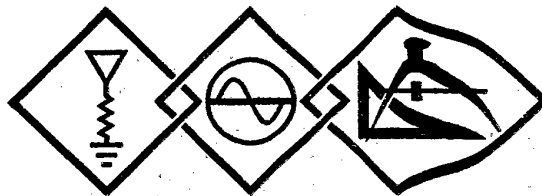
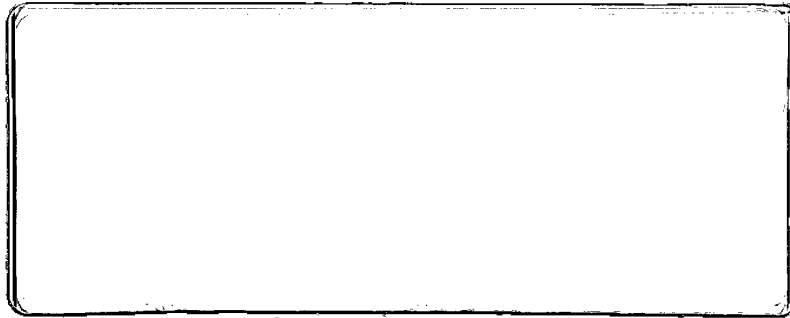


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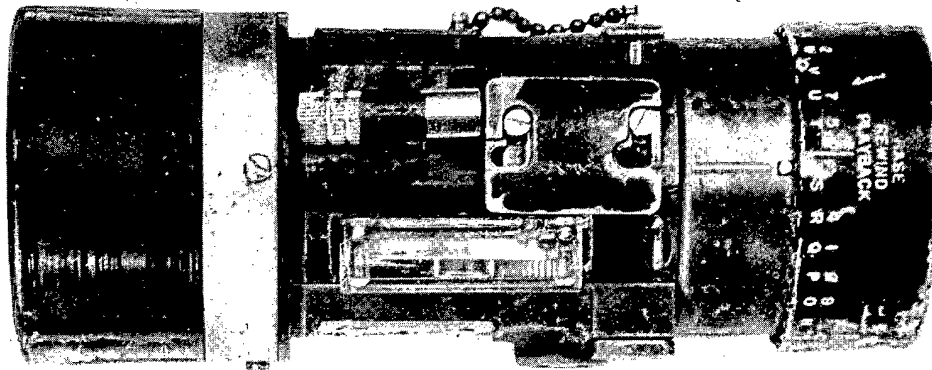
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A&A Report No. 477

TC-1
(Service Test Model)

CLASS "A" EVALUATION



Project No. 2658

Date: 17 Feb. 1964

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GROUP 1
Excluded from automatic
downgrading and
declassification

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50X1

ABSTRACT

A Class A evaluation was performed on the [redacted]
(service test model) by the R&D Laboratory.

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The TC-1 performed satisfactorily at room temperature. During temperature extremes the communicator failed to meet manufacturer's WPM specifications. It ran about 70 WPM slow.

There were no encoding or transmission errors at any temperature.

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1. INTRODUCTION

The TC-1 [redacted] is a completely transistorized, miniature tape recorder designed to manually record a precoded message and play-back the message at a rapid rate [redacted]

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The communicator produces a teletypewriter five level, eight unit inverted Baudot code. The coder is arranged so that when the message is played back the letters can be read [redacted] but the message will be backwards.

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The TC-1 communicator is manufactured by the [redacted]
[redacted]

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2. SUMMARY OF TEST DATA AND COMPARISON WITH THE
ENGINEERING MODEL AND MANUFACTURER'S DATA

ITEM	TEST DATA	TC-1 ENGINEERING MODEL	MANUFACTURER'S DATA
Seven volt battery current drain	Record - 2.3 ma Playback - 3.4 ma Erase - 4.1 ma	Record - 1 ma Playback - 3 ma Erase - 4 ma	None
Message error rate	0.0%	2.5%	2.0%
Code	Eight element inverted Baudot	Eight element inverted Baudot	Eight element inverted Baudot
Word capacity	115 words of 6 characters	100 words	100 words
Transmission speed	1071 - 1182 WPM	1192 - 1218 WPM	1140 - 1260 WPM
Transmission on air time	6.0 - 6.5 seconds	4.93 - 4.94 seconds	-----
Erase characteristics	22 - 47 db reduction of signal after erasure depending on temperature	19 db	-----
Operation at temperature extremes	70 WPM slow	-----	-----
Operation after vibration	Satisfactory	-----	-----

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3. DETAILS OF TEST DATA

3.1. Mechanical Section

3.1.1. Mechanical Inspection

The TC-1 appears to be well constructed and mechanically sound. It has several minor faults which should be corrected.

In the record position the cap indexes sloppily. Although the wrong character cannot be selected there is a large amount of play in the cap on either side of the correct character.

During the 110°F, 90% humidity test the paint on the unit began to peel.

During the same test the windup key rusted badly.

The red marks signaling the end of tape are difficult to see.

The on-off switch is spring loaded and can slip out of the operator's fingers to the off position. If the TC-1 is operated with the remote transducer, the on-off switch is difficult to locate by touch while the unit is in an operator's pocket.

When the transducer is inserted into the TC-1 it sometimes makes a poor contact. The communicator should be tried out immediately after the transducer is inserted to make sure the transducer is working properly.

3.1.2. Size and Weight

TC-1

Size : 4 1/4 L x 1 3/4 D

Weight : 14 ounces

Remote Unit

Weight : 3 ounces

Carrying case with keys and batteries

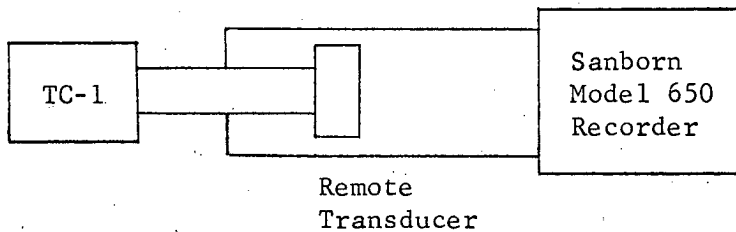
Size : 6 3/4 L x 6 5/8 W x 2 5/8 D

Weight : 13 ounces

3.2. Test Section

3.2.1. TC-1 Record, Playback and Erase Characteristics

Test Setup:



Test Procedure:

- (a) A message was recorded on the entire length of the tape.
- (b) The tape was played back and the output recorded on photographic paper by means of the Sanborn recorder.
- (c) The Words Per Minute were calculated at the beginning, middle, and end of the tape by measuring the time of transmission for two words (12 characters).
- (d) The overall speed was calculated by measuring the playback time of the complete reel of tape and counting the total number of characters transmitted.
- (e) The element, character, and stop-space times were recorded.
- (f) The amplitude variation of the pulses was noted.
- (g) The tape was started in the middle of a message and the time required before reception of characters was noted.
- (h) The tape was erased and the erase characteristics were noted.

3.2.1. TC-1 Record, Playback and Erase Characteristics (Continued)

Test Results:

Words Per Minute

Beginning of tape	1182
Middle of tape	1173
End of tape	1158
Overall	1170
Word capacity	115 words
Character length	8.2 - 9.1 ms
Element length	1.05 - 1.18 ms
Stop-Space length	1.96 - 2.45 ms
Amplitude variation	3.6 db
DB reduction of signal after erasure	32.6

After restarting the tape in the middle of a message approximately 0.15 second was required before the characters appeared (the amplifier was evidently off) and 0.213 - 0.232 second total time was required before the characters were received undistorted.

3.2.2. Operational Test (Message Transmission Over Phone Lines)

Test Procedure:



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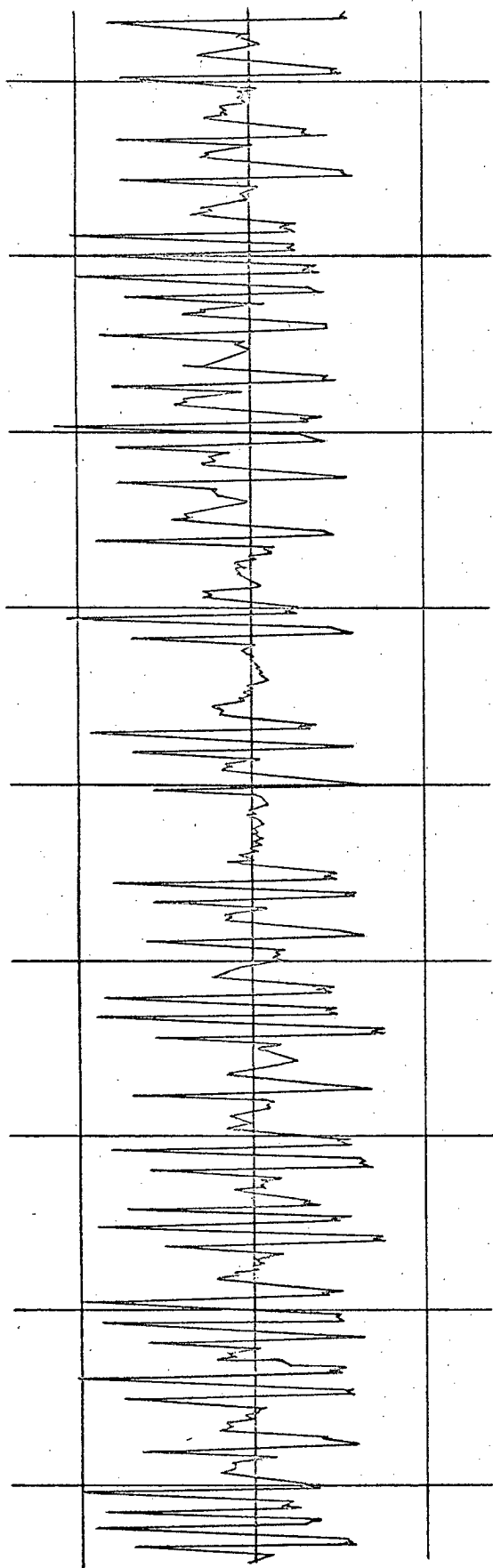
(b) The message was sent twice (TEST 1 and TEST 2) and recorded on photographic paper by means of the Sanborn recorder.

Test Results:

See Figure 1

The recorder gain controls were unchanged between TEST 1 and TEST 2. Timing lines are 10 ms apart.

TEST 1



TEST 2

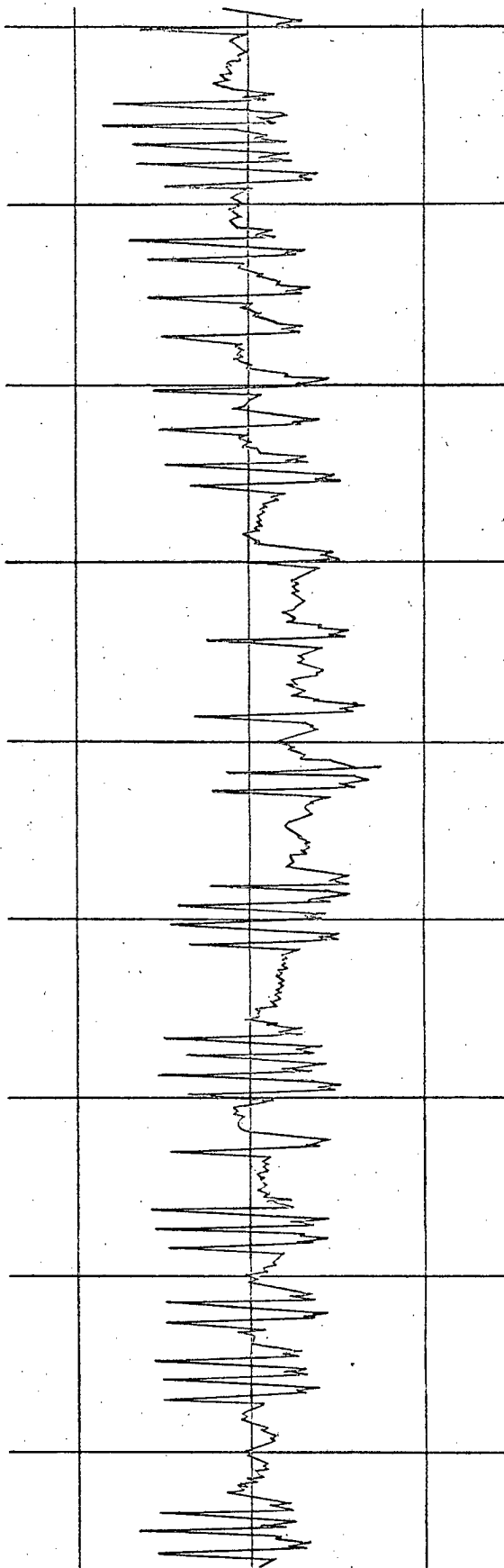


FIGURE 1

3.2.3. Operational Test - Encoding

Test Procedure:

An attempt was made to generate encoding errors with the TC-1.

Test Results:

With a little care a message can be encoded with no errors. However, if the cap is allowed to spring back up unchecked while encoding, errors can be generated. See Figure 2B.

TIMING LINES-0.01 SEC. APART

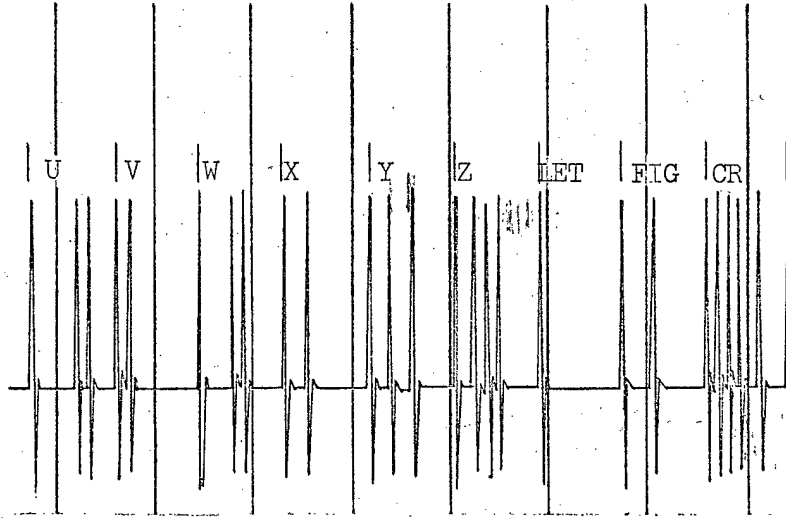


FIGURE 2A CORRECT ENCODING

TIMING LINES-0.01 SEC. APART

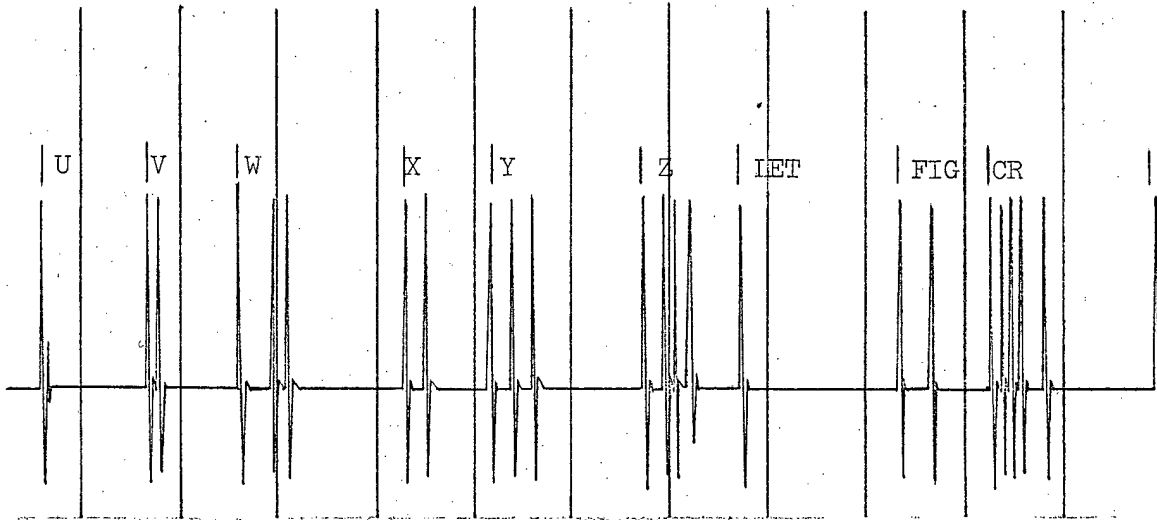
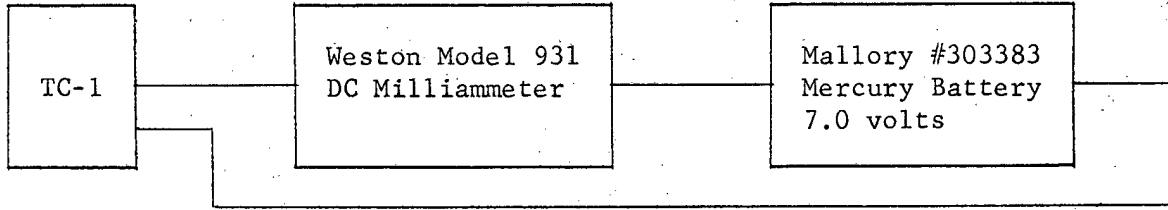


FIGURE 2B ERRORS GENERATED DURING ENCODING BY
ALLOWING CAP TO SPRING BACK UNCHECKED

3.2.4. Battery Current Drain

Test Setup:



Test Conditions:

A fresh battery with open circuit voltage of 7.2 volts was used.

Test Procedure:

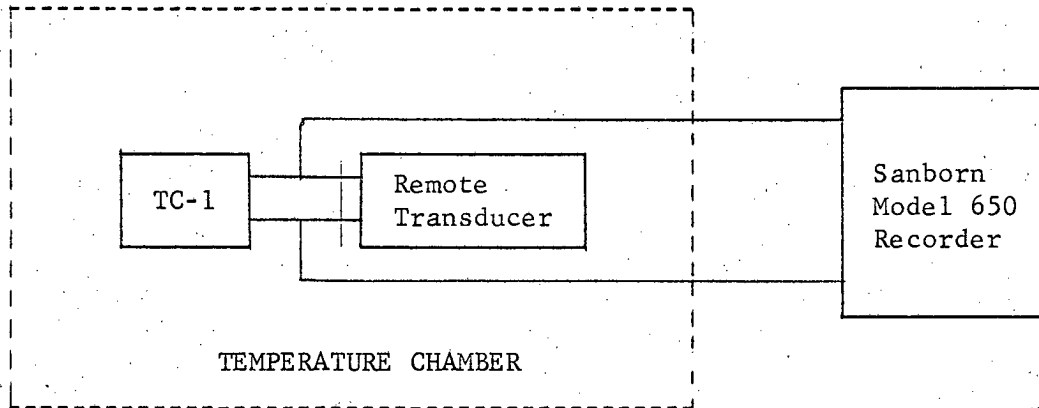
A DC milliammeter was connected in series with the TC-1 battery and the current drain was measured with the TC-1 operating in the record, playback and erase positions.

Test Results:

Record	2.3 ma
Playback	3.4 ma
Erase	4.1 ma

3.2.5. Temperature Tests

Test Setup:



Test Procedure:

- (a) The TC-1 remained at the specified temperature for one hour before measurements were conducted.
- (b) Tests were conducted at 110^oF with 90% humidity and at 0^oF.
- (c) Each character was recorded three times.
- (d) All data was obtained on photographic paper by means of the Sanborn recorder.
- (e) The tape was played back and the following was noted:
 - (1) Any recording or transmission errors
 - (2) Words Per Minute (measured by the transmission time for 12 characters)
 - (3) Playback time for a complete reel of tape (from red section of tape to end)
- (f) The tape was erased once and played back to note the erase characteristics.
- (g) After the temperature tests the words per minute and playback time at room temperature for a complete reel of tape (from red section of tape to end) was noted.

3.2.5. Temperature Tests (Continued)

Test Results:

ITEM	0°F	110°F	Room Temperature
Encoding or playback errors	None	None	None
Words Per Minute	1106 - 1112	1071 - 1074	1158 - 1182
Playback time for a complete reel of tape	6.203 seconds	6.464 seconds	6.00 seconds
DB reduction of signal after erasure	47.2	22.8*	32.6

*Not a complete erasure of all characters. Although the signal was considerably reduced in amplitude a few of the characters could be picked out of the background noise on the Sanborn recording.

3.2.6. Vibration Test

Test Procedure:

- (a) The fixture without the TC-1 was vibrated to check for resonances, then the TC-1 was vibrated in two mutually perpendicular planes (flat and standing up) at a constant displacement of 0.4 inch double amplitude from 5 to 10 cps, and at a constant acceleration of 2 G's from 10 to 500 cps.
- (b) The sweep rate was set to 15 minutes from minimum to maximum and back to minimum.

3.2.6. Vibration Test (Continued)

- (c) Three complete cycles were run for a total of 45 minutes of vibration testing in each plane.
- (d) The TC-1 record, playback, and erase functions were checked after the test and the playback time for a complete reel of tape was noted.

Test Results

No resonant points were observed. The TC-1 encoded and transmitted all characters correctly. The tape speed and erase characteristics were satisfactory.

4. CONCLUSIONS

The TC-1 performed satisfactorily except that it failed to meet the manufacturer's specifications for words per minute at both temperature extremes.

There were no encoding or transmission errors.

5. RECOMMENDATIONS

The TC-1 cap should be arranged so that it indexes sharply.

The communicator speed should be brought up to specifications at the temperature extremes.

The communicator should employ a more weather resistant paint.

The windup key should be made of a non-ferrous material.

The on-off switch should have an external button attached to make it easier to grasp.

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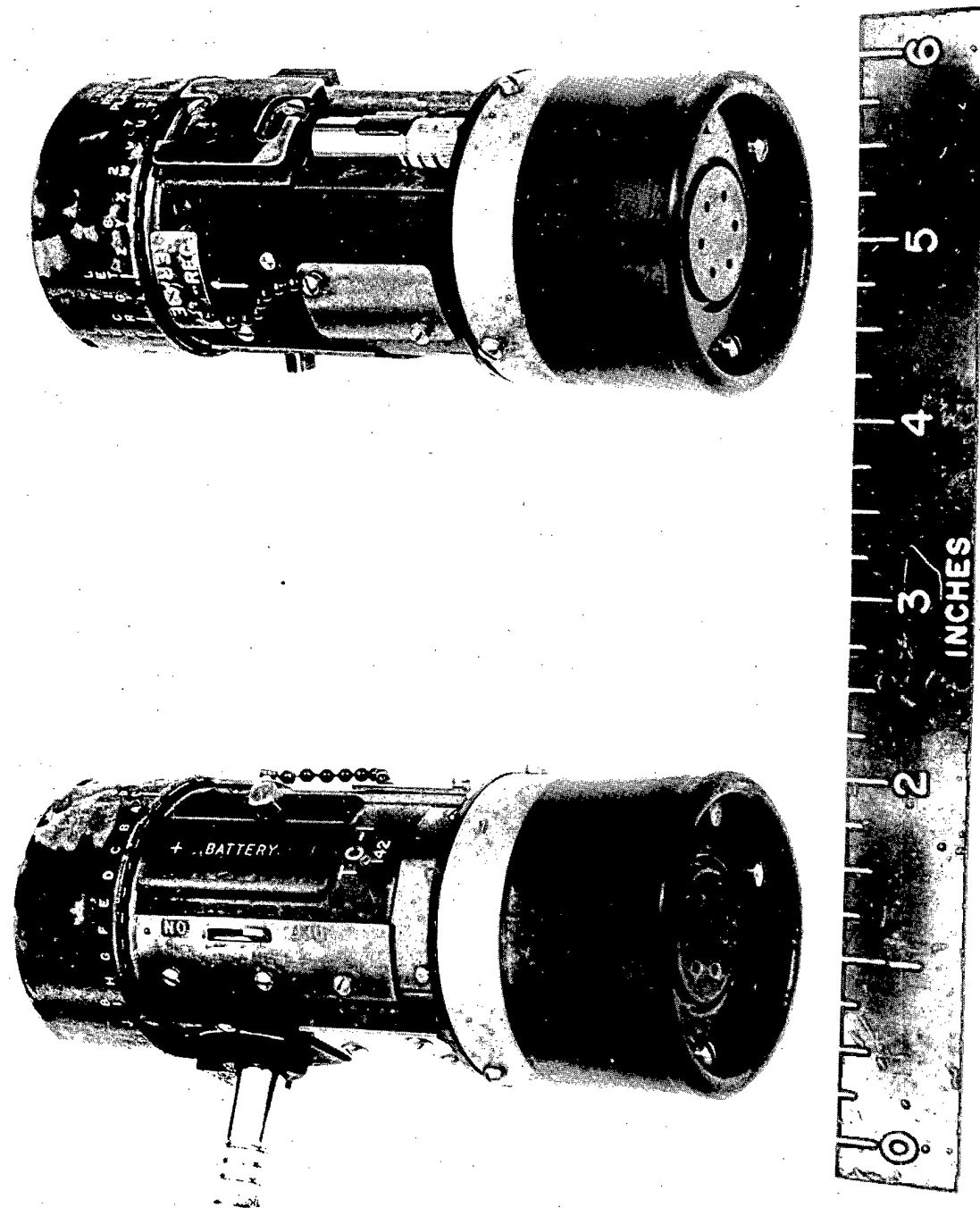


Figure 3. TC-1

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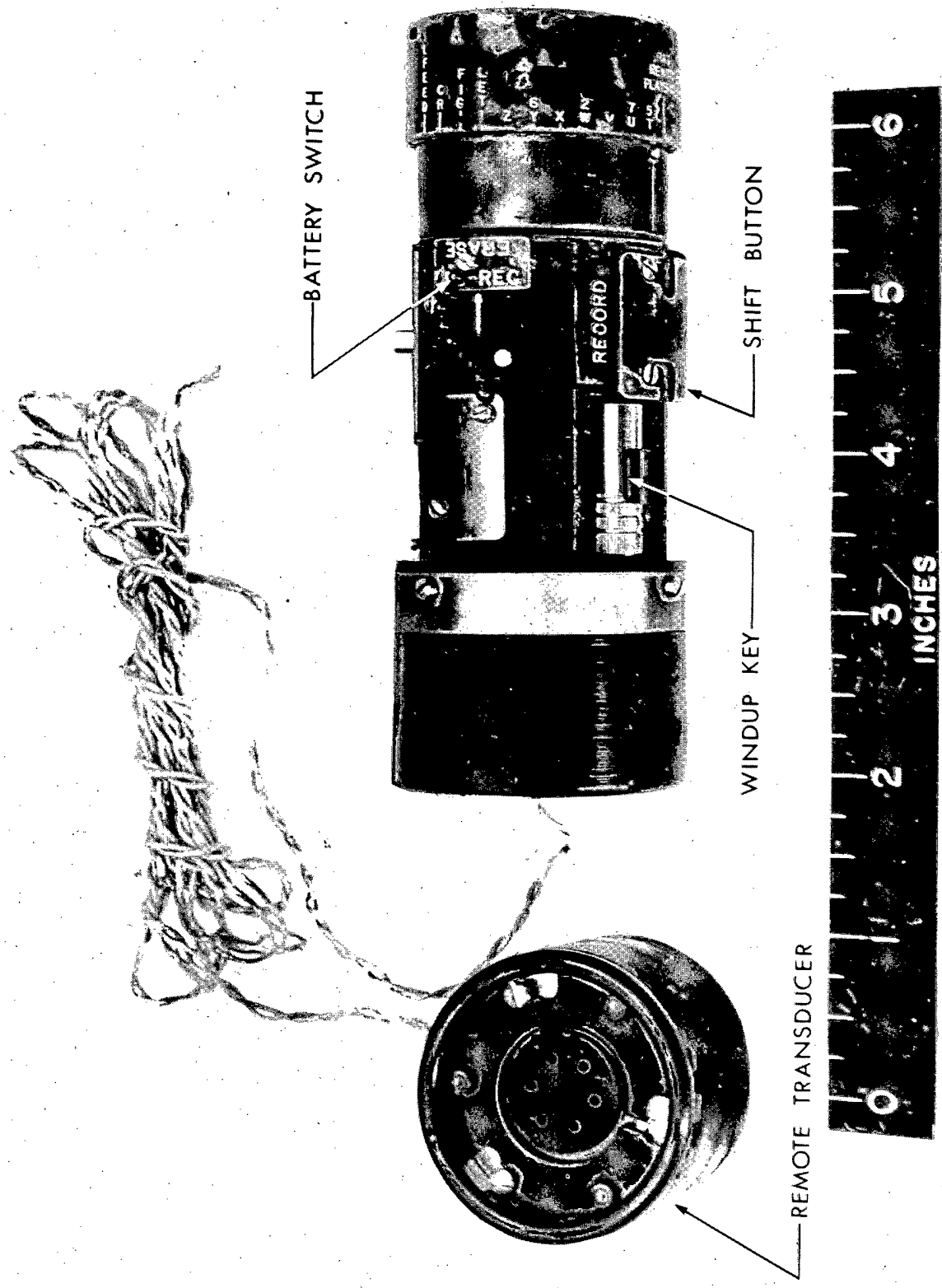


Figure 4. TC-1 in Record Position

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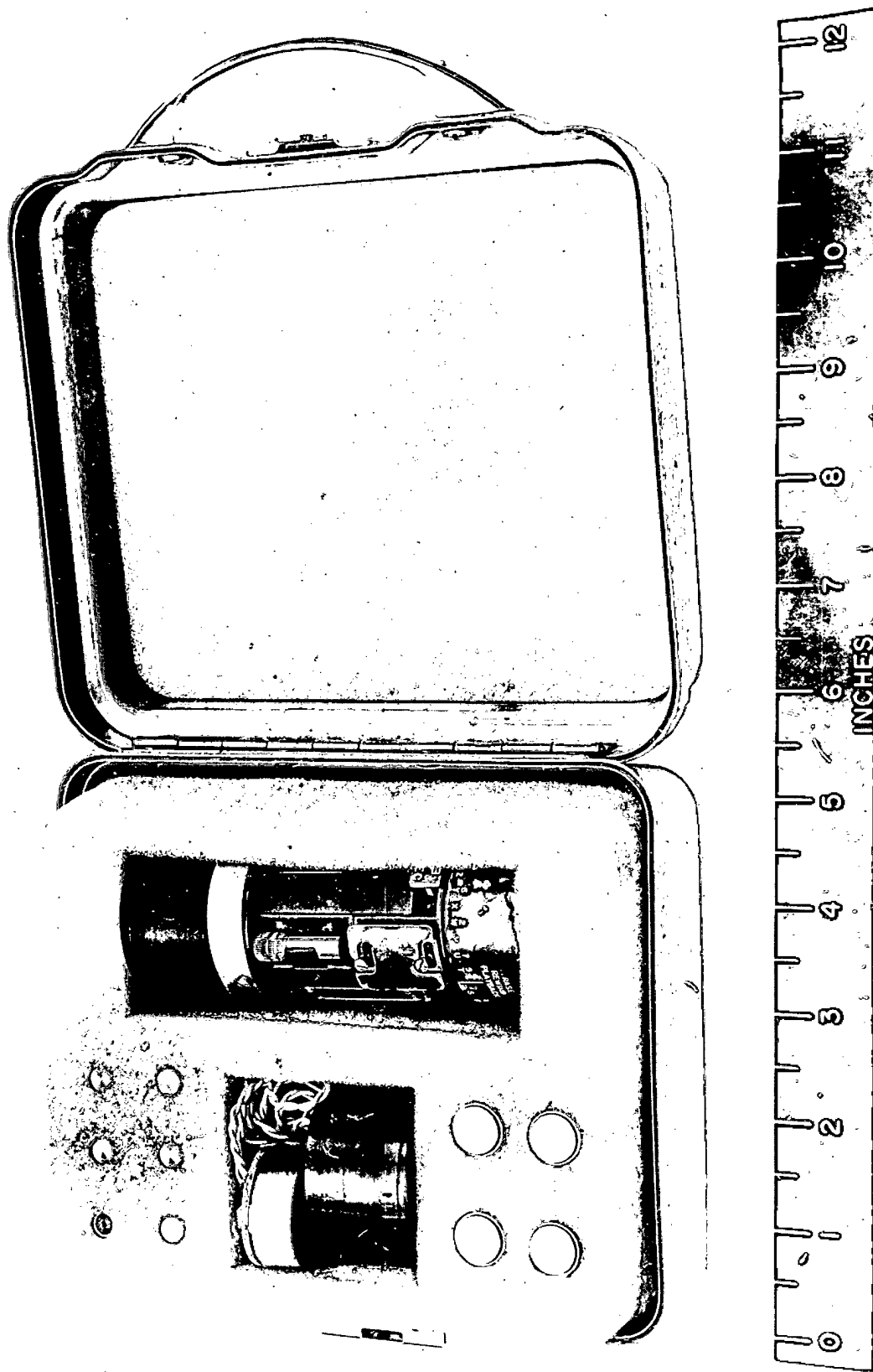


Figure 5. TC-1 With Carrying Case and Accessories

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A D D E N D U M

In testing the DR-8, tests were run on TC-1 serial No. 138 to determine whether it was operating properly.

The speed of the TC-1 varied from 1127 to 1176 wpm. This is not within specifications.

The numbers 3 and 6 do not appear on the recording head.

When the TC-1 is placed on [redacted], the ON-OFF switch must be pressed away [redacted] while trying to hold the TC-1 next [redacted]. This is difficult to do. Operation would be simplified if the switch moved in the opposite direction (down toward the telephone for ON, up for OFF).

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While transmitting with the TC-1, it is possible to move the RECORD-SHIFT button. This will lock the TC-1 and the button will have to be placed in the PLAYBACK position before transmission is possible.

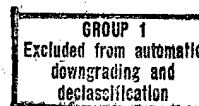
The TC-1 must be brought up to specifications in PLAYBACK speed. Neither the previous model tested nor the present model of the TC-1 did 1200 wpm. In both models the top speed was less than 1200 wpm. This makes it easy for the TC-1 to slip out of tolerance on the low end.

The numbers 3 and 6 should be added to the record head.

Operation of the ON-OFF switch should be reversed.

There should be a positive lock on the RECORD-SHIFT button locking it in the PLAYBACK position.

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