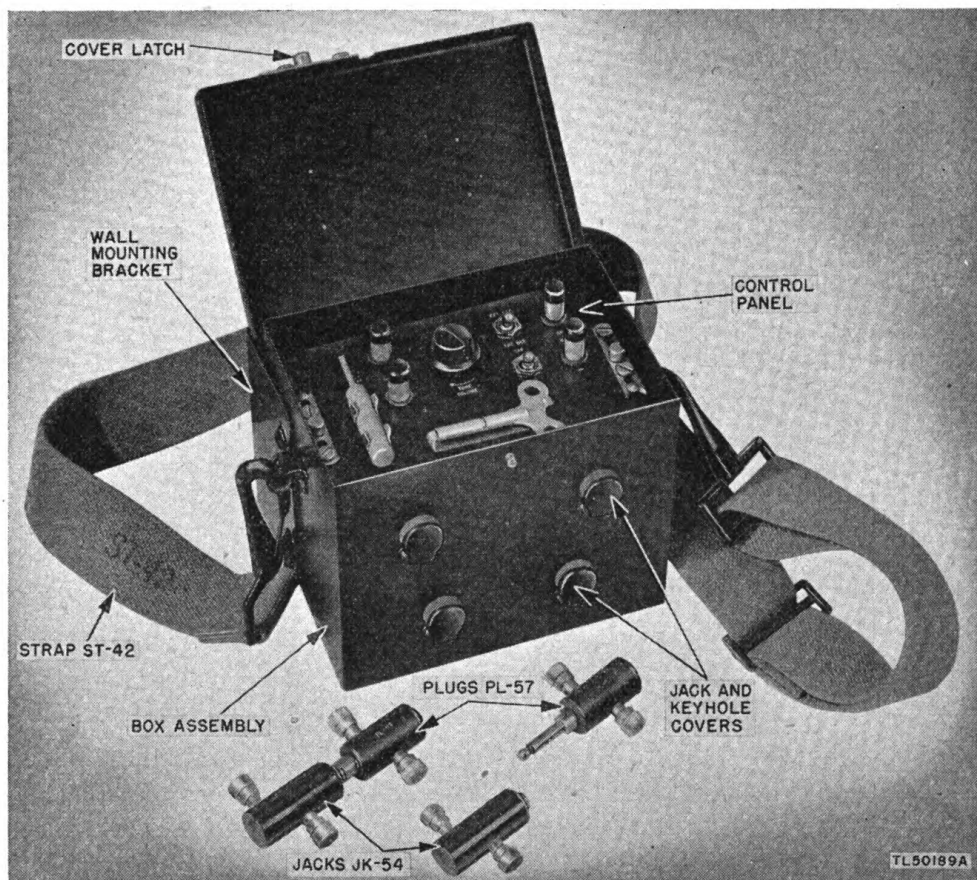


Figure 2. Time Interval Unit ML-138 with Plugs PL-57 and Jacks JK-54.

The bracket must be removed from the time interval unit by loosening the four screws on the sides of the case before it can be mounted on a support.

c. The control panel (fig. 4) is mounted in the top of the box just under the cover, and is held in place by two slide fasteners, one at each end of the unit. The two binding posts marked EXT BAT in the upper-right-hand corner of the panel are for connecting an external battery as a source of power. The toggle switch marked EXT BAT-INT BAT to the left of the external battery binding posts is used for shifting the interrupter input from the internal-battery to the external-battery terminals. Battery power is turned ON or OFF by the ON-OFF toggle switch. The TONE VOLUME control is mounted in the center of the panel and is used to vary the intensity of the tone placed on the line. Turning the control in the direction of the arrow increases the volume. The two binding posts designated LINE are connected in parallel with Jacks JK-44 at the front of the unit, and are used when it is desired to connect the incoming line wires directly to the unit. A key for winding the clock in the unit and a screw driver are also mounted on the control panel.

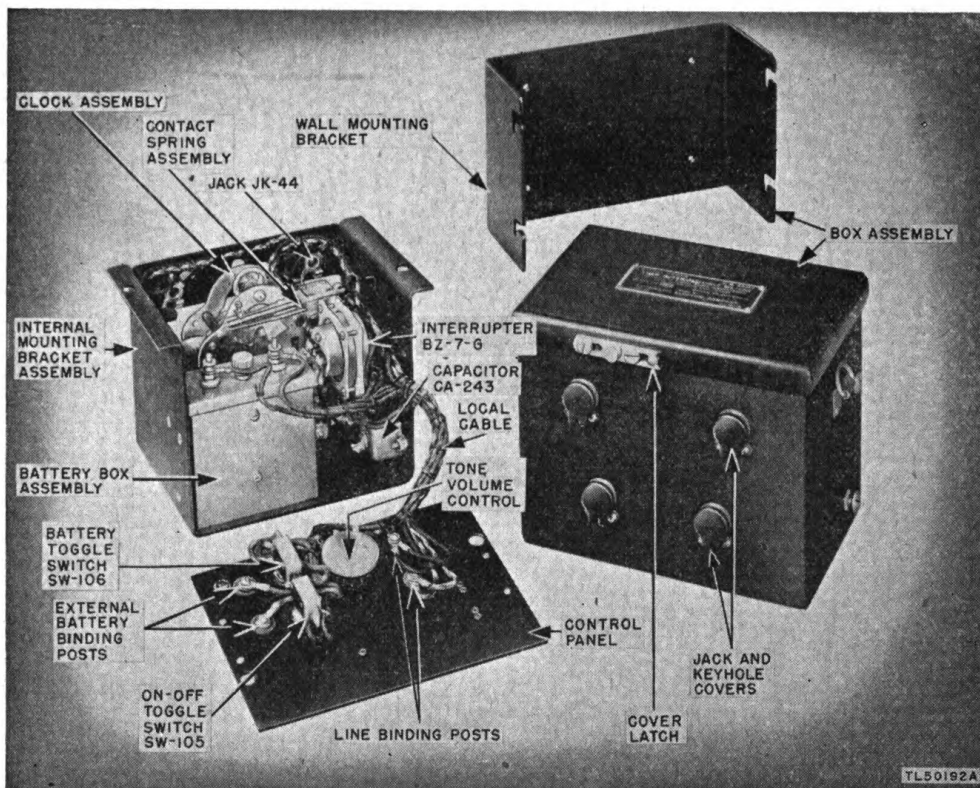


Figure 3. Time Interval Unit ML-138—control panel and mounting brackets removed from box.

d. The control panel and the internal mounting bracket assembly (fig. 3) may be lifted out of the case when the slide fasteners on each side of the control panel are released. The internal mounting bracket assembly rests on the same two shelves of the case as the control panel. The panel is connected to the bracket by a short cable. The internal mounting bracket assembly contains the clock assembly, Jacks JK-44, the battery box assembly, and Interrupter BZ-7-G.

e. Time Interval ML-138 is $7\frac{11}{16}$ inches long, $5\frac{7}{16}$ inches deep, and $6\frac{7}{32}$ inches high. It weighs approximately $10\frac{1}{2}$ pounds.

4. Head and Chest Set HS-25-(*)

Head and Chest Set HS-25-(*) (fig. 5) consists of a lightweight chest type transmitter and a single-receiver headset. A 10-foot, rubber-covered Cord CD-1175 leads from the connection block on the chest plate, terminating in Plug PL-47 which will fit Jacks JK-44 on the time interval unit and Jack JK-54 which terminates the communication line. The transmitter and receiver units are sound powered, requiring no battery for operation. Both the units are connected in parallel in the connection block on the transmitter chest plate.

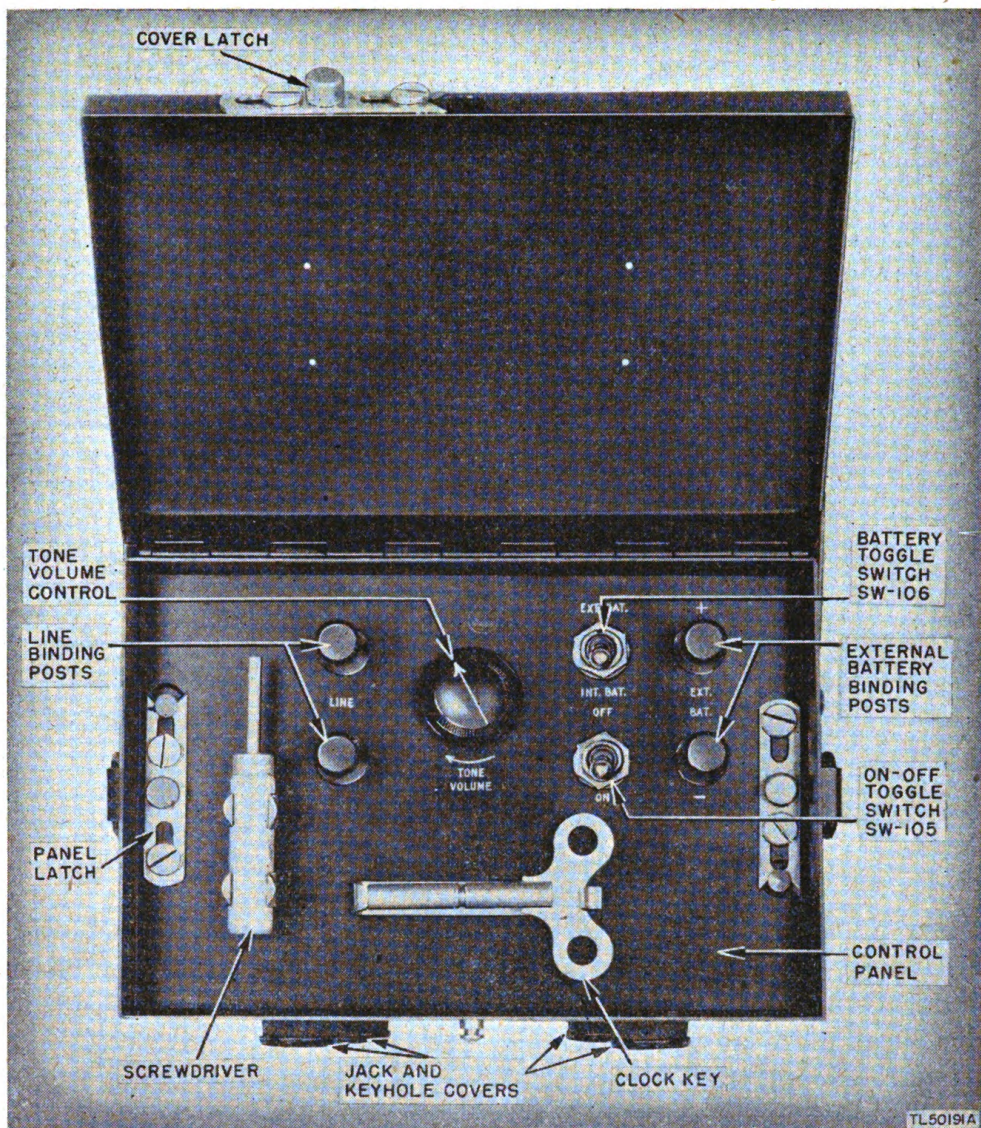


Figure 4. Time Interval Unit ML-138, control panel—face view.

Note. In this manual, Head and Chest Set HS-25-(*) refers to Head and Chest Set HS-25, HS-25-A, or B.

a. **HEADSET.** The headset consists of a single receiver with a sponge-rubber earpiece mounted on a flexible wire headband. A leather pad is mounted on the other end of the headband. The receiver cord terminates in a short plug which fits into a rubber-covered Jack JK-26 on a short Cord CD-1174 leading to the connection box on the chest plate.

b. **CHEST SET.** The chest set consists of a transmitter assembly and a connection block mounted on a flat metal plate. The transmitter is mounted on the end of a curved metal arm. The transmitter arm is attached to the chest unit by a swivel flange, and may be adjusted to the desired position by a knurled thumb-

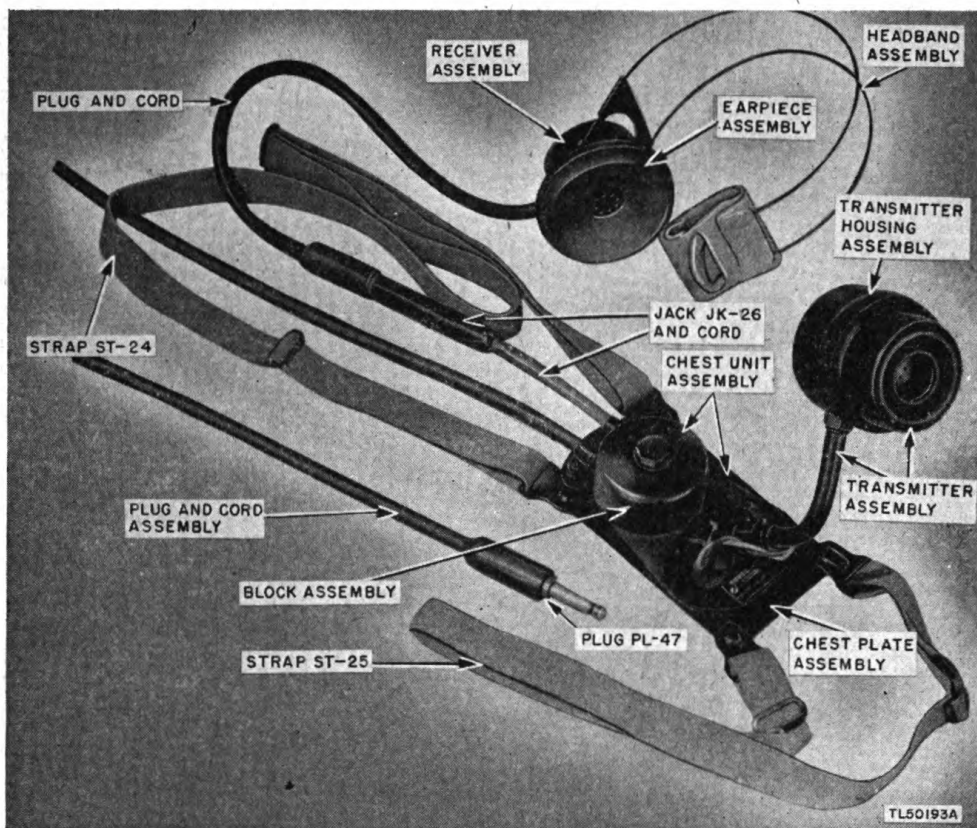


Figure 5. Head and Chest Set HS-25-A.

screw at the base of the arm. Two straps of canvas webbing, Straps ST-24 and ST-25, are attached permanently to the chest plate at one end and by a spring clip which hooks onto a stud on the chest plate at the other end. Straps ST-24 and ST-25 are similar, except that Strap ST-24 is 33 inches long while Strap ST-25 is 54 inches long. Both straps are adjusted in length by metal slides.

5. Jack JK-54

Jack JK-54 (fig. 2) is used at the theodolite station for connecting Head and Chest Set HS-25-(*) to the communication line. It is a two-way extension jack inclosed in a phenolic shell through which two external binding posts protrude. The two-wire communication line from the plotting station connects to the binding posts of the jack.

6. Plug PL-57

Plug PL-57 (fig. 2) is used to connect the communication line from the theodolite station to the time interval unit. It is a single-shank, two-conductor plug similar to a standard telephone

plug except that two binding posts protrude through the phenolic shell. These binding posts are connected to the tip and sleeve of the plug, respectively. The incoming two-wire communication line connects to the binding posts of the plug.

7. Reel RL-39-(*)

Note. In this manual, Reel RL-39-(*) refers to Reel RL-39 or RL-39-A.

Reel RL-39-(*) (fig. 6) is a lightweight, portable unit designed to be carried by one man. It is used for laying and recovering Wire W-130-A over short distances, and consists of Spool DR-8, a handle assembly, axle and crank, and adjustable straps. Spool DR-8 is a steel drum 9 inches in diameter and 8 inches wide which will hold up to $\frac{1}{2}$ mile of Wire W-130-A or its equivalent. Mounted on one side of the spool is a terminal plate, Connector M-221, fitted with two brass thumbnut terminals. A hole in the spool flange just below the terminal plate permits the reel end of the wire to be connected to these terminals. The handles are two U-shaped steel rods with a loop formed at each end to encircle the bearing assembly. Steel braces are riveted across the corners of both handles to hold the snaps of the carrying straps in position. The bearing assembly consists of a brass housing containing a steel center with a square hole. The two bearings support the axle and spool and rotate freely when wire is played out or when the crank is used to rewind the wire. The axle is a steel shaft $\frac{5}{16}$ inch square and $11\frac{1}{16}$ inches long. A crank consisting of a lever arm and a cast-iron knob is attached to one end. The arm and knob are joined together by a brass spindle, and the complete crank is riveted to the axle. A cotter pin in the open end of the axle permits the complete assembly to be removed from the handles. The straps are of cotton webbing and are adjusted by metal buckles. Carrying Strap ST-35 has a ring at each end with two shorter straps, equipped with snap fasteners, sewed to each ring. Strap ST-34 is 42 inches long with snaps at both ends. Reel RL-39-(*) weighs approximately 17 pounds when loaded with $\frac{1}{4}$ mile of Wire W-130-A.

8. Strap ST-42

Strap ST-42 (fig. 2) is an adjustable strap of heavy canvas webbing provided for carrying Time Interval Unit ML-138. The strap is adjusted by a metal slide buckle. Snap hooks on either end of the strap fasten through the carrying rings on the ends of the case of the time interval unit.

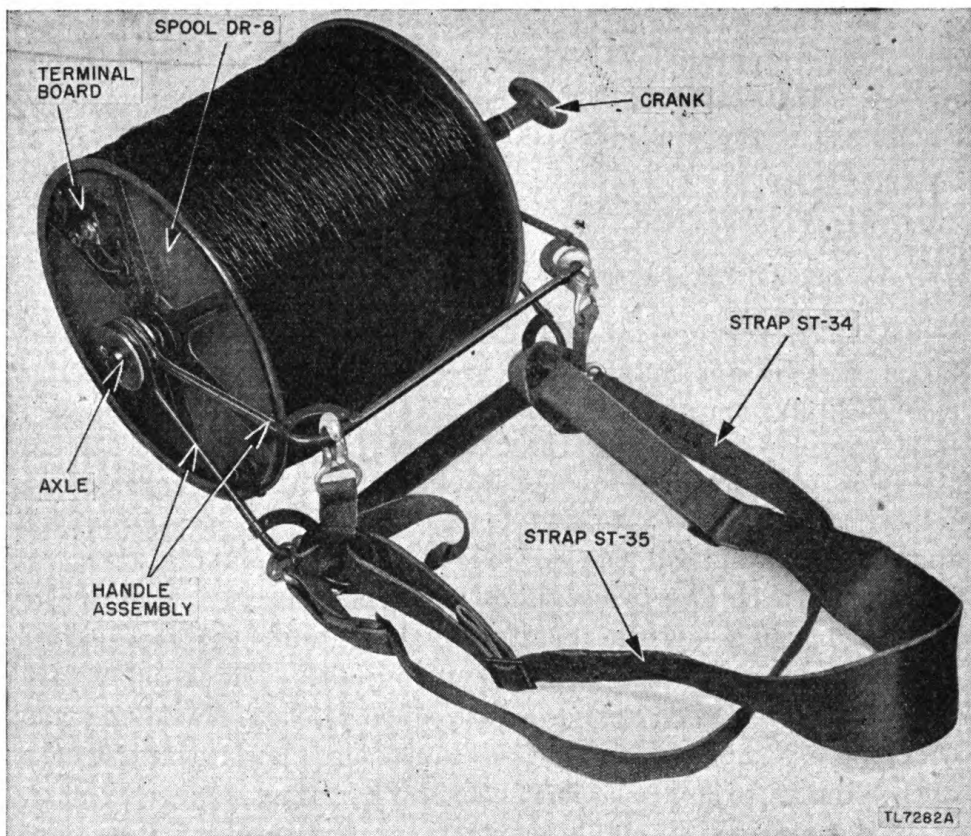


Figure 6. Reel RL-39.

9. Wire W-130-A

Assault Wire W-130-A is a twisted pair, each conductor consisting of one copper and six steel strands with vinylite insulation. One-quarter mile of Wire W-130-A is issued with each timing and telephone set.

10. Shipping Weights and Dimensions of Packed Timing and Telephone Set

a. The components of Timing and Telephone Set ML-110 are packed in two shipping containers.

(1) The crate containing Time Interval Unit ML-138, Head and Chest Sets HS-25-(*), Jacks JK-54, Plugs PL-57, Strap ST-42, and the Technical Manuals is marked PKG-1. This crate is approximately 25 inches long, 15¼ inches wide, and 14¼ inches high over-all and displaces 2 cubic feet. It weighs about 36 pounds. Each of these components is packaged separately in corrugated fiberboard boxes, and the separate containers are packed in a wooden shipping crate with a waterproof liner.

(2) Reel RL-39-(*) is shipped disassembled. Each crank and handle are individually wrapped in greaseproof paper and flex-

ible corrugated paper. Small metal parts are packed in a cardboard carton. Straps ST-34 and ST-35 are individually packed in corrugated cartons. Spool DR-8, the wrapped crank and handle, and the small cartons containing the parts and straps are packed in a fiberboard box cushioned with fiberboard cells. This box is placed in a wooden crate approximately 12 inches long, 10½ inches wide, and 13¾ inches high over-all and displaces 2 cubic feet. It weighs about 22 pounds.

b. Some variation from these figures should be expected because of differences in the weights of shipping containers.

11. Differences in Models of Timing and Telephone Set ML-110

All Timing and Telephone Sets ML-110 are operationally identical. Sets formerly designated as Timing and Telephone Sets ML-110-A, B, C, ML-210-A, and B differed only in the equipment issued with Time Interval Unit ML-138, in the type of wire or cable issued with the set, or in that no wire or cable was furnished.

a. JACK JK-39. Jack JK-39 is replaced in current issues of Timing and Telephone Set ML-110 by Jack JK-54. Jack JK-39 is an extension jack inclosed in a bakelite shell and is used at the theodolite station to connect Head and Chest Set HS-25-(*) to the communication line. Screws on the spring terminals secure the line wires to the terminals.

b. AXLE RL-27-A OR B. Axle RL-27-A or B with Reel DR-4 was formerly issued with Timing and Telephone Sets ML-110-A, B, and C. Axle RL-27-A or B consists of an axle and a crank. The axle holds one Reel DR-4.

c. WIRE W-110-B. A 2,400-foot length of Wire W-110-B was supplied only as a part of Timing and Telephone Set ML-110-A.

d. CORD. Four hundred feet of rubber-sheathed cord with two #18 AWG stranded conductors was issued as a part of Timing and Telephone Sets ML-110-B and C.

e. HEAD AND CHEST SETS. Head and Chest Set HS-25-A was supplied with Timing and Telephone Sets ML-110-A, B, C, and ML-210-A. Head and Chest Set HS-25-B was supplied as a part of ML-210-B.

Section II. INSTALLATION AND ASSEMBLY

12. Siting

a. Select the locations for the theodolite station or stations and the plotting board to be within the range of the equipment (3 miles of Wire W-130-A or its equivalent). Time Interval Unit

ML-138 has been weatherproofed and can be used indoors or outdoors. The unit may be placed on the ground, attached to a wall, or hung by the carrying strap to any convenient support. When using the equipment out-of-doors, however, place it so that it is somewhat protected from driving rain or sleet.

b. For mounting in a building or vehicle, screw or bolt the mounting bracket of the time interval unit to the wall of the building or vehicle. Mount or hang the equipment in such a way that the incoming lines from the theodolite station will not become tangled with the cord from the head and chest set.

c. Locate the time interval unit near the plotting board, allowing enough slack in the head and chest set cord for the user to work conveniently at the plotting board. The cord from the unit to the plotter's head and chest set and the line to the theodolite observer's head and chest set should not pass across any part of the surface of the plotting board. Mount the unit so that the clock may be wound and the batteries changed. Keep the unit as level as possible.

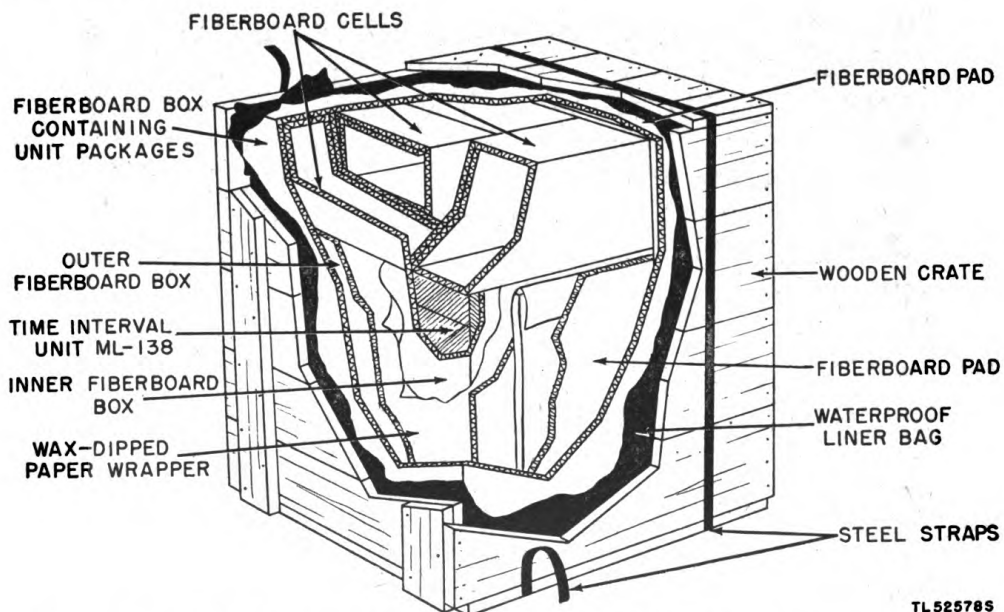
13. Unpacking and Uncrating

Be careful when unpacking or handling the equipment because it can be damaged easily when not protected by the packing case. In unpacking, follow the steps outlined below:

a. Place the packing case as near the operating location as is convenient.

b. Cut the steel straps.

c. Remove the nails, using a nail puller, and remove the sides of the packing case.



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Figure 7. Timing and Telephone Set ML-110 packaged for oversea shipment.

d. Lift off the top of the case and remove the liner bag of waterproof paper.

e. Remove all the fiberboard cells and cushioning of corrugated paper.

f. Lift out the smaller packages containing the component parts.

g. Unpack Time Interval Unit ML-138 as follows:

(1) Remove the outer fiberboard box.

(2) Remove the wax-dipped paper wrapper, and open the inner fiberboard box.

(3) Lift out the time interval unit by the rings on the sides of the case.

(4) Open the cover of the unit and remove the three bags of silica gel. Remove the two bags of silica gel from between the unit and the mounting bracket.

(5) Place the time interval unit near its final operating position.

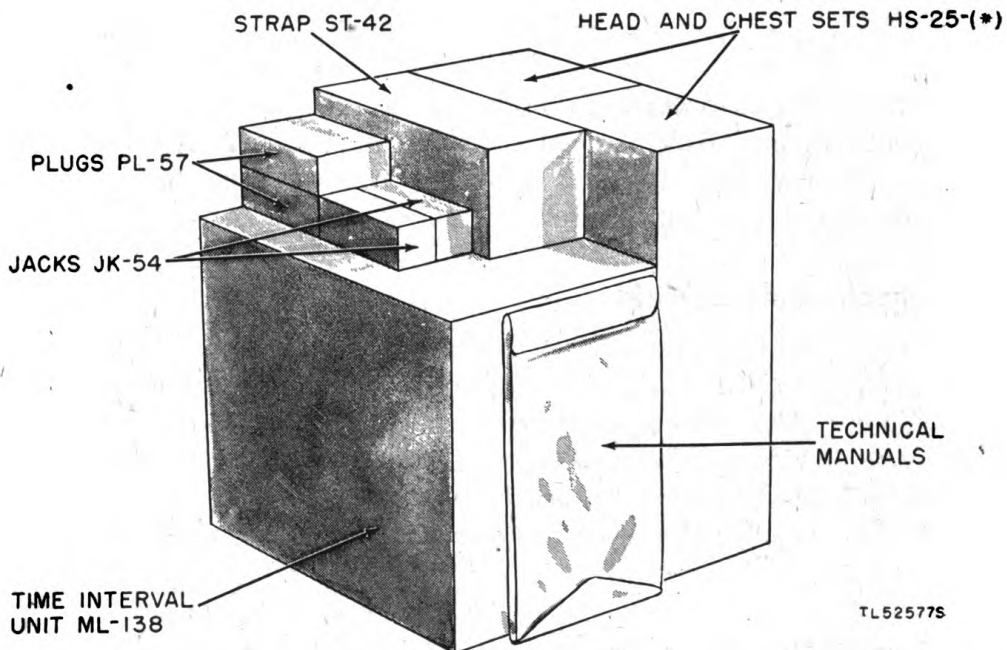


Figure 8. Timing and Telephone Set ML-110—arrangement of components inside packing case.

h. Unpack the two boxes containing the head and chest sets, the box containing the strap, and the four boxes containing the jacks and plugs.

Caution: When removing waterproofing and other protective coatings, be careful not to damage vital parts of the timing and telephone set. Do not remove moistureproofing and fungiproofing lacquer from the time interval unit.

i. Cut the steel straps on the wooden crate containing Reel RL-39-(*). Reel RL-39-(*) is shipped disassembled.

- j.* Remove the nails, using a nail puller, and remove the sides of the crate.
- k.* Lift off the top of the case and take out the fiberboard box.
- l.* Remove the corrugated cardboard cells and lift out the three small cartons containing the straps and the small parts.
- m.* Lift out the wrapped crank and handle and Spool DR-8.
- n.* Remove the wrappings from the crank and handle, and open the box containing the small parts. Remove all waterproofing and protective coatings.

14. Assembly of Reel RL-39-(*)

- a.* Assemble the bearing bushings on the handles with the oil cups on the outside and the retaining disks facing each other. Tighten the screws securely.
- b.* Lubricate according to instructions in paragraph 41.
- c.* Place the handles astride the spool so that the bearings in the handles line up with the square opening in the center of the spool.
- d.* Push the axle through both the handle bearings and the spool, and insert the cotter pin. A slight rotation of the spool and axle may be necessary to match the holes before the axle can be pushed into position.

15. Checking Equipment

Use the table of components (par. 2) for a check list of the unpacked equipment. Check the equipment for the following points:

- a.* Check the cord connections on the head and chest sets for damaged insulation and tightness of connection.
- b.* Check the microphone units for chips and cracks.
- c.* Check the jacks and plugs for chips, cracks, and damaged parts.

16. Installation of Batteries

a. INTERNAL BATTERY OPERATION. (1) Open the cover of the time interval unit and remove the control panel by sliding the catches and lifting the control panel off the unit.

(2) Remove the battery box cover by unscrewing the knurled thumbscrew.

(3) Insert one Battery BA-30 into the side of the battery box which has a flat contact strip at the bottom so that the positive battery terminal comes in contact with the contact strip. Insert a second Battery BA-30 with the positive terminal up.

(4) Replace the cover on the battery box. The battery box cover provides connections between the two batteries.

Caution: If the batteries are improperly installed, one or more coil springs will fail to make contact.

(5) Replace the control panel.

b. **EXTERNAL BATTERY OPERATION.** If it is necessary to use an external battery, connect a 3-volt battery to the two binding posts marked EXT BAT on the control panel of the time interval unit. Connect the positive battery terminal to the binding post marked +, and the negative terminal to the binding post marked -.

Caution: The potential of the external battery must not be higher than 3 volts.

17. Laying Wire with Reel RL-39-(*)

a. Unsnap the straps from the reel unit. Carry them around the neck so that they will not be lost.

b. Bring the handles of the reel unit together so that they can be held in one hand, and carry the unit at the side. Walk toward the objective. The spool should rotate freely, allowing the wire to unwind. Remove as much wire as is needed from the reel.

c. If it is necessary to crawl toward the objective, pull the spool with the wire unwinding as the spool rolls over the ground.

18. Connection of Time Interval Unit ML-138 to Communication Line

a. **AT PLOTTING STATION.** The communication line may be either of the aerial type or of the ground line type with field wire. Normally any two-conductor line offering reasonable protection against dampness will be satisfactory. Connect Plug PL-57 to the communication line by attaching a conductor of the line to each of the binding posts on the plug. Insert Plug PL-57 into one Jack JK-44 of the time interval unit. In permanent installations, the communication line may be terminated directly on the LINE binding posts of the unit. Insert Plug PL-47 of the head and chest set into the other jack JK-44 of the time interval unit. If Wire W-130-A on Reel RL-39-(*) is used over short distances, connection may be made without cutting the wire or removing any remaining wire from the reel. Using a short piece of field wire, make connections between Plug PL-57 or the LINE binding posts of the time interval unit and the terminals of Connector M-221 on Spool DR-8.

Caution: Do not use a pair in an existing battery-power telephone system cable for communication since crosstalk will interfere with the successful use of the sound-powered units.

b. AT THEODOLITE STATION. The end of the communication line at the theodolite station terminates on the binding posts of Jack JK-54. If Jack JK-39 is used, make the connection by unscrewing the sleeve from the jack assembly, threading the communication line through the sleeve, and fastening the conductors to the spring terminals on the jack assembly. The wires and spring terminals should not touch. Tighten the terminal screws, pull the excess wire through the sleeve until the jack part just touches the assembly, and screw the sleeve onto the jack. Jack JK-54 or JK-39 should be at the theodolite station to permit the observer to move around the theodolite while making observations. Insert Plug PL-47 of the head and chest set into Jack JK-54 or JK-39 to make connection with the distant plotting station.

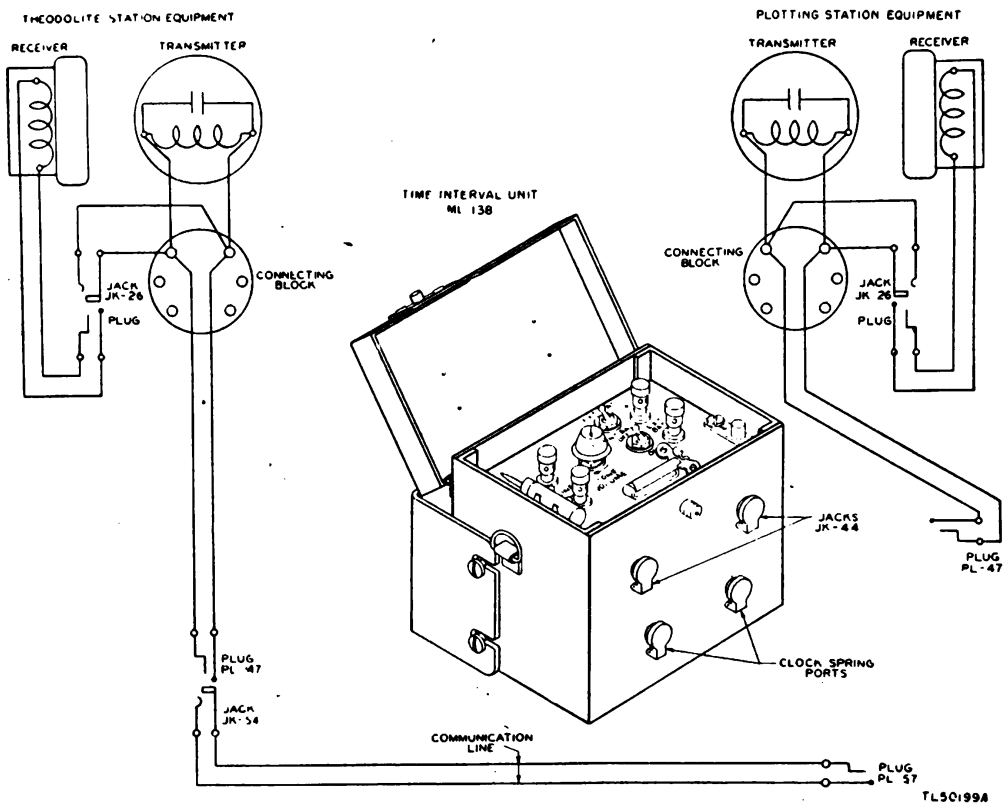


Figure 9. Timing and Telephone Set ML-110—connection diagram.

19. Preliminary Tests

a. Test each head and chest set for proper operation of the receiver by listening in the receiver while tapping with a fingernail on the mouthpiece of the transmitter. A faint tapping sound should be heard in the receiver. Blow across the transmitter mouthpiece. A sound of rushing air should be heard in the receiver.

b. Make a test check of the transmitter by communicating with the theodolite station to insure that voice transmission between the stations is satisfactory.

20. Removing Time Interval Unit ML-138 from Service

When Time Interval Unit ML-138 is to be removed from service to be stored for short periods of time or transported for short distances, the procedure outlined below should be followed:

a. Disconnect incoming line wires from the time interval unit, and remove the head and chest set plugs.

Caution: Be sure that the clock key is in its holder on the panel of the unit.

b. Lift off the control panel and the cover of the battery box and remove the batteries from the time interval unit. If operation has been on external battery, disconnect the 3-volt battery leads from the EXT BAT binding posts.

c. Replace and fasten the control panel on the time interval unit, and close and latch the cover.

21. Recovering Wire with Reel RL-39-(*) or Reloading

a. Snap the ends of Strap ST-35 to the handles of the unit and place the strap around the neck so that the weight of the reel is supported on the shoulders.

b. Attach Strap ST-34 to the lower handle with the strap passing around the waist. This prevents the equipment from swinging. The spool is held away from the body by the lower handle, allowing free rotation of the drum.

c. Insert the wire through the rubber bushing and connect it to the terminals. Turn the crank with one hand while walking in the direction of the wire, and guide the wire evenly on the spool with the other hand. Continue to turn the crank until the desired amount of wire has been wound onto the spool.

d. When the operator cannot expose himself, hold the reel unit by the handles without the straps and take in the wire from a crouched position.

Section III. INITIAL ADJUSTMENTS

22. Toggle Switches

With the equipment connected as described in paragraph 18, set the EXT BAT-INT BAT toggle switch to INT BAT for internal battery operation or to EXT BAT for operation with an external 3-volt battery. Turn the ON-OFF toggle switch ON.

23. Clock

a. Take the key from the control panel and open the keyhole covers. Insert the key in turn into each keyhole, and turn the key counterclockwise until each spring is fully wound.

b. Note on an accurate watch the position of the second hand at the end of the first tone signal. *Write this down.*

c. Check the clock timing by counting the number of tone signals for 20 minutes and comparing with the accurate watch. For example, if the first tone signal ends when the second hand of the watch is at the 15-second mark, and if the twentieth signal ends with the second hand passing the 18-second mark on the watch, the clock has fallen 3 seconds behind the accurate watch in 20 minutes.

d. If the clock has fallen behind the watch more than 2 seconds in the 20-minute interval, advance the regulator slightly toward the fast position, or to the right when looking at the clock from the contact spring assembly side. If the clock has gained on the watch, move the regulator slightly toward the *slow* position, or to the left.

e. Recheck the clock after making the adjustment. Count the tone signal for 20 minutes to see that there is no noticeable error in timing.

f. Check the clock 2 hours later and note the point which the second hand is passing when the tone signal ends. If an error greater than 10 seconds in 2 hours is present, readjust the clock regulator.

24. Tone Volume Control

Rotate the TONE VOLUME adjustment until a satisfactory signal is obtained at both stations. A tone signal of about 7 seconds duration should be heard in each telephone receiver at 1-minute intervals. There should be no evidence of tone signal during the interval. The signal should start and stop abruptly and be constant in volume and frequency throughout its duration. If the tone signal fails to function properly, see paragraph 55 for the probable cause and remedy.

PART TWO

OPERATING INSTRUCTIONS

Note. For instructions to prevent use of equipment by the enemy, see the destruction notice in the front of this manual.

Section IV. PROCEDURE FOR OPERATION

25. Operation

a. Leave the ON-OFF switch ON for the duration of the observation. If the clock is not operating, rewind both spring barrels.

b. The tone signal given each minute lasts for 7 seconds. The beginning of the tone serves as a warning. The end of the tone serves as a reading signal.

c. When the observation is completed, return the ON-OFF switch to OFF.

26. Emergency Use of Receiver as Transmitter

Sound-powered telephone receivers will transmit as well as receive. If a sound-powered transmitter becomes defective and cannot be repaired or replaced at once, maintain communication by using the receiver both as a transmitter and a receiver.

27. Emergency Use of Time Interval Unit ML-138 with Telephone EE-8-()

In the absence of sound-powered telephone equipment, Time Interval Unit M-138 may be used by connecting into a Telephone EE-8-() line. Using field wire, connect the LINE binding posts on the time interval unit directly to the LINE binding posts of Telephone EE-8-(). Use the telephone in the usual way for communication with the theodolite station.

28. Precautions During Operation

a. Guard against high-tension, commercial, or other wires carrying foreign currents coming in contact with the communication line.

b. Keep the cover of the time interval unit closed except when adjusting the unit to protect the interior of the unit from rain, snow, and dirt.

c. Leave the ON-OFF switch OFF except when sending time signals. The switch continuously ON will cause undue wear on the batteries.

29. Consideration for Operation in Extremes of Temperature and Humidity

a. Operation and maintenance of Timing and Telephone Set ML-110 in arctic, tropical, or desert regions involve a number of problems which are peculiar to these regions. Excessive moisture directly affects operation of the connecting wire lines, causing short circuits and crosstalk. Deterioration of parts due to rust and corrosion may lead to complete break-down of the equipment. Guard against corrosion by keeping equipment as dry as possible. Keeping dirt, dust, and sand out of the time interval unit results in better operation and lessens the possibility of break-down. Dry batteries become completely inoperative in extreme cold. Warm up dry batteries before use. In extremely cold regions use the equipment in a heated inclosure.

b. See paragraph 73 for a list of publications on operating equipment under extreme conditions.

Section V. EQUIPMENT PERFORMANCE CHECK SHEET

30. Purpose and Use of Equipment Performance Check Sheet

a. GENERAL. The equipment performance check sheet (par. 31) will help the operator to determine whether Timing and Telephone Set ML-110 is functioning properly. The check sheet gives the item to be checked, the action which must be taken to check the item or the conditions under which the item is checked, the normal indications, and the corrective measures that the operator can take. Items 1 through 10 are performed before operation, items 11 and 12 during operation, and items 13 and 14 when stopping operation.

b. ACTION OR CONDITION. Information given in the action or condition column represents an action that must be taken or a condition that must be met in order to make the check given in the normal indications column.

c. NORMAL INDICATIONS. The normal indications listed include the visible and audible signs that the operator perceives when he checks the items listed. If the indications are not

normal, the operator should apply the recommended corrective measures.

d. CORRECTIVE MEASURES. The corrective measures listed are those that the operator can make without turning the equipment in for repairs. References to paragraphs in part five in the check sheet indicate that the correction of the trouble cannot be effected during operation and that trouble shooting by an experienced repairman is called for. If the set is completely inoperative, or if the recommended corrective measures do not yield results, trouble shooting is necessary. However, if the tactical situation requires that communication be maintained and if the set is not completely inoperative, the operator must maintain the set in operation as long as it is possible to do so.

31. Equipment Performance Check Sheet

Item No.	Item	Action or condition	Normal indications	Corrective measures
1	Batteries BA-30 (internal battery operation).	Install in battery box		
2	External 3-volt battery (external battery operation).	Connect positive terminal to EXT BAT binding post + and negative terminal to EXT BAT binding post --.		
3	EXT BAT-INT BAT toggle switch.	Turn to EXT BAT for external battery operation. Turn to INT BAT for internal battery operation.		
4	Clock	Insert key in each key opening in turn and turn key counterclockwise.	Ticking of clock	Replace clock. (See par. 60.)
5	Head and chest set test (plotting and theodolite stations).	Listen in receiver while tapping on mouthpiece of transmitter. Listen in receiver while blowing across transmitter mouthpiece.	Faint tapping sound heard in receiver. Sound of rushing air heard in receiver.	Check connections. If faulty, replace. If no sound-powered unit is available, operate with Telephone EE-8-().
6	Head and chest set (plotting station).	Plug into Jack JK-44 on time interval unit.		

PREPARATORY

7	ON-OFF toggle switch.	Turn to ON		
8	TONE VOLUME control.	Adjust for satisfactory tone signal.		
9	Communication line.	Connect at plotting station by inserting Plug PL-57 into one Jack JK-44. If no Plug PL-57 is available, terminate on LINE binding posts.		
10	Head and chest set (theodolite station).	Connect at theodolite station by connecting to Jack JK-54 or JK-39. Plug into Jack JK-54 or JK-39.		
11	Tone signal		Tone lasting 7 seconds at 1-minute intervals.	See paragraph 55.
12	Transmission	Communicate with theodolite station.	Signal heard and voice transmission satisfactory.	See paragraph 55.
13	ON-OFF toggle switch.	Turn to OFF.		
14	Head and chest set (theodolite station).	Remove from Jack JK-54 or JK-39.		

PREPARATORY

EQUIPMENT PERFORMANCE

STOP

PART THREE

MAINTENANCE INSTRUCTIONS

Section VI. PREVENTIVE MAINTENANCE TECHNIQUES

32. Meaning of Preventive Maintenance

Preventive maintenance is a systematic series of operations performed at regular intervals on equipment, when turned off, to eliminate major break-downs and unwanted interruptions in service, and to keep the equipment operating at top efficiency. To understand what is meant by preventive maintenance, it is necessary to distinguish preventive maintenance from trouble shooting and repair. The prime function of preventive maintenance is to *prevent* break-downs and, therefore, the need for repair. The prime function of trouble shooting and repair is to locate and correct *existing* defects. The importance of preventive maintenance cannot be overemphasized. The entire system of wire communication depends upon each piece of station equipment being usable when needed and upon its operating efficiency. It is vitally important that station equipment operators and repairmen maintain their station equipment properly.

Note. The operations in paragraphs 32 through 41 are first and second echelon (organization operators and repairmen) maintenance. Some operations in paragraphs 42 through 45 are higher echelon maintenance.

33. Description of Preventive Maintenance Techniques

a. GENERAL. Most of the electrical parts used in Timing and Telephone Set ML-110 require routine preventive maintenance. Those requiring maintenance differ in the amount and kind required. Because maintenance techniques cannot be applied indiscriminately, definite and specific instructions are needed. This section of the manual contains these specific instructions and serves as a guide for personnel assigned to perform the six basic maintenance operations: namely, Feel, Inspect, Tighten, Clean, Adjust, and Lubricate. Throughout this manual the lettering system for these six operations will be as follows:

F—Feel.
I—Inspect.
T—Tighten.
C—Clean.
A—Adjust.
L—Lubricate.

The first two operations establish the need for the other four. The selection of operations is based on a general knowledge of field requirements. For example, the dust encountered on dirt roads during cross-country travel filters into the equipment no matter how much care is taken to prevent it. Rapid changes in climatic conditions (such as heavy rains followed by blistering heat), or excessive dampness, snow, and ice tend to cause deterioration of exposed surfaces and parts.

b. **FEEL (F)**. The Feel operation is used most extensively to check rotating machinery. Feeling may indicate the need for lubrication or the existence of some other type of defect requiring correction.

Note. It is important that the feel operation be performed as soon as possible after the shut-down, and always before any other maintenance is done.

c. **INSPECT (I)**. (1) *General*. Inspection is the most important of all the preventive maintenance operations. If more than one man is available to do this work, choose the most observant, for careful observation is required to detect defects in the functioning of moving parts and to discover any other abnormal conditions. To carry out the inspection operation most effectively, make every effort to become thoroughly familiar with normal operating conditions and to be able to recognize and identify abnormal conditions readily.

(2) *Inspection*. Inspection consists of carefully observing all parts in the equipment, noticing their color, placement, cleanliness, etc. Inspect for the following conditions:

(a) Placement, by observing that all leads and cabling are in their original positions.

(b) Cleanliness, by carefully examining all recesses in the units for accumulated dust, especially between connecting terminals. Parts, connections, and joints should be free of dust, corrosion, and other foreign matter. In tropical and high-humidity locations, look for fungus growth and mildew.

(c) Tightness, by testing any connection or mounting which appears to be loose, by slightly pulling on the wire, or by feeling the lug or terminal screw.

d. **TIGHTEN (T)**. Any movement of the equipment caused by transportation, by concussion from falling shells, or by vibration from moving machinery may result in loose connections which

are likely to impair the operation of the set. The importance of firm mountings and connections cannot be overemphasized. However, never tighten screws, bolts, and nuts unless it is known definitely that they are loose. Fittings that are tightened beyond the pressure for which they are designed will be damaged or broken. When tightening, always be certain to use the correct tool.

e. **CLEAN (C).** When the preventive maintenance check list calls for a cleaning operation, it does not mean that every item which bears the designation C must be cleaned each time it is inspected. Clean parts only when inspection shows that it is necessary. The cleaning operation to be performed on each part is described in the paragraph pertaining to that part.

f. **ADJUST (A).** Adjustments are made only when necessary to restore normal operating conditions. Specific types of adjustment are described in the paragraph on that part.

g. **LUBRICATION (L).** Lubrication means the addition of oil or grease to form a film between two surfaces that slide against each other in order to prevent mechanical wear from friction.

34. Preventive Maintenance Tools and Materials

a. The following tools and materials will be needed in performing preventive maintenance:

Bristle brush, soft.

Bristle brush, stiff.

Clean cloth.

Open-end wrench.

Dry-cleaning solvent (SD).

Polish, metal, paste (Sig C stock No. 6G1516).

Sandpaper, #0000.

Screw driver.

b. Make sure that all tools and materials required are on hand before starting preventive maintenance operations.

Note. Gasoline will not be used as a cleaning fluid for any purpose. Solvent, Dry Cleaning, is available as a cleaning fluid through established supply channels. Oil, Fuel, Diesel, may be used for cleaning purposes when dry-cleaning solvent (SD) is not on hand. Carbon tetrachloride will be used as a cleaning fluid only in the following cases: where inflammable solvents cannot be used because of the fire hazard, and for cleaning electrical contacts including relay contacts, plugs, commutators, etc.

35. Exterior of Time Interval Unit ML-138 and Face of Control Panel

a. **INSPECT (I).** Inspect the exterior of the case, face of the control panel, and carrying strap for broken or damaged parts,

loose or missing screws, setscrews, or mounting nuts, chipped paint, dirt, dust, rust, corrosion, and fungus growth. Inspect the jack and keyhole covers for tightness of closure and damaged seals. Check to see that the TONE VOLUME control knob turns freely in both directions.

b. **TIGHTEN (T)**. Carefully tighten all loose screws and setscrews with a suitable screw driver only until they are snug. Tighten loose mounting nuts securely with a suitable open-end wrench.

c. **CLEAN (C)**. (1) *Case*. Wipe all dirt and dust off the case and from around the jack and keyhole openings with a soft, dry cloth.

(2) *Carrying strap*. Wash the carrying strap with a stiff bristle brush and soap and water. Scrub the carrying strap until it is free of dirt, and rinse the strap in clear water until the soap is removed.

(3) *Latches*. Remove rust and corrosion from the latches with a soft cloth moistened with dry-cleaning solvent (SD).

(4) *Face of control panel*. Remove dirt and dust from the face of the panel and from around switches, controls, and binding posts with a soft bristle brush.

(5) *Binding posts*. Remove all dirt and dust from the binding posts with a clean, soft cloth. If any metal parts are corroded, clean with a soft cloth moistened with dry-cleaning solvent (SD). Never use a damp or wet cloth to clean the binding posts.

36. Head and Chest Sets HS-25-(*)

a. **INSPECT (I)**. (1) *Headsets and chest sets*. Inspect the headsets and chest sets for dirt, dust, loose or missing mounting screws, and chipped or cracked places. Do not disassemble the units.

(2) *Cords*. Inspect the cords for dirt, dust, oil, grease, and broken or damaged insulation. Examine the cords where they enter the headsets and chest sets for worn places and tightness of connection.

(3) *Plugs and jacks*. Carefully inspect the plugs and jacks for dirt and corrosion.

b. **TIGHTEN (T)**. Tighten all loose mounting screws securely.

c. **CLEAN (C)**. (1) *Headsets and chest sets*. Wipe off all dust and dirt with a clean, dry cloth. If it is necessary to remove oil or grease, use dry-cleaning solvent (SD).

(2) *Cords*. Wipe off dirt and dust with a clean, dry cloth. Use dry-cleaning solvent (SD) to remove oil and grease.

(3) *Plugs and jacks*. Wipe all dust, dirt, and foreign matter from the plugs and jacks with a clean, dry cloth. Clean plugs

with Polish, Metal, Paste (Sig C stock No. 6G1516). Do not apply an excess amount of polish to the plug. Be sure to remove all the residue polish after the cleaning operation in order to maintain maximum electrical conductivity.

37. Interior of Time Interval Unit ML-138 and Back of Control Panel

a. **INSPECT (I).** Carefully inspect the interior of the time interval unit and the back of the control panel for dirt, dust, corrosion, fungus growth, and damaged places. Pay particular attention to obscure places. Inspect for loose or broken leads, poorly soldered connections, and loose or missing mounting screws and nuts.

(1) *Batteries BA-30.* Check the batteries periodically. Install new batteries when the voltage per cell falls to 0.8 volt under load.

(2) *Battery box.* Inspect the contacts in the bottom of the box and in the cover for corrosion.

(3) *Capacitor CA-243.* Examine the leads for poor insulation, for cracks, and for evidence of dry rot. Cut away frayed strands on the insulation. If the wire is exposed, wrap it with friction tape. The terminals of the capacitor should not be cracked or broken.

(4) *Interrupter BZ-7-G.* Check for dents, cracks, and breaks in the case of the interrupter. Check for loose connections.

(5) *Clock.* Inspect for dirty contacts and broken or damaged parts. Do not disassemble any part of the clock. Check the clock timing over a period of 2 hours. (See par. 23.)

(6) *Jacks JK-44.* Inspect for dirt, corrosion, and broken or damaged parts. Insert a plug into each jack and inspect to make certain proper contact is made with each jack spring.

b. **TIGHTEN (T):** Tighten all loose mounting screws with a suitable screw driver. Tighten loose mounting nuts with a suitable open-end wrench. Tighten or resolder all loose connections.

c. **CLEAN (C).** Carefully remove all dirt, dust, and foreign matter from the interior of the unit with a soft brush. Be careful not to disconnect any wiring. Brush all dirt and dust away from the component parts mounted on the internal mounting bracket assembly and on the back of the control panel.

(1) *Battery box.* Clean the battery box with a soft, dry cloth. Clean the contacts with a soft cloth moistened with dry-cleaning solvent (SD).

(2) *Capacitor CA-243.* Clean the capacitor and dirty or corroded connections with a clean, dry cloth. If a deposit of dirt is

difficult to remove, moisten the cloth with dry-cleaning solvent (SD).

(3) *Interrupter BZ-7-G*. Clean the external portion of the case with a soft bristle brush.

(4) *Clock*. Carefully brush dust and foreign matter from the spring assembly and from the front surface of the clock with a soft bristle brush.

(5) *Jacks JK-44*. Carefully wipe the jacks with a clean, dry cloth. If the contacts are corroded, clean with a soft cloth moistened with dry-cleaning solvent (SD).

d. ADJUST (A). If it is necessary to adjust the timing of the clock, see paragraph 23.

38. Jack JK-54 and Plug PL-57

a. INSPECT (I). Carefully inspect Jack JK-54 and Plug PL-57 and their external binding posts for dirt and corrosion. Do not attempt to disassemble either the jack or the plug.

b. CLEAN (C). (1) *Jack JK-54*. Carefully wipe all dirt and dust from the jack shell with a clean, dry cloth. If any external metal parts are corroded, clean with a soft cloth moistened with dry-cleaning solvent (SD). Never use a damp or wet cloth to clean the binding posts.

(2) *Plug PL-57*. Carefully wipe all dirt and dust from the plug with a clean, dry cloth. Clean the plugs with a small amount of Polish, Metal, Paste (Sig C stock No. 6G1516). Be sure to remove all the residue polish after the cleaning operation. Clean corroded binding posts with a soft cloth moistened with dry-cleaning solvent (SD). Do not use a damp or wet cloth to clean the binding posts.

39. Reel RL-39-(*)

a. FEEL (F). Turn the crank to see that the axle rotates smoothly on the bearings and that the crank handle turns freely.

b. INSPECT (I). Inspect the handle assembly and drum for dirt, dust, oil, grease, rust, corrosion, loose or missing screws, and broken or damaged parts. Inspect the carrying straps for dirt, fungus, cuts, tears, and abrasions.

c. TIGHTEN (T). Tighten all loose screws on the retaining disks of the bearing bushings.

d. CLEAN (C). Wipe all dust and dirt from the axle and drum with a clean, dry cloth. Remove rust and corrosion with a soft cloth moistened with dry-cleaning solvent (SD). Use dry-cleaning solvent (SD) to remove oil and grease. Scrub the carrying

straps with a stiff bristle brush and soap and water. Rinse the straps in clear water to remove the soap.

e. LUBRICATE (L). If lubrication of Reel RL-39-(*) is necessary, see paragraph 41.

Section VII. PREVENTIVE MAINTENANCE CHECK LIST

40. Preventive Maintenance Check List

The following check list is a summary of the preventive maintenance operations to be performed on Timing and Telephone Set ML-110. The time intervals shown on the check list may be reduced at any time by the local commander. For best performance of the equipment, perform operations at least as frequently as called for in the check list. The echelon column indicates which operations are first echelon maintenance and which items are second echelon maintenance. Operations are indicated by the letters of the word FITCAL. For example, if the letters ITCA appear in the operation column, the item to be treated must be inspected (I), tightened (T), cleaned (C), and adjusted (A).

Item	Operations	Description	When performed			Echelon
			Daily	Weekly	Monthly	
1	ITC	Exterior of Time Interval Unit ML-138 and face of control panel. (See par. 35.)	X			1st
2	ITC	Head and Chest Sets HS-25-(*). (See par. 36.)	X			1st
3	ITCA	Interior of Time Interval Unit ML-138 and back of control panel. (See par. 37.)		X		2d
4	IC	Jack JK-54 and Plug PL-57. (See par. 38.)		X		2d
5	FITC	Reel RL-39-(*). (See par. 39.)		X		2d
6	L	Reel RL-39-(*). (See par. 41.)			X	2d

Note. "X" indicates when operations are to be performed.

F I T C A L
 FEEL INSPECT TIGHTEN CLEAN ADJUST LUBRICATE

Section VIII. LUBRICATION

Note. Reel RL-39-(*) is the only part of Timing and Telephone Set ML-110 which requires lubrication.

41. Reel RL-39-(*)

a. GENERAL. Reel RL-39-(*) should be lubricated after each month's service. Lubrication does not require disassembly of the axle from Spool DR-8.

b. LUBRICATION. Place a few drops of Oil, Engine, OE 30 in the small oil fittings in each bearing of the reel unit handles and in the oilhole of the crank handle. (See fig. 10.)

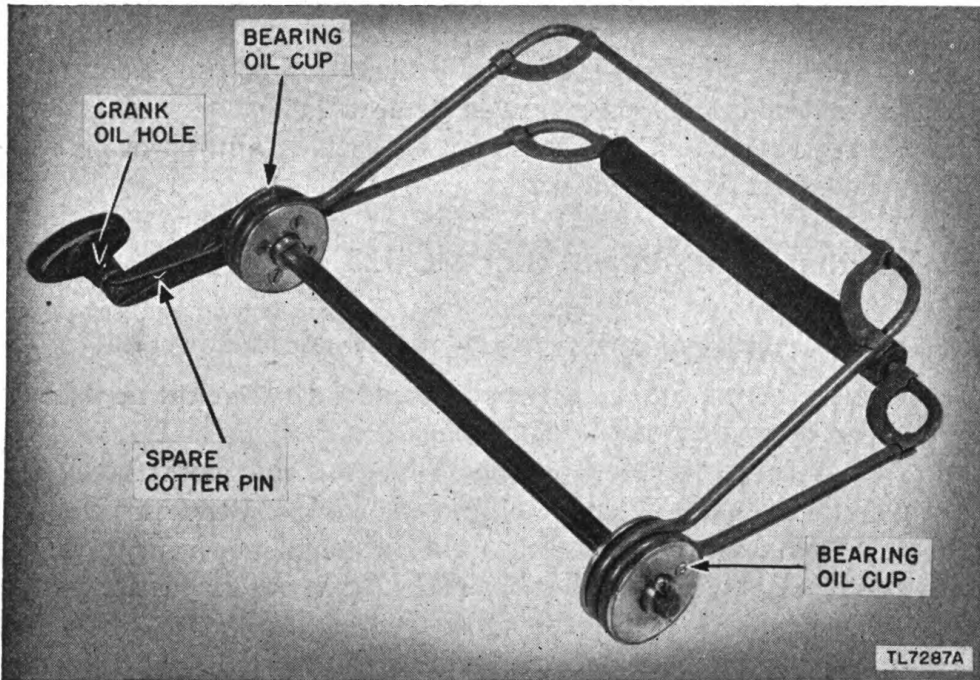


Figure 10. Reel RL-39, handle and axle assembly, lubrication points.

Section IX. MOISTUREPROOFING AND FUNGIPROOFING

42. General

a. When equipment is operated in highly humid climates, excessive failure of parts and decreased operating efficiency are usually caused by the accumulated effects of moisture rather than by inferior parts. Rapid temperature changes accompanied by fog, rain, dew, or high humidity promote such failures.

b. The effects of moisture on resistors, capacitors, terminal boards, and insulating strips can be recognized in the form of corrosion, low-insulation resistance, flash-overs, and crosstalk.

Moisture also accelerates fungus growth which increases these effects.

43. Reducing Failures

a. A moistureproofing and fungiproofing treatment has been devised which, if properly applied, provides a reasonable degree of protection. The treatment consists of applying a film of moisture- and fungi-resistant varnish to all susceptible parts of the equipment. This film provides a nonwetting surface. Equipments which have been treated have been marked with the letters MFP and the date of treatment. Equipments not marked should be examined and, if treatment has not been applied, the equipment should be returned to third or higher echelon maintenance units for treatment.

b. TB SIG 13 contains a detailed description of this treatment.

c. Retreatment may be required after a period of use. Need for this retreatment is indicated by excessive failures or by the effects listed in paragraph 42.

44. Treating Time Interval Unit ML-138

Note. Time Interval Unit ML-138 is the only part of Timing and Telephone Set ML-110 to receive moistureproofing and fungiproofing treatment.

a. PREPARATION. Make all repairs and adjustments necessary for proper operation of the equipment.

d. DISASSEMBLY. (1) Open the cover of the metal box.

(2) Slide back the catches holding the control panel in place.

(3) Lift the control panel and the internal mounting bracket with the clock, buzzer, capacitor, and all wiring from the metal box. The inside of the box is to be treated.

(4) Remove the four screws holding the clock to the internal mounting bracket.

(5) Remove the two screws and lockwashers holding the clock contact bracket to the frame of the clock.

(6) Remove the clock assembly from the mounting bracket. The clock assembly is not to be treated.

Caution: Be extremely careful when handling the clock mechanism. Only qualified personnel should be allowed to perform the disassembly and assembly operations.

(7) Remove the batteries (not to be treated) from the battery box and reassemble the battery box cover. All remaining equipment and wiring inside the internal mounting bracket is to be treated. The under side of the control panel and wiring are also to be treated.

c. **CLEANING.** Clean all dirt, dust, rust, fungus, oil, grease, etc., from the equipment to be processed. Clean all oil and grease from the surfaces to be varnished.

d. **MASKING.** (1) Wrap masking tape around the clock contacts.

(2) Wrap masking tape on the jack contacts, being sure to cover the jack openings.

(3) Mask the side of the clock contact bracket which fits against the frame of the clock.

(4) Mask the battery lead terminals.

e. **DRYING.** Place the equipment in an oven or under heat lamps and dry for 2 or 3 hours at 140° to 160° F. *Do not exceed 160° F.*

f. **VARNISHING.** (1) Apply three coats of moistureproofing and fungiproofing varnish (Lacquer, Fungus-resistant, Sig C stock No. 6G1005.3, or equal) with spray gun or with brush, or both. Allow each coat to air-dry for 15 or 20 minutes before applying the next coat.

(2) Apply varnish immediately after the equipment is dried. If varnish is not applied immediately, moisture condenses on the equipment. Varnish applied over the moisture peels off readily after the varnish has dried.

g. **REASSEMBLY.** (1) Remove all masking tape, being careful not to peel varnish from nearby areas.

(2) Clean all contacts with varnish remover and burnish the contacts.

(3) Reassemble the set and test its operation.

h. **MARKING.** Mark the letters MFP and the date of treatment near the nameplate.

Example: MFP-15 Aug 45.

45. Treating Equipment After Repairs

If the coating of protective varnish has been punctured or broken during repair and if complete treatment is not needed to reseal the break, brush-coat the affected part. Be sure the break is completely sealed.

PART FOUR
AUXILIARY EQUIPMENT

(Not Used.)

PART FIVE

REPAIR INSTRUCTIONS

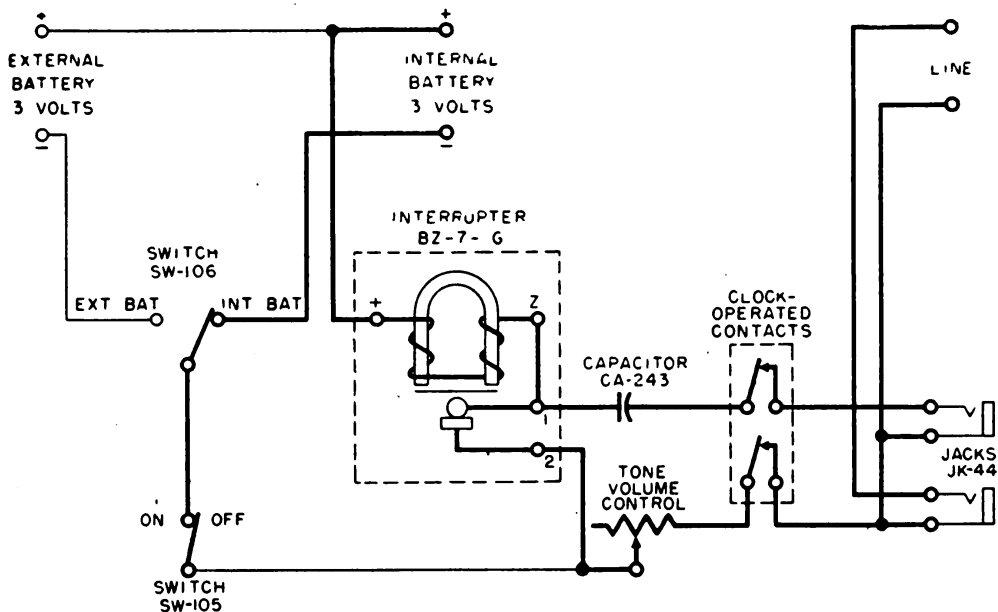
Note. Failure or unsatisfactory performance of equipment used by Army Ground Forces and Army Service Forces will be reported on WD AGO Form 468 (Unsatisfactory Equipment Report); by Army Air Forces, on Army Air Forces Form 54 (Unsatisfactory Report). If Form 54 is not available, prepare the data according to the form reproduced in figure 23.

Section X. THEORY OF EQUIPMENT

46. Time Interval Unit ML-138

Figure 11 and 12 are circuit diagrams of the time interval unit, the purpose of which is to produce a tone signal of approximately 7 seconds duration once each minute. With the ON-OFF switch ON, battery current is supplied to terminals + and 2 of the interrupter from either an externally connected battery with the EXT BAT-INT BAT switch on EXT BAT (fig. 12), or from internal batteries installed in the battery box of the unit with the EXT BAT-INT BAT switch on INT BAT. (See fig. 11.) Output of the interrupter is across terminals 1 and 2, of which are connected internally to opposite electrodes of the carbon granule chamber. The voltage drop across the carbon chamber of the interrupter varies according to the position of a central diaphragm which is caused to vibrate by the electromagnet behind it. Fluctuating current passes from terminal 2 to the TONE VOLUME rheostat. The volume of the tone is adjusted by this TONE VOLUME control. From this rheostat, the current flows to one pair of springs on the clock. When these springs are closed by action of the clock, the current flows over the lead to one LINE terminal. From this LINE terminal, the fluctuating current flows out over the line, through the sound-powered head and chest sets connected across the line, and back to the other LINE terminal. The LINE terminals and jacks are connected in parallel so that the fluctuating tone current will also flow through any equipment, such as the sound-powered head and chest sets, which is plugged into the jacks. From the second LINE terminal, the current flows to a second pair of contact

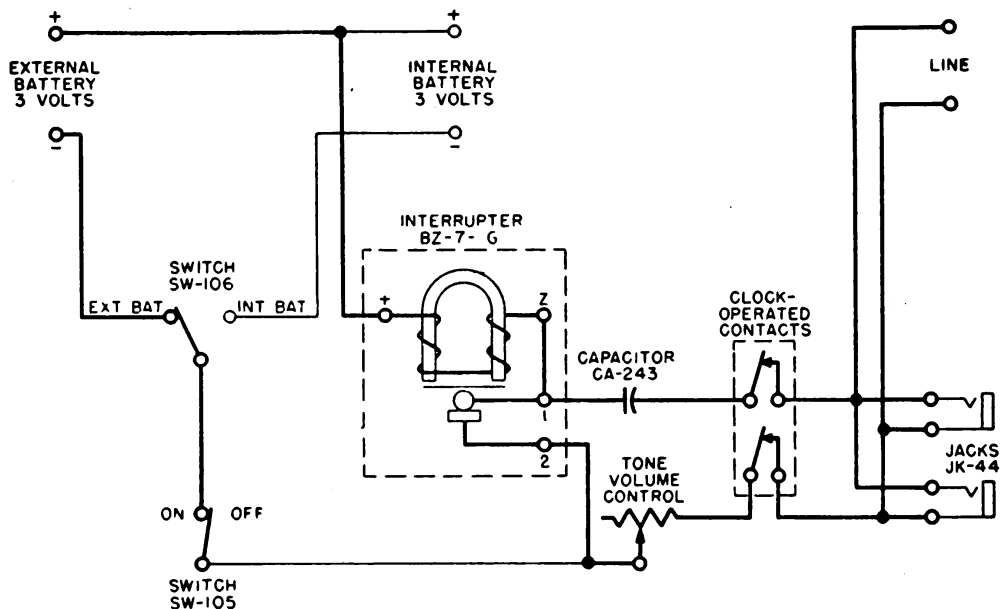
springs on the clock. These springs close simultaneously with the first pair of springs. Current now flows back to the interrupter through a capacitor wired in series with the output. The capacitor permits only the alternating component of the fluctuating current to flow over the line, keeping direct current off the line and out of the sound-powered units on the head and chest sets.



NOTE —|— IS SYMBOL FOR FIXED CAPACITOR

TL 525895

Figure 11. Time Interval Unit ML-138—circuit diagram, internal battery operation.



NOTE —|— IS SYMBOL FOR FIXED CAPACITOR

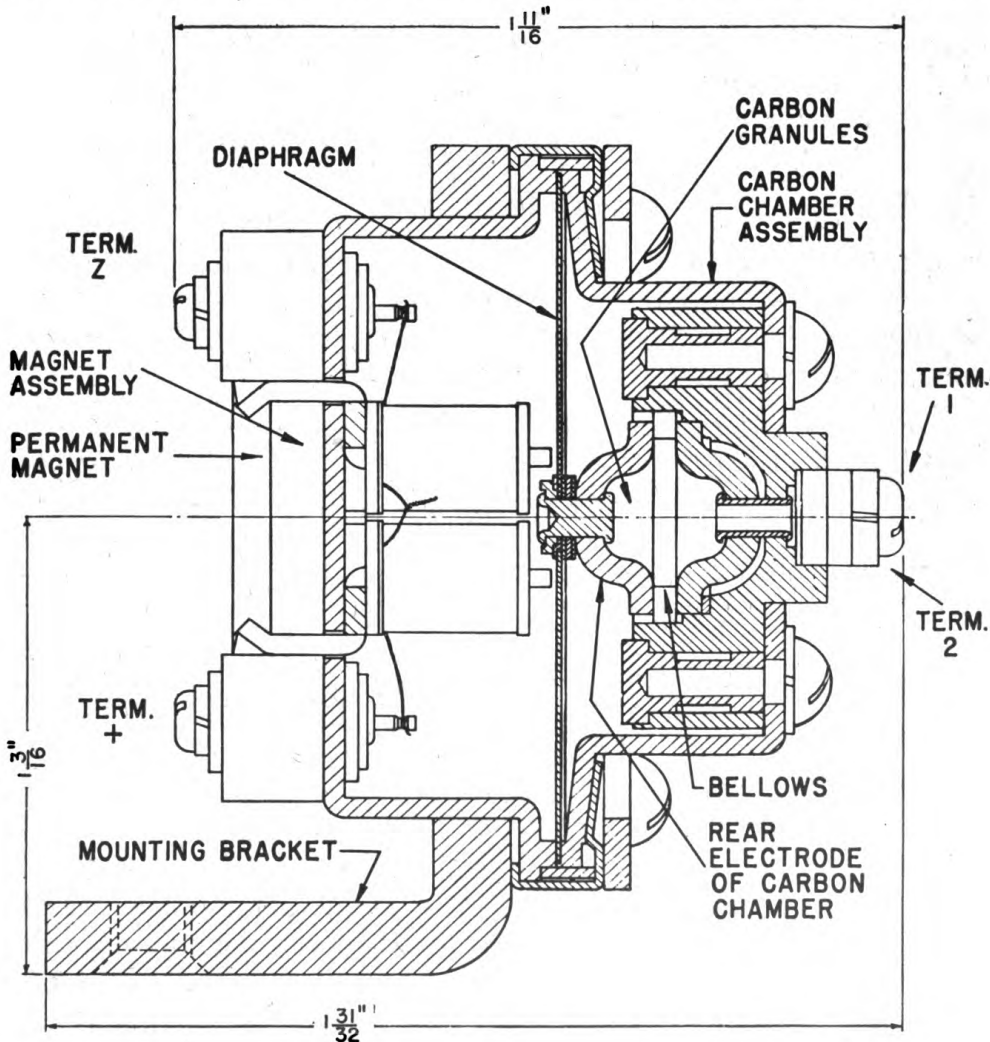
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Figure 12. Time Interval Unit ML-138—circuit diagram, external battery operation.

47. Interrupter BZ-7-G

a. Interrupter BZ-7-G (fig. 13) is essentially a telephone transmitter and receiver combined to oscillate at a desired frequency. On one side of a central thin iron diaphragm is a magnet assembly consisting of a permanent magnet, around each pole of which is wound a coil of wire such as is used in a telephone receiver. On the other side of the diaphragm is a carbon granule chamber similar to that used in telephone transmitters. The coils are wired in series with the carbon granule chamber and the battery. When the ON-OFF switch is ON, current flows in the circuit through the carbon granules and through the magnet windings, increasing the magnetic flux and attracting the diaphragm toward the pole pieces.

b. As the diaphragm moves toward the magnet poles the two electrodes of the carbon granule chamber are pulled apart, in-



TL50194

Figure 13. Interrupter BZ-7-G—cross-section view.

creasing the resistance of the circuit and decreasing the current flow. As a result, the magnetic flux around the pole pieces decreases, permitting the diaphragm to restore partially to normal. As the diaphragm restores, it compresses the carbon granules in the granule chamber, increasing the current flow. The diaphragm is again attracted toward the magnet poles. This cycle of operation is repeated approximately 1,000 times per second. With each cycle of operation there is a change in the voltage drop across the carbon granule electrodes, resulting in a fluctuating d-c voltage across terminals 1 and 2.

c. The alternating tone current is produced as a fluctuating direct current, which is equivalent to a d-c voltage plus and a-c voltage. Capacitor CA-243, in series with the output, prevents the d-c component of the fluctuating current from passing out over the line. The capacitor passes alternating current and maintains an open circuit to direct current. Thus the alternating, or tone, current is separated from the direct current of the battery voltage. The interrupter operates continuously as long as the ON-OFF switch is ON.

48. Timing and Switching Mechanism

The timing mechanism consists of a standard clock, modified by the addition of a switching mechanism which regulates the time of transmission of tone from the interrupter and connects the tone signal to the line at the desired intervals.

a. Flow of alternating tone current from the interrupter to the line is controlled by clock-operated contacts, consisting of two sets of make springs mounted side by side. The clock is a standard 8-day mechanism with two spring barrels which must be wound separately. A paddle-shaped cam, mounted on the second hand spindle, strikes a phenolic strip fastened to the two armature springs and makes these springs simultaneously once each minute. This closes both circuits and permits the flow of current through Jacks JK-44 over the communication line.

b. The circuits should be closed for approximately 7 seconds. The length of time they are closed depends upon the time at which the armature-spring contacts strike the make-spring contacts. If the contacts close early, or relatively long before the cam has reached the highest point in its travel, the timing period will be long. If they close just as the cam reaches its highest point, the timing period will be short. Length of this timing period can be regulated by adjusting the two setscrews located just above the contact springs.

49. Head and Chest Set HS-25-(*)

a. GENERAL. Head and Chest Set HS-25-(*) is a sound-powered unit used for providing telephonic communication between one station and another. In addition, the tone signals from the time interval unit are heard simultaneously in the receivers. The coil and pole-piece assembly of the sound-powered transmitter and receiver units is identical in both the receiver and the transmitter, but the units have different housings and different diaphragm caps. Each transmitter unit is a generator of electrical energy, deriving its power directly from the sound waves set up by the spoken word and capable of converting sound energy directly into electrical energy. Each receiver unit is capable of converting the electrical energy output of a transmitter to a sound-level output sufficient to reproduce intelligible speech. The transmitter and receiver units of each head and chest set are connected in parallel. When two head and chest sets are plugged into a communication line there are four sound-powered units in parallel, each electrically identical, with an approximate impedance of 900 ohms.

b. CONSTRUCTION OF SOUND-POWERED TRANSMITTER AND RECEIVER UNITS. A sound-powered unit with the diaphragm at the top is shown in figure 14. Both the transmitter and receiver units have a permanent bar magnet with two pole-piece assemblies, an armature of magnetic material, and a coil. The magnet, shown vertically at the left center, maintains a concentrated magnetic field between the two gaps separating the pole pieces. The armature is pivoted between the pole pieces. It is held midway in the gaps between the poles by its center suspension inside the coil spool and by a coupling rod at one end which connects the center of the diaphragm to one end of the armature. The coupling rod is of light alloy, threaded at each end and provided with adjustment nuts.

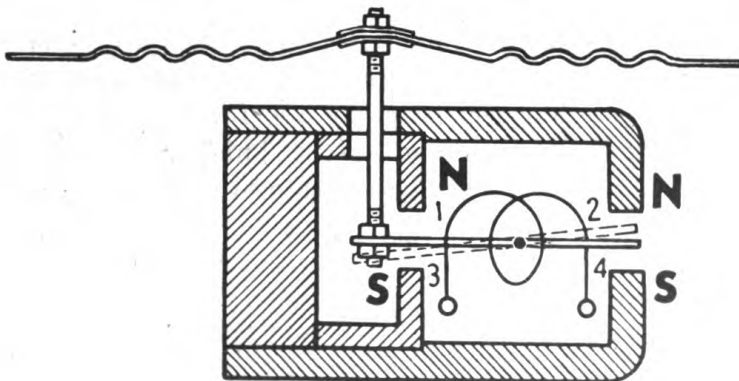


Figure 14. Diaphragm of sound-powered transmitter or receiver unit.

(1) *Transmitter unit.* The sound-powered transmitter unit (fig. 15) is housed in a molded case and has a mouthpiece over the diaphragm. The mouthpiece and the unit are held in the case by a metal retaining ring which engages a lip on the mouthpiece and threads on the case. The acoustics of the mouthpiece are such as to collect and reinforce the sounds entering. A resonant cavity increases the acoustic-electric efficiency of the transmitter in the frequency range where the greatest efficiency is needed for clear reproduction of speech.

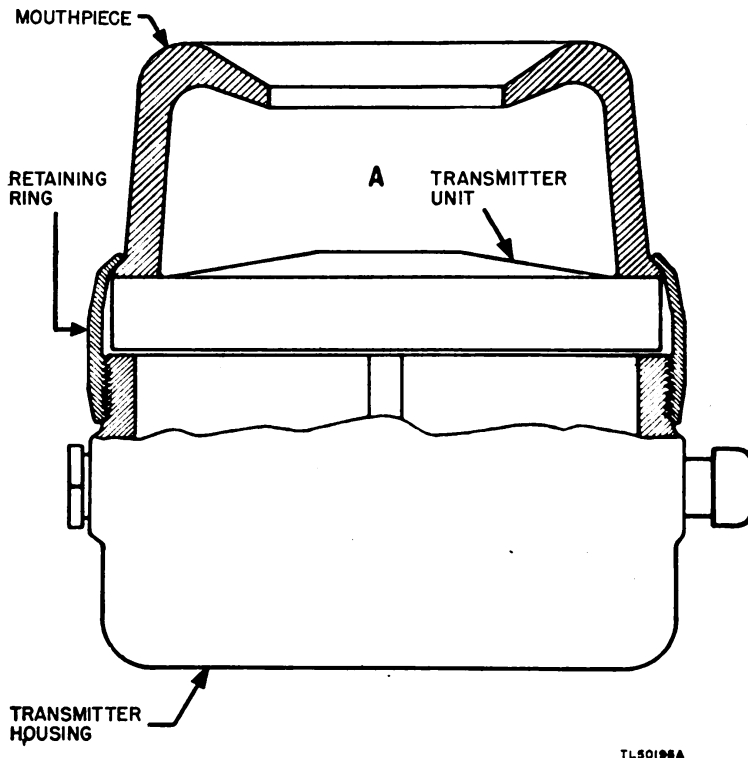


Figure 15. Diagram of sound-powered transmitter assembly.

(2) *Receiver unit.* The sound-powered receiver unit is housed in a plastic case and has a sponge-rubber receiver cushion. The unit for the receiver uses the same type coil and pole piece as the transmitter. The soft receiver ear cap forms a seal between the diaphragm and the ear of the user. This keeps out extraneous noises and insures that the vibrations of the diaphragm reach the ear of the user.

50. Transmitting

a. Sound waves striking on the diaphragm of the transmitter unit cause the diaphragm and armature, which is polarized by the field of the permanent magnet, to vibrate. This vibration results in a change in polarity of the armature, which causes a voltage to

be induced in the coil. The resulting voice current is then transmitted over the line. When acoustical power drives the diaphragm downward (fig. 14), the right-hand end of the pivoted armature approaches the north (N) pole of the magnet and the left-hand end approaches the south (S) pole, placing the armature in position 2-3. This causes the passage of a magnetic flux (strength of magnetism) from the right-hand north pole through the armature to the left-hand south pole. As the armature starts to return, the magnetic flux in the armature diminishes, reaches zero when the armature is exactly midway between the poles, and continues to decrease to a maximum negative as the rarefaction (reduced pressure) following the passing of the sound wave draws the armature past the neutral or midposition. When the diaphragm moves upward, the left-hand end of the armature approaches the north pole and the right-hand end approaches the south pole, placing the armature in position 1-4 and causing the passage of a magnetic flux from the left-hand north pole to the right-hand south pole. This reversal of direction of flux in the armature causes the voltage to be induced in the coil which surrounds the armature. As this rarefaction passes, the armature again returns to the neutral position and the flux through the armature reduces to zero.

b. The important factor in the function of the transmitter is the voltage induced in the coil. This voltage depends directly on the rate of change of the magnetic flux in the armature, not on the amount of flux. In general, the voltage is independent of the position of the armature but depends on how fast the armature is moving. Most speech sounds involve complicated waveforms, and the actual voltage generated at any instant can be determined only by consideration of the instantaneous velocity of the armature. The voltage across the terminals practically follows the variations of sound waves striking the diaphragm, and an alternating voltage is generated as the diaphragm oscillates back and forth.

51. Receiving

Alternating current flowing in the coil of the receiver brings about variations in the magnetization of the armature of the receiver. This variation in magnetism causes the armature to vibrate. The diaphragm vibrates simultaneously with the armature because of the mechanical link between the two parts. The vibrations of the diaphragm produce sound waves which are audible. When the alternating current from the distant transmitter is applied to the winding of the receiver, the armature is magnetized. When the current is in such a direction that a north pole is induced at the right-hand end of the armature and a

south pole at the left-hand end (fig. 14), the right-hand end moves downward and the left-hand end moves upward (position 2-3). When the current changes in direction, the poles in the armature reverse (position 1-4) and cause the diaphragm to move downward. As the diaphragm of the receiver unit duplicates the motions of the transmitter diaphragm, the original sound will be duplicated at the receiver, which may be a considerable distance from the transmitter.

Section XI. TEST EQUIPMENT

52. Test Equipment

a. GENERAL. Any ohmmeter or multimeter which is available may be used for making continuity tests to locate trouble. This is the only type of test equipment which is normally required for field maintenance of Time Interval Unit ML-138.

b. TEST SETS. Suitable test sets which will be available to using units in the field are Test Set I-77-() and Multimeter TS-297/U.

(1) *Test Set I-77-()*. Test Set I-77-() is a pocket type volt-ohm-milliammeter provided with detachable red and black leads and a leather carrying strap. It has a single rotary type switch for selecting range and function. The voltage and resistance ranges of Test Set I-77-() are as follows:

- (a) D-c voltage ranges from 0 to 30/300/1,500 volts.
- (b) A-c voltage ranges from 0 to 15/150 volts.
- (c) Resistance ranges from 0 to 3,000/300,000 ohms.
- (d) D-c milliampere range from 0 to 150 milliamperes.

(2) *Multimeter TS-297/U*. Multimeter TS-297/U is a portable volt-ohm-milliammeter in a welded aluminum case. The test set is provided with two sets of test leads and Cord CX-468/U and uses one Battery BA-31. It differs from Test Set I-77-() in that it has greater ranges, the indicating instrument is hermetically sealed, and the selector switch is omitted. The voltage and resistance ranges of Multimeter TS-297/U are as follows:

- (a) A-c and d-c voltage ranges from 0 to 1,500 volts in six steps, sensitivity 1,000 ohms per volt.
- (b) Resistance ranges from 0 to 100,000 ohms in three steps.
- (c) D-c milliampere range from 0 to 150 milliamperes in four steps.

Section XII. TROUBLE SHOOTING

53. General

No matter how well equipment is designed and manufactured, faults occur in service. When such faults occur the repairman must locate and correct them as rapidly as possible. This section contains general information to aid personnel engaged in the important duty of trouble shooting.

a. TROUBLE-SHOOTING DATA. Take advantage of the material supplied in this manual to help in the rapid location of faults. Consult the following trouble-shooting data when necessary:

- (1) Trouble-shooting chart. (See par. 55.)
- (2) Wiring diagram of Time Interval Unit ML-138. (See fig. 21.)
- (3) Circuit diagrams of Time Interval Unit ML-138. (See figs. 11 and 12.)
- (4) Illustrations of components which aid in locating or identifying parts. (See figs. 2 through 6.)

b. TROUBLE-SHOOTING STEPS. First, analyze the trouble report to determine the probable causes of the trouble. When analyzing the trouble report, use the circuit diagrams to localize the fault to a particular component. Make a complete visual inspection of the wiring and connections to the associated equipment. If no wires or connections are broken, the trouble must be located by making continuity measurements. By following the circuit with a systematic process of elimination, the fault can usually be located in the least amount of time. Start at a point where the circuit is known, from the analysis, to be good and proceed step by step, eliminating parts of the circuit until the fault is located.

54. Procedures

To aid the repairman in locating or localizing faults, probable failures and tests for localizing the fault are described in *a*, *b* and *c* below. The trouble-shooting chart (par. 55), if properly used, simplifies trouble shooting.

a. WIRING. The most probable failures will be loose contacts at the screw binding posts in various parts of the circuit. Wires may break at soldered terminals if subjected to severe vibration. If visual inspection fails to reveal the cause of the trouble, make a continuity test with an ohmmeter to locate failures in the wiring or contacts.

b. CAPACITOR CA-243. (1) If the capacitor is open, no tone will be heard in any headsets plugged into the unit. To test for this condition, momentarily short out the capacitor by placing an

insulated test lead across the terminals of the capacitor. If this test restores normal tone in the headsets, it indicates that the capacitor is open. Replace the capacitor. (See par. 58.)

(2) If the capacitor is internally shorted, tone will be heard in the headsets, but direct current from the batteries will be on the tone circuit and will cause loud clicks when the head and chest sets are plugged into the jacks. Disconnect the line while the test is being made to be certain that the clicks are not being caused by induction on the communication line. If the capacitor is found to be shorted, replace the capacitor. (See par. 58.)

c. INTERRUPTER BZ-7-G. If the tone signal fails and the batteries are found to be good, test the interrupter for proper functioning in the following manner:

(1) Remove the internal batteries and test the interrupter with a 3-volt battery connected directly to the battery binding posts of the interrupter. Connect the positive battery lead to the binding post marked + and the negative lead to the binding post marked 2.

(2) Plug a headset into a jack of the time interval unit.

(3) Close the clock-operated contacts by hand.

(4) Turn the TONE VOLUME control rheostat up full. If no tone can be heard, check for current flow from the battery through the interrupter. If the normal current (6 ma or slightly less) is flowing, the internal circuit of the interrupter is complete.

(5) Check the output of the interrupter by removing the regular lead from terminal 2 but leaving the battery across terminals + and 2. Connect a receiver across terminals 1 and 2, the output terminals of the interrupter.

(6) Touch the tip of the plug to one terminal and the sleeve to the other. If the circuit is complete a decided click should be heard in the receiver. The tone signal should also be heard loud and strong if the interrupter is functioning properly.

(7) If the interrupter is functioning properly but the tone signal cannot be heard when the head and chest set is plugged into one of the jacks of the time interval unit, check the internal wiring of the time interval unit step by step from the interrupter terminals 1 and 2. Check the TONE VOLUME control (par. 24), capacitor (*b* above), the contacts of the clock springs (par. 56), and the jack contacts (par. 55).

(8) If any of these tests indicate that the interrupter is faulty, replace the interrupter. (See par. 59.)

55. Trouble-Shooting Chart.

The trouble-shooting chart, if properly used, simplifies trouble shooting. The chart can be used for diagnosing and locating trouble in any part of the timing and telephone set.

Symptoms	Probable troubles	Corrections
Failure of voice transmission and tone signal.	Faulty transmission between head and chest set at time interval unit and head and chest set at theodolite station.	Check for open in communication line. Check tightness of terminals to line. Locate fault or break and repair.
	Open in wiring between jacks or between jacks and line terminals.	Locate fault or break and repair.
	Faulty jack contact	Clean plugs. (See par. 36.) If plug does not fit jack snugly, adjust jack contact.
	Failure of either transmitter or receiver unit.	Replace defective head-set or chest set.
Failure of voice transmission (tone signal good).	Faulty transmitter unit or loose connections.	Check cord connections to chest set and transmitter. Repair. If transmitter unit is faulty, replace chest set.
Failure of tone signal (voice transmission good).	ON-OFF switch OFF	Turn switch ON.
	ON-OFF switch defective	Check continuity through switch. Replace if faulty.
	EXT BAT-INT BAT switch on incorrect position.	Check. Turn to EXT BAT for external battery operation and to INT BAT for internal battery operation.
	Clock not running	Wind clock.
	Cam is not closing contact springs to make contact.	Adjust armature springs. (See par. 56.)
	Tone volume too low	Adjust TONE VOLUME control. (See par. 24.)
	Loose contacts in wiring	Check contacts. Resolder.
	Broken wire	Locate failure with ohmmeter. (See par. 54.) Repair break.

Symptoms	Probable troubles	Corrections
	Batteries incorrectly installed.	Check installation and install correctly. (See par. 16.)
	Corroded contacts in battery box.	Remove and clean battery box and contacts. (See par. 63.)
	Battery voltage low	Replace batteries.
	Failure of interrupter	Check with external 3-volt battery. (See par. 54.) If faulty, replace.
	Open capacitor	Test for open. (See par. 54.) If faulty, replace.
	Faulty TONE VOLUME control.	Replace. (See par. 62.)
Continuous tone signal	Clock stopped or stalled with contacts made.	Wind clock and start balance wheel by hand.
	Armature springs out of adjustment.	Readjust armature springs. (See par. 56.)
Intermittent failure of conversation (cut-out).	Broken conductor in headset or chest set cord.	Replace cord. (See par. 64.)
Loud clicks when head and chest sets are plugged into jacks.	Internally shorter capacitor.	Replace capacitor. (See par. 58.)

Section XIII. ADJUSTMENTS

56. Clock-Operated Contacts and Switching Mechanism

Be sure that the clock is wound at least two full turns before making adjustments.

a. CAM. (1) Check to see that the cam is securely fastened to the shaft. If the cam is loose, carefully tighten the cam mounting screw with a small screw driver.

(2) Check to see that the contact surface of the cam is smooth and free from roughness. If it is roughened, loosen the mounting screw, remove the cam, and burnish it carefully with #0000 sandpaper.

(3) See that the contact surface of the cam strikes the phenolic buffer plate squarely. If it does not, loosen the cam mounting screw, adjust the cam, and tighten the screw securely.

b. CONTACTS. (1) Check to see that the contacts are securely fastened to the springs and that they are clean and free from cracks and irregularities. If the contacts are loose, replace the spring assembly. Clean dirty contacts with a contact burnisher. Wipe off the burnisher with a clean, dry cloth, close the contacts by hand, and rub the flat side of the burnisher blade back and forth between the contacts two or three times. When unable to clear contact trouble by burnishing only, clean and flush the contacts with carbon tetrachloride. Dip the flat end of a clean, new toothpick in the carbon tetrachloride to a depth of about $\frac{1}{2}$ inch and, without rubbing, deposit the liquid on the contacts. Dip the flat end of another clean, new toothpick in carbon tetrachloride and again deposit the liquid on the contact, without rubbing, to flush away the dirt which has been loosened by the first application. Be careful not to get the carbon tetrachloride on the insulators. When the contacts are thoroughly dry, burnish them to be sure that no foreign material remains on the contacts.

(2) Check to see that the contacts are not out of alignment by more than one-fifth their diameter. To align the contacts, loosen the four screws on the top plate of the spring pile-up, bring the springs into alignment, and tighten the screws securely.

(3) See that the contacts make and break so that not less than half their surfaces appear to be in contact. If any spring is canted so that the contacts do not make squarely, correct by straightening the faulty spring with a suitable spring bender. (See fig. 16.) If the armature spring next to the clock frame is faulty, remove the spring assembly from the clock frame before straightening. (See par. 57b.)

c. SPRINGS. (1) Remove the battery box. With a gram gauge, measure the tension between the make springs and their stop screws. (See fig. 17.) Tension the springs against their screws with 50 grams minimum by turning the adjusting screws slightly with a suitable screw driver. Turn the screws clockwise to increase the tension. Turn them counterclockwise to decrease the tension. Judge by eye to see that both contacts make at the same time.

(2) When the cam is at its point of highest rise, stop the clock by touching the balance wheel gently with a finger. With the battery box removed, measure the pressure between the contacts with a gram gauge. (See fig. 18.) It should be not less than 2 grams. If the tension is too low, increase the tension between the make springs and their stop screws by turning the screws down slightly.

(3) With the springs at normal position, use a thickness gauge to see that there is a minimum 0.020-inch contact gap.

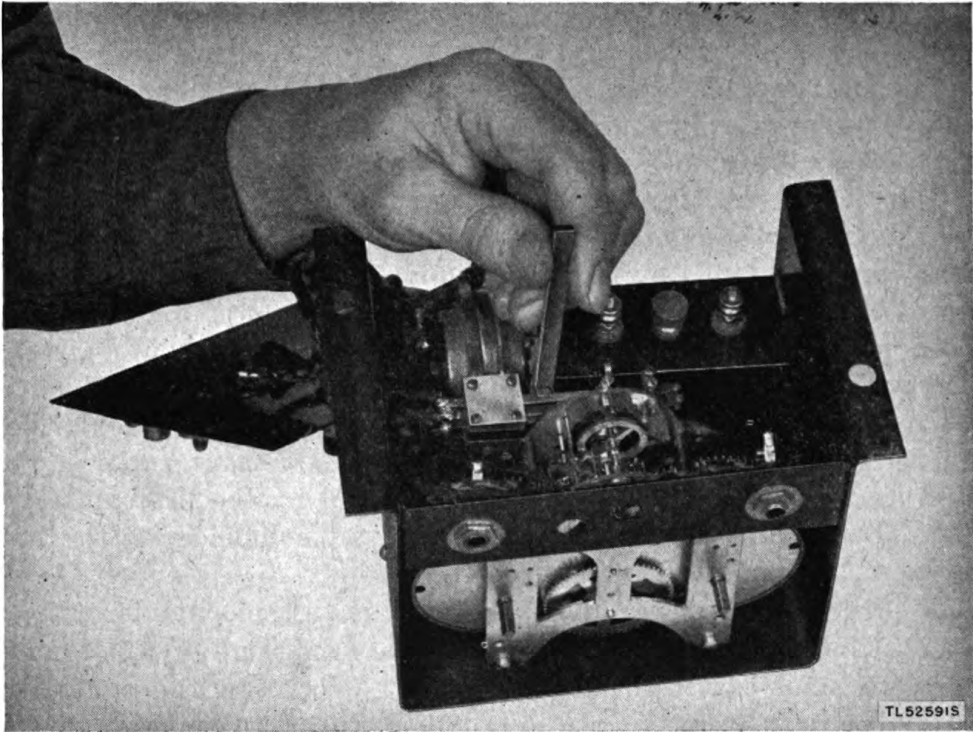


Figure 16. Straightening canted spring with spring bender.

(See fig. 19.) If the contact gap is too small, back the stop screws off slightly or readjust the spring mechanism. (See par. 57.)

(4) If the clock stalls when the cam engages the armature springs the spring adjustment may be too tight. Adjust by backing the adjusting screw out slightly with a suitable screw driver.

57. Signal Time

Check to see that the contacts remain closed for a period of from 6 to 8 seconds. If the signal time is too long or too short, adjust the length of the signal time in the following manner:

a. Remove the battery leads, and loosen the interrupter without disconnecting any leads by removing the two screws which hold it to the side of the internal mounting bracket. With the interrupter hanging free of the bracket, replace the battery leads to test tone.

b. Using the screw driver mounted on the control panel, loosen the two screws holding the spring assembly to the clock frame. (See fig. 20.)

c. Move the entire spring assembly closer to the rotating cam on the clock shaft to increase the time of duration of the tone signal. Move the spring assembly farther from the rotating cam to decrease the time of duration of the tone signal. This adjust-

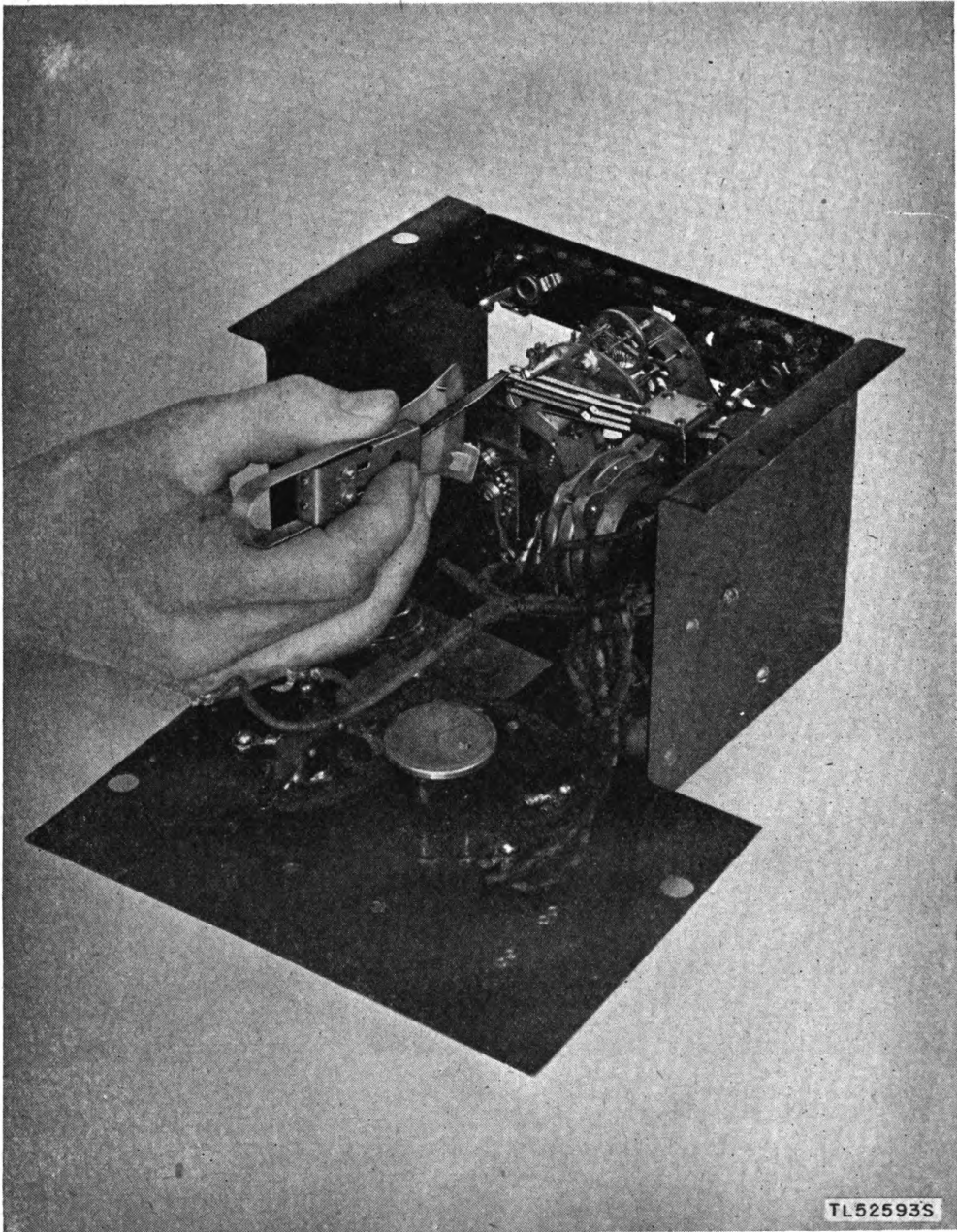


Figure 17. Measuring tension of make springs against their stop screws.

ment is very critical and should be repeated until the tone signal is of approximately 7 seconds duration.

d. Fasten the screws securely after adjustment of signal time is obtained and readjust the spring tension. (See par. 56c.) Replace the interrupter and the battery leads. The duration of contact in the clock-operated contacts should not vary noticeably during a 50-hour test.

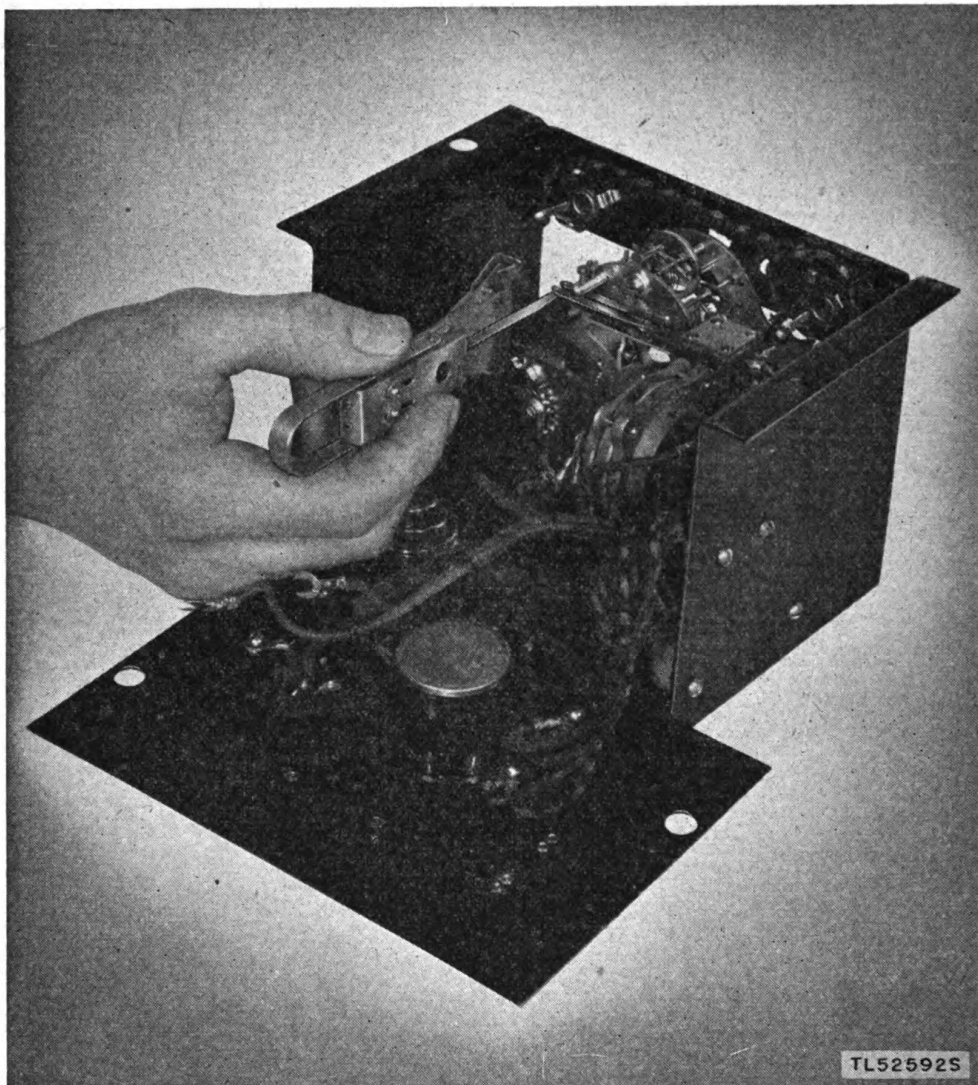


Figure 18. Measuring tension of contacts with cam at point of highest rise.

Section XIV. REMOVAL AND REPLACEMENT OF PARTS

58. Capacitor CA-243

- a. Remove the control panel and the internal mounting bracket to gain access to the defective capacitor.
- b. Unsolder the wires connected to the capacitor.
- c. Remove the two mounting bolts that hold the capacitor to the mounting bracket.
- d. Remove the defective capacitor and install the replacement capacitor by reversing the above procedure.

59. Interrupter BZ-7-G

If the interrupter is faulty, remove it and return it for repair.

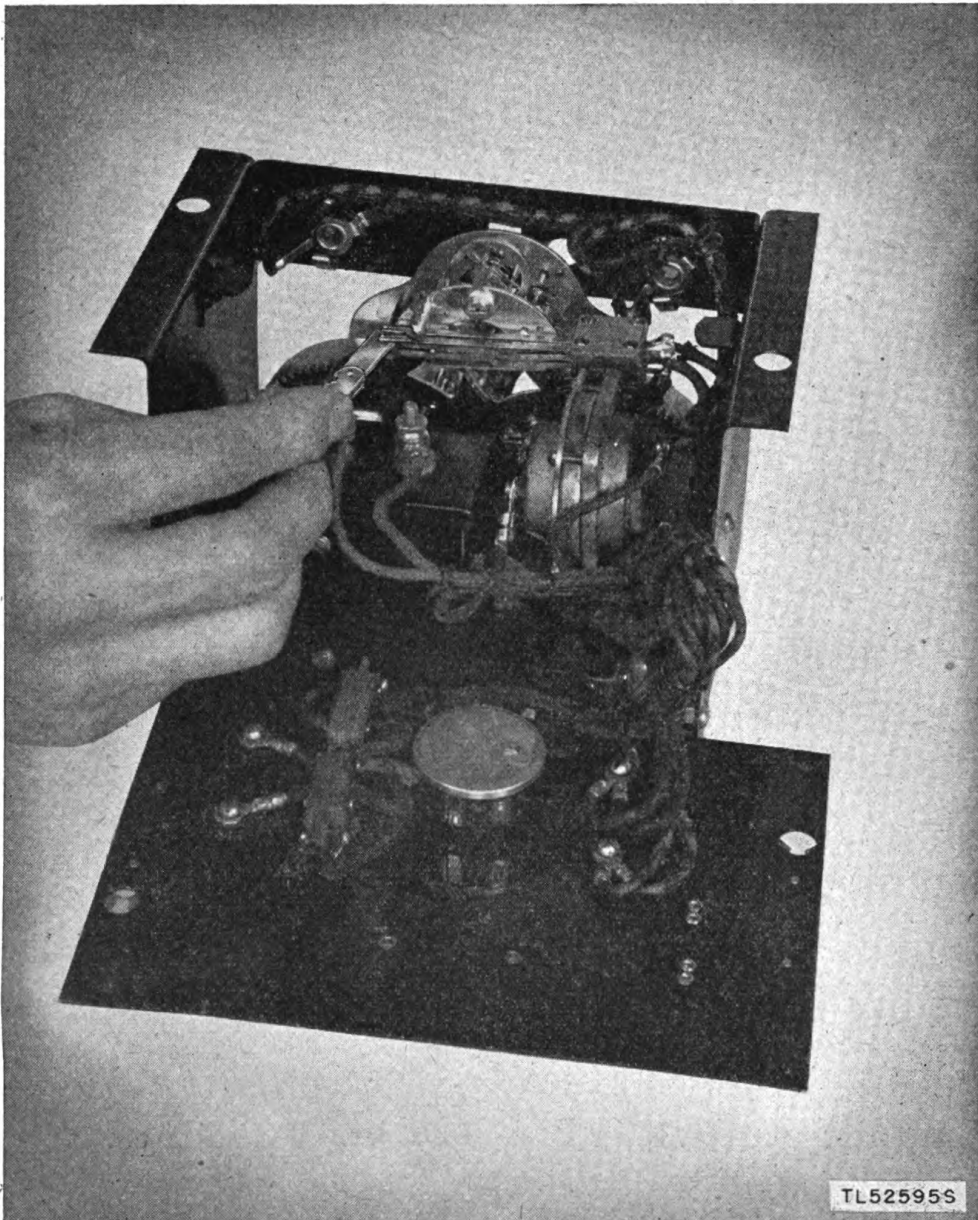


Figure 19. Measuring contact gap.

Caution: Do not attempt repair of Interrupter BZ-7-G in the field.

a. Remove the two leads labeled 1 and 2 from the front of the interrupter.

b. Remove the two screws on the outside of the mounting bracket that hold the interrupter to the bracket.

c. Remove the two leads labeled + and Z from the back of the interrupter.

d. Install a replacement interrupter by reversing the above procedure. Follow the wiring diagram (fig. 21) for the proper color coding of wires.

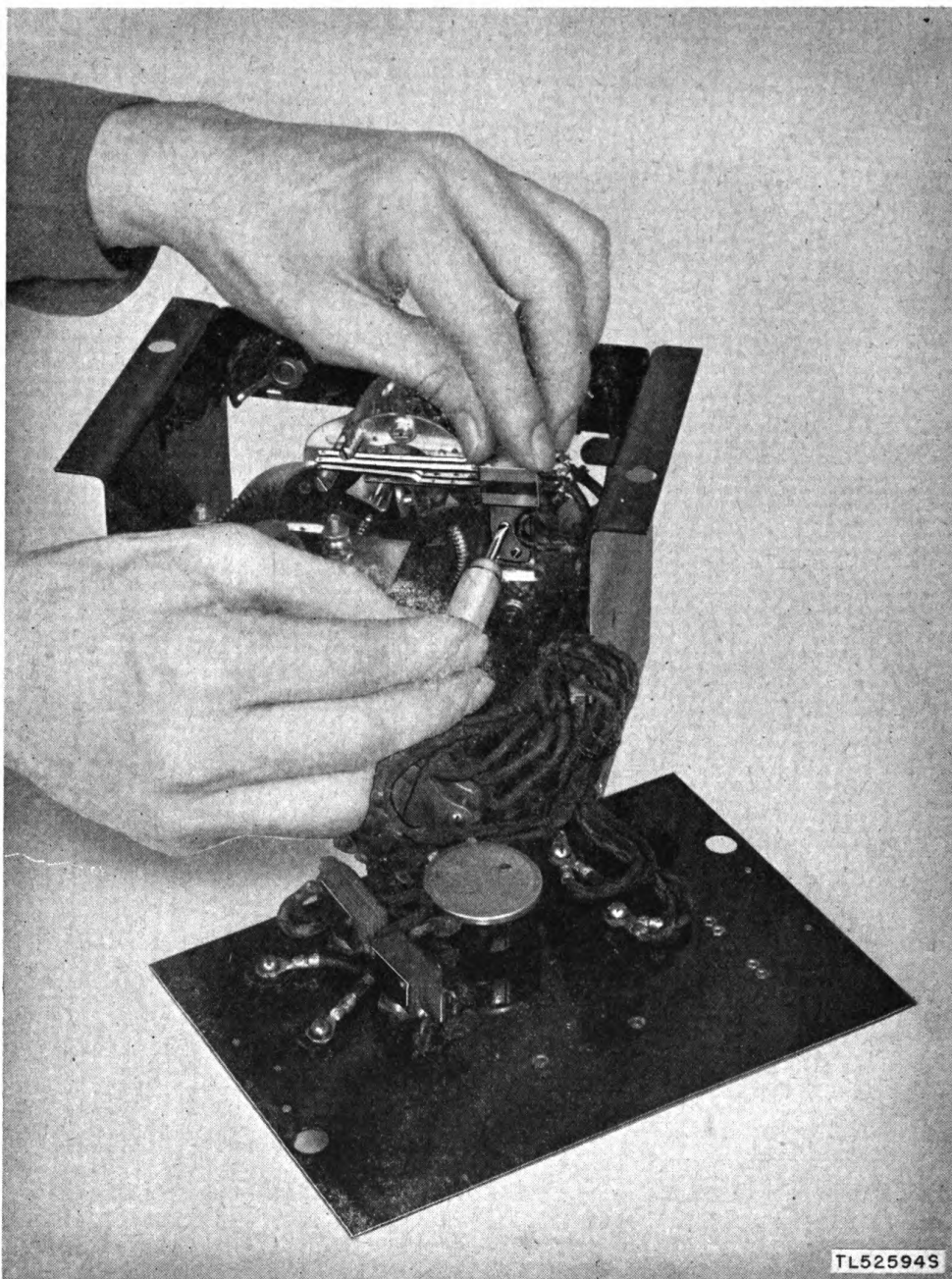


Figure 20. Changing position of spring assembly in relation to cam.

60. Clock

With both clock springs fully wound, the clock should run. If ticking cannot be heard, remove the operating panel and the internal mounting bracket to gain access to the clock. Motion of the balance wheel will indicate whether the clock is running. If the clock will not run when properly wound, remove it and return it for replacement through the usual channels.

Caution: Never attempt to repair the clock in the field.

- a. Unsolder the four wires connected to the switch unit of the clock.
- b. Remove the four screws that mount the clock to the interior mounting bracket.
- c. Remove the defective clock from the mounting bracket and install the replacement clock by reversing the above procedure. Consult the wiring diagram (fig. 21) for the proper color coding of wires.
- d. Check the timing of the replacement clock. (See par. 23.)

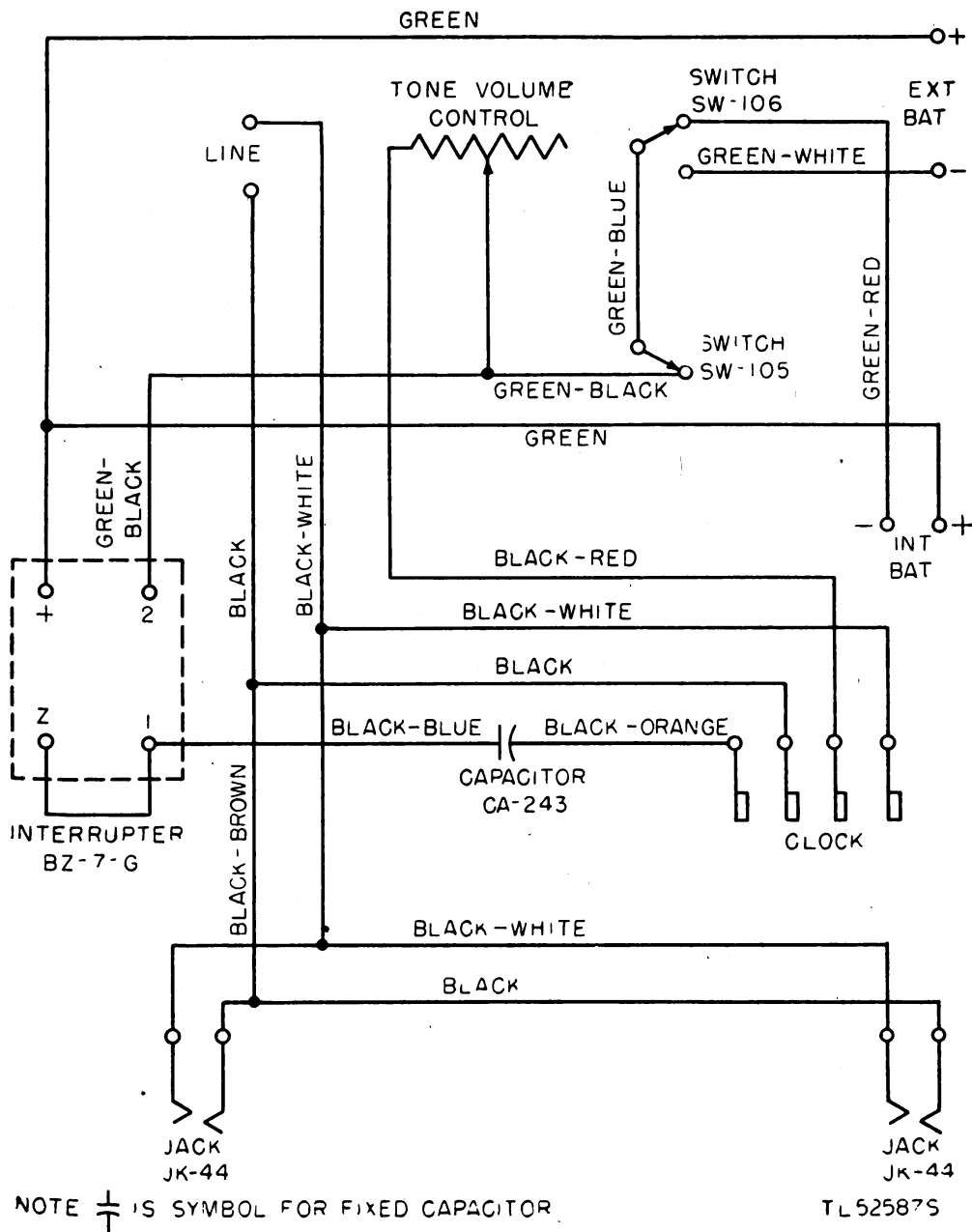


Figure 21. Time Interval Unit ML-138—wiring diagram.

61. Switches SW-105 and SW-106

- a. Remove the operating panel and unsolder the wires connected to the defective switch.
- b. Remove the retaining nut on the face of the panel associated with the defective switch. Pull the switch out of the panel.
- c. Install the replacement switch by reversing the above procedure. Align the switch so that it operates in accordance with the markings on the face of the operating panel.

62. Tone Volume Rheostat

- a. Remove the operating panel and unsolder the wires connected to the rheostat terminals. Remove the fiberboard separator.
- b. Loosen the setscrew on the side of the control knob and remove the knob from the shaft.
- c. Remove the retaining nut on the face of the control panel and pull the rheostat out of the panel.
- d. Remove the retaining nut from the threaded portion of the shaft of the defective rheostat. Place the nut on the threaded shaft of the replacement rheostat to hold the control in the correct position on the back of the panel.
- e. Install the replacement rheostat by reversing the above procedure. When replacing the control knob, be sure that the setscrew is over the flat portion of the shaft.

63. Battery Box

If it is necessary to remove and clean the battery box and install new linings because Batteries BA-30 have been discharged to such a point that the cells have burst with an overflow of liquid in the box, use the procedure outlined below. Each time batteries are replaced, inspect the contacts in the battery box and cover for corrosion. If the contacts are corroded, clean them.

- a. Take off the cover of the box by removing the positive and negative leads and loosening the knurled thumbscrew.
- b. Remove the battery box by removing the three screws on the outside of the internal mounting bracket and lifting the box from the bracket.
- c. Remove the center separator between the cells and the fiber lining in each cell compartment. Swing the contact strip mounting out from the bottom of the mounting bracket.
- d. Clean all parts and dry thoroughly. If necessary, clean heavily corroded contacts with #0000 sandpaper.
- e. Swing the contact strip mounting back into place and replace the center separator in the battery box.

f. Install new linings. If fiber sheets are not available, use heavy paper.

g. Replace the battery box and tighten the screws securely.

64. Head and Chest Set HS-25-(*)

Attempt no repairs on the head and chest set other than replacement of the headband or rubber ear cushion on the headset or of the cord assemblies. Do not attempt repair of either the transmitter or receiver units or remove them from their mountings. Repair of broken wires or loose connections cannot be attempted because of the sealed rubber construction of the cords.

a. HEADBAND. (1) Pull the wires of the defective headband out of the holes in either side of the receiver unit and remove the headband.

(2) Install the replacement headband by sliding the clips of the replacement headband over the receiver unit until they settle firmly into the holes in the side of the unit.

b. EAR CUSHIONS. (1) Pry the defective ear cushion with its attached copper disk out of its seat in the receiver unit.

(2) Coat the outside rim of the diaphragm and the inside rim of the unit with rubber cement and press the replacement ear cushion firmly into place.

c. CORD ASSEMBLIES. (1) Remove the nut which holds the cover on the connection block with a suitable wrench. Be careful not to lose the rubber washer.

(2) Remove the small nut and washer which holds the staycord of the defective cord in place and lift the staycord off the screw stud.

(3) Loosen the screws on the terminals to which the leads of the cord assemblies are connected, and pull the spade type terminals of the defective cord away from the terminals on the connection block.

(4) Loosen the three screws which hold the cord clamp to the chest plate and carefully pull the defective cord assembly out from the connection block.

(5) Install the replacement cord assembly by reversing the above procedure. Be sure to place the white and black leads on the same terminals from which the old leads were removed, the black lead on the terminal marked T and the white lead on the unmarked terminal. Pull the staycord taut to avoid strain on the leads, and tighten all screws and nuts securely.

65. Reel RL-39-(*)

a. CLEANING BEARING BUSHINGS. (1) Pull out the cotter pin at the end of the axle and remove the axle from the handles.

(2) Unscrew the four flathead machine screws on the inner side of each bearing bushing and remove the retaining disks.

(3) Clean the bearing bushings with a soft cloth moistened with dry-cleaning solvent (SD).

(4) Reassemble the bearing bushings with the oil cups on the outside. Make sure that the sides containing the machine screws are facing each other.

(5) Put a few drops of Oil, Engine, OE 30 in each oil cup after the unit has been completely reassembled.

b. REPLACEMENT OF HANDLE ASSEMBLY. (1) Pull out the cotter pin at the end of the axle and remove the axle from the handle assembly and spool.

(2) Install the replacement handle assembly by placing the handles astride the spool so that the bearings line up with the square opening in the center of the spool. Push the handles through both the handle bearings and the spool and replace the cotter pin.

(3) Lubricate the bearings in the replacement handle assembly according to instructions in paragraph 41.

c. RUSTPROOFING AND REPAINTING. (1) Remove rust by cleaning corroded metal with dry-cleaning solvent (SD). In severe cases, use dry-cleaning solvent to soften the rust and #00 or #000 sandpaper to complete the preparation for painting.

Caution: Do not use steel wool. Minute particles of steel wool may enter the bearings and cause harmful friction.

(2) Touch up the exposed metal parts with a sizing coat.

(3) When the sizing coat has dried, repaint the equipment.

(a) When a touch-up job is necessary, apply the paint with a brush.

(b) When numerous scars and scratches warrant complete repainting, spray-paint the axle, crank, handles, and drum. Be careful not to get an excessive amount of paint on the movable parts of the crank and handle or around the small oil fittings on the crank.

66. Unsatisfactory Equipment Report

a. When trouble in equipment used by Army Ground Forces or Army Service Forces occurs more often than repair personnel feel is normal, WD AGO Form 468 (Unsatisfactory Equipment Report) should be filled out and forwarded through channels to the Office of the Chief Signal Officer, Washington 25, D. C.

b. When trouble in equipment used by Army Air Forces occurs more often than repair personnel feel is normal, Army Air Forces Form 54 (Unsatisfactory Report) should be filled out and

forwarded to the Commanding General, Air Technical Service Command, Wright Field, Dayton, Ohio, in accordance with Army Air Forces Regulation No. 15-54. If form is not available, prepare the data according to the sample form reproduced in figure 23.

WAR DEPARTMENT UNSATISFACTORY EQUIPMENT REPORT					
FOR	TECHNICAL SERVICE Signal Corps	MATERIEL	DATE 15 Mar 45		
FROM	ORGANIZATION 568 Signal Repair Co.		STATION San Francisco, Calif		
TO	NEXT SUPERIOR HEADQUARTERS Signal Officer, Sixth Army	STATION APO 001 San Francisco, Calif	TECHNICAL SERVICE Signal Corps		
COMPLETE MAJOR ITEM					
NOMENCLATURE Telephone KE-00-B		TYPE Field, portable	MODEL B		
MANUFACTURER Blank Co.		U S A REG NO 20000-Phila-44	SERIAL NO 500	DATE RECEIVED 1 Mar 45	
EQUIPMENT WITH WHICH USED (If applicable)					
DEFECTIVE COMPONENT—DESCRIPTION AND CAUSE OF TROUBLE					
PART NO. Sig C	TYPE Stock No. 3E333 Cord CC-333	MANUFACTURER Blank Co.		DATE INSTALLED 1 Feb 45	
DESCRIPTION OF FAILURE AND PROBABLE CAUSE (If additional space is required, use back of form) Cord breaks near connections to telephone.					
DATE OF INITIAL TROUBLE 5 Mar 45	TOTAL TIME INSTALLED			TOTAL PERIOD OF OPERATION BEFORE FAILURE	
	YEARS	MONTHS	DAYS	YEARS	MONTHS
		1	5		31
BRIEF DESCRIPTION OF UNUSUAL SERVICE CONDITIONS AND ANY REMEDIAL ACTION TAKEN Operation in tropics. Stay cord retied by means of two clove hitches around end of cord.					
TRAINING OR SKILL OF USING PERSONNEL		RECOMMENDATIONS (If additional space is required, use back of form)			
POOR	FAIR	GOOD	Clamps be added to telephone to hold end of cord near terminals.		
		<input checked="" type="checkbox"/>			
ORIGINATING OFFICER					
TYPED NAME GRADE AND ORGANIZATION Ralph J. Andermann, Capt., Sig C, 568 Signal Repair Co.			SIGNATURE <i>Ralph J. Andermann</i>		
FIRST ENDORSEMENT					
TO CHIEF	TECHNICAL SERVICE	OFFICE			
NAME GRADE, AND STATION		STATION		DATE	
<i>Instructions</i>					
<ol style="list-style-type: none"> 1. It is imperative that the chief of technical service concerned be advised at the earliest practical moment of any constructional, design or operational defect in materiel. This form is designed to facilitate such reports and to provide a uniform method of submitting the required data. 2. This form will be used for reporting manufacturing, design or operational defects in materiel, petroleum fuels, lubricants, and preserving materials with a view to improving and correcting such defects, and for use in recommending modifications of materiel. 3. This form will not be used for reporting failures, isolated material defects or malfunctions of materiel resulting from fair-wear-and-tear or accidental damage nor for the replacement repair or the issue of parts and equipment. It does not replace currently authorized operational or performance records. 4. Reports of malfunctions and accidents involving ammunition will continue to be submitted as directed in the manner described in AR 750-10 (change No. 3). 5. It will not be practicable or desirable in all cases to fill all blank spaces of the report. However, the report should be as complete as possible in order to expedite necessary corrective action. Additional pertinent information not provided for in the blank spaces should be submitted as inclosures to the form. Photographs, sketches, or other illustrative material are highly desirable. 6. When cases arise where it is necessary to communicate with a chief of service in order to assure safety to personnel, more expeditious means of communication are authorized. This form should be used to confirm reports made by more expeditious means. 7. This form will be made out in triplicate by using or service organization. Two copies will be forwarded direct to the technical service, one copy will be forwarded through command channels. 8. Necessity for using this form will be determined by the using or service troops. 					
W. D., A. G. O. Form No. 468 20 August 1944			This form supersedes W. D., A. G. O. Form No. 468, 1 December 1943, which may be used until existing stocks are exhausted.		
U S GOVERNMENT PRINTING OFFICE 16-41840-1			7L53176 S		

Figure 22. WD AGO Form 468 (Unsatisfactory Equipment Report) with sample entries.

WAR DEPARTMENT AAF Form No. 54 (Return 2-15-54)		WAR DEPARTMENT ARMY AIR FORCES		LEAVE BLANK	
TO BE FILLED IN BY STATION		UNSATISFACTORY REPORT		A. S. C. SERIAL No.	REFER TO
STATION SERIAL No.	DATE SUBMITTED	(See AAF Reg 15-54 for information on Proper Use of this Form)		CLASS	
SCSG-33-309	15 Dec 45				
STATION APO 353, c/o PK, San Francisco, Calif.			ORGANIZATION 709th Sig Co, Service Gp.		
SUBJECT OF REPORT Property Class—Name Telephone ET-00		Manufacturer Blank Co.		AAF Order or Shipping No.	
AIRCRAFT—Model & AAF Serial No.		ENGINE—Model & AAF Serial No.		UNIT OR ACCESSORY—Type, Model and Serial No.	
AIRCRAFT REPORTS ONLY LAST O. I. R.—Depot		Date		Flying Time Since	
ENGINE REPORTS ONLY LAST OVERHAUL—Depot		Hours Since		Depots and Hours At Each Previous Overhaul	
PART Name Handset TS-00, Transmitter Unit		PART DRAWING, SERIAL AND SPECIFICATION No. 4148799B/3			
Time in Use		Quantity on Hand		Quantity Known Defective	
Unknown		6		6	
No Previous Failures		Manufacturer		Inspector's No. or Identification	
30		Blank Co.			
Indicate by "X" Disposition of Exhibit		Photographed and Prints Enclosed		Held for Instructions	
<input checked="" type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>	
		Sent Under Separate Cover		Sent in Attached Package	
		<input type="checkbox"/>		<input type="checkbox"/>	
		Repaired and Returned to Service		Discarded of (Explain Reason)	
		<input type="checkbox"/>		<input checked="" type="checkbox"/>	
		To Overhaul Facility (INITIALS)		<input type="checkbox"/>	
				<input type="checkbox"/>	
GIVE COMPLETE DETAILS, PROBABLE CAUSES AND RECOMMENDATIONS BELOW: (Use Only Applicable Spaces Above—Avoid Unnecessary Repetition)					
EXPEDITE					
<p>1. DESCRIPTION OF UNSATISFACTORY CONDITION: The transmitter unit was found to have a very high resistance (5,000 to 100,000 ohms) across its terminals. Corrosion between the diaphragm and the case of the transmitter prevents normal microphone current through the diaphragm to the button. Trouble has been experienced in securing enough transmitter units to keep the handsets in operation.</p> <p>2. PROBABLE CAUSES: The most probable cause for the corrosion between the diaphragm and case of the transmitter is moisture. Although the unit is sealed against moisture, enough gets into the unit to corrode it. Another probable cause is a reaction between the cement used to seal the unit and the aluminum case. Electrolysis undoubtedly adds to both reactions.</p> <p>3. RECOMMENDATIONS: The seal on this unit should be strengthened and a type of cement used that will not react with the aluminum case and diaphragm.</p> <p>4. DISPOSITION: Since transmitter units are expendable all inoperative units were discarded.</p>					
<p><i>James P Jones</i></p> <p>JAMES P. JONES 1st Lt, Signal Corps Operations Officer</p>					
<p>ROUTING SEND ORIGINAL AND TWO COPIES DIRECT TO COMMANDING GENERAL, HQ. AIR SERVICE COMMAND, PATTERSON FIELD, FAIRFIELD, OHIO. U. S. GOVERNMENT PRINTING OFFICE 1943 16-34513-1</p>					

Figure 23. Army Air Forces Form 54 (Unsatisfactory Report) with sample entries.

APPENDIX I

MAINTENANCE PARTS FOR TIMING AND TELEPHONE SET ML-110

The following information was compiled on 1 January 1945. The appropriate pamphlets of the Army Service Forces Signal Supply Catalog for Timing and Telephone Set ML-110 are—

Organizational spare parts:

SIG 7—ML-110.

Higher echelon spare parts:

SIG 8—HS-25.

SIG 8—ML-110.

SIG 8—ML-138.

SIG 8—RL-39.

Fixed plant maintenance list:

SIG 10-900.

For an index of available catalog pamphlets, see the latest issue of Army Service Forces Signal Supply Catalog, SIG 2.

Note. This list covers first, second, and third echelon maintenance parts.

<i>Reference</i>	<i>Signal Corps Stock No.</i>	<i>Name</i>
	7A1850	TIMING AND TELEPHONE SET ML-110.
	3A30	BATTERY BA-30.
Fig. 6	3Z1373-221	BOARD, terminal.
Fig. 3	3DA500-462	CAPACITOR.
Fig. 5	3E4058-5	CORD ASSEMBLY: (transmitter).
Fig. 5	3E4058-6	CORD ASSEMBLY: (receiver).
Figs. 2, 3	7A1838.1/C2	COVER: (telephone jack).
Fig. 6	6H3039/4	CRANK, hand.
Fig. 6	6H3039/H1	HANDLE ASSEMBLY: (reel).
Fig. 5	4B1285A	HEAD AND CHEST SET HS-25-A.
Fig. 5	4C4153BA	HEADBAND.
Fig. 3	4Z5007G	INTERRUPTER BZ-7-G.
Fig. 5	3E2058-4	JACK JK-26 AND CORD.
Fig. 3	2Z5544	JACK JK-44.

<i>Reference</i>	<i>Signal Corps Stock No.</i>	<i>Name</i>
Fig. 2	2Z5549-54	JACK JK-54
Fig. 4	7A588/K1	KEY, winding: (clock).
Fig. 4	2Z5786.77	KNOB: round (tone volume control).
Fig. 5	4B2501/1	PAD: (ear cushion).
Fig. 2	2Z7157	PLUG PL-57.
Fig. 4	3Z739-2	POST, binding.
Fig. 3	2Z7270.43	RESISTOR, variable (potentiometer; tone volume control).
	7A1838.1/S3	SCREW, adjustment.
Fig. 4	6R15021	SCREW DRIVER, cabinet.
Fig. 6	6H7108A	SPOOL DR-8-A.
Fig. 5	4Z6924	STRAP ST-24.
Fig. 5	4Z6925	STRAP ST-25.
Fig. 6	4Z6934	STRAP ST-34.
Fig. 6	4Z6935	STRAP ST-35.
Fig. 2	2Z9042	STRAP ST-42.
Fig. 3	3Z8105	SWITCH SW-105.
Fig. 3	3Z8106	SWITCH SW-106.
Fig. 2	7A1838.1	TIME INTERVAL UNIT ML-138.

APPENDIX II

REFERENCES AND ABBREVIATIONS

Note. For availability of items listed, check FM 21-6 and Army Service Forces Catalog SIG 2. Also see FM 21-6 for applicable Technical Bulletins and Modification Work Orders.

1. Parts List

- SIG 1, Introduction to Army Service Forces Signal Supply Catalog.
- SIG 2, Complete Index to Army Service Forces Signal Supply Catalog.
- SIG 3, List of Items for Troop Issue.
- SIG 4-1, Allowances of Expendable Supplies.
- SIG 4-2, Allowances of Expendable Supplies for School, Training Centers, and Boards.
- SIG 5, Stock List of All Items.
- SIG 6, Sets of Equipment.
- SIG 7, Organizational Spare Parts.
- SIG 8, Higher Echelon Spare Parts.
- SIG 10, Fixed Plant Maintenance Lists.
- SB 11-6, Dry Battery Supply Data.

2. Painting, Preserving, and Lubrication

- TB SIG 13, Moistureproofing and Fungiproofing Signal Corps Equipment.

3. Shipping Instructions

- U. S. Army spec. No. 100-14A, Army-Navy General Specifications for Packaging and Packing for Oversea Shipment.

4. Decontamination

TM 3-220, Decontamination.

5. Demolition

FM 5-25, Explosives and Demolitions.

6. Camouflage

FM 5-20, Camouflage, Basic Principles.

7. Other Technical Publications

FM 11-5, Mission, Functions, and Signal Communication in General.

FM 21-8, Military Training Aids.

FM 24-20, Field Wire Systems.

TB SIG 66, Winter Maintenance of Ground Signal Equipment.

TB SIG 72, Tropical Maintenance of Ground Signal Equipment.

TB SIG 75, Desert Maintenance of Ground Signal Equipment.

TB 11-430-1, Maintenance of Batteries in Nontemperate Areas.

TM 1-235, Weather Station Handbook for the Observer.

TM 1-455, Electrical Fundamentals.

TM 11-430, Batteries for Signal Communication Except Those Pertaining to Aircraft.

TM 11-462, Signal Corps Reference Data.

TM 37-250, Basic Maintenance Manual.

TM 11-1158A, Radio Set SCR-658.

8. Forms

WD AGO Form 468, Unsatisfactory Equipment Report.

AAF Form 54, Unsatisfactory Report.

9. Abbreviations

ac.....Alternating current (noun).

a-c.....Alternating current (adj).

AWG.....	American Wire Gauge.
dc.....	Direct current (noun).
d-c.....	Direct current (adj).
EXT BAT.....	External battery.
INT BAT.....	Internal battery.
ma.....	milliampere.
MFP.....	Moistureproofed and fungiproofed.
OD.....	Outside diameter.
OE.....	Engine oil.
SD.....	Dry-cleaning solvent.

