RESTRICTED

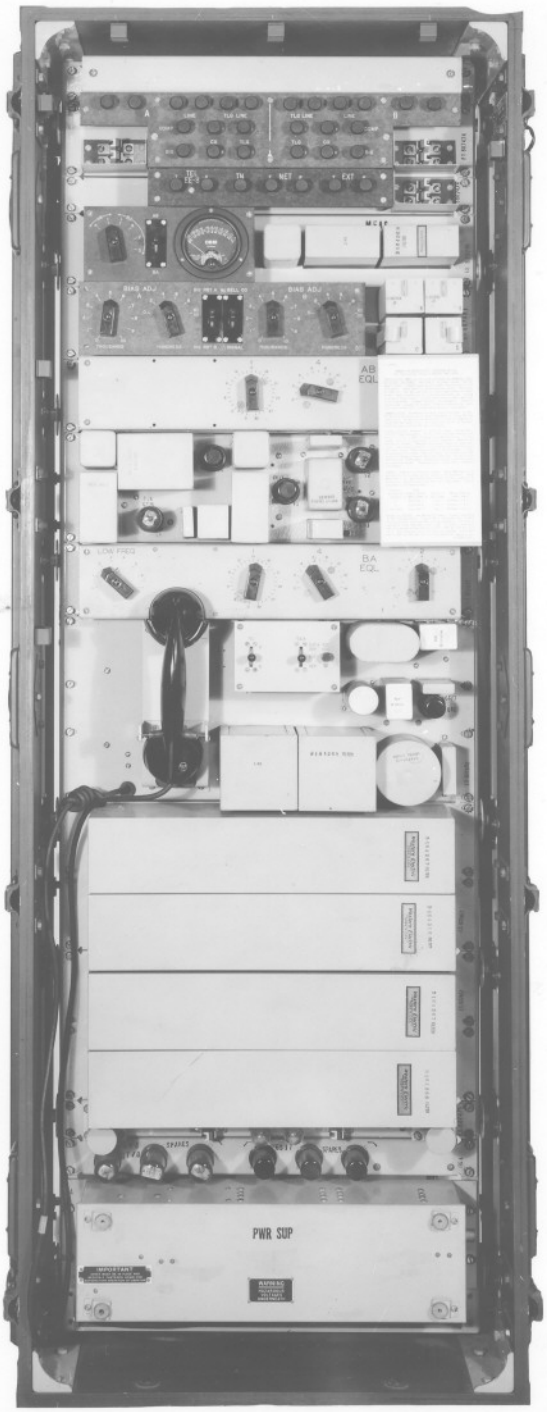
RESTRICTED

CONVERTER CF-4-T1 (Carrier, 2 Wire-4 Wire) . PART of CONVERTER SET TC-33-( )

(Carrier, 2 Wire-4 Wire) . Front View . Showing Arrangement of Operating Controls

DATE 12-27-43 SIGNAL CORPS GROUND SIGNAL AGENCY NO SCGSA 10304

RESTRICTED



RESTRICTED

REPEATER CF-5-T2 (Carrier, 2 Wire) . PART of REPEATER SET TC-37-( ) (Carrier, 2 Wire)

Front View . Showing Arrangement of Operating Controls

DATE 12-27-43 SIGNAL CORPS GROUND SIGNAL AGENCY NO. SCGSA 10296

Incl 2

UNCLASSIFIED

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TELEPHONE UNIT EE-105-T2 . For USE with CARRIER TELEPHONE SYSTEMS

Prepared for Field Operation

DATE 12-27-43 SIGNAL CORPS GROUND SIGNAL AGENCY NO. SCGSA 10292

UNCLASSIFIED

UNCLASSIFIED

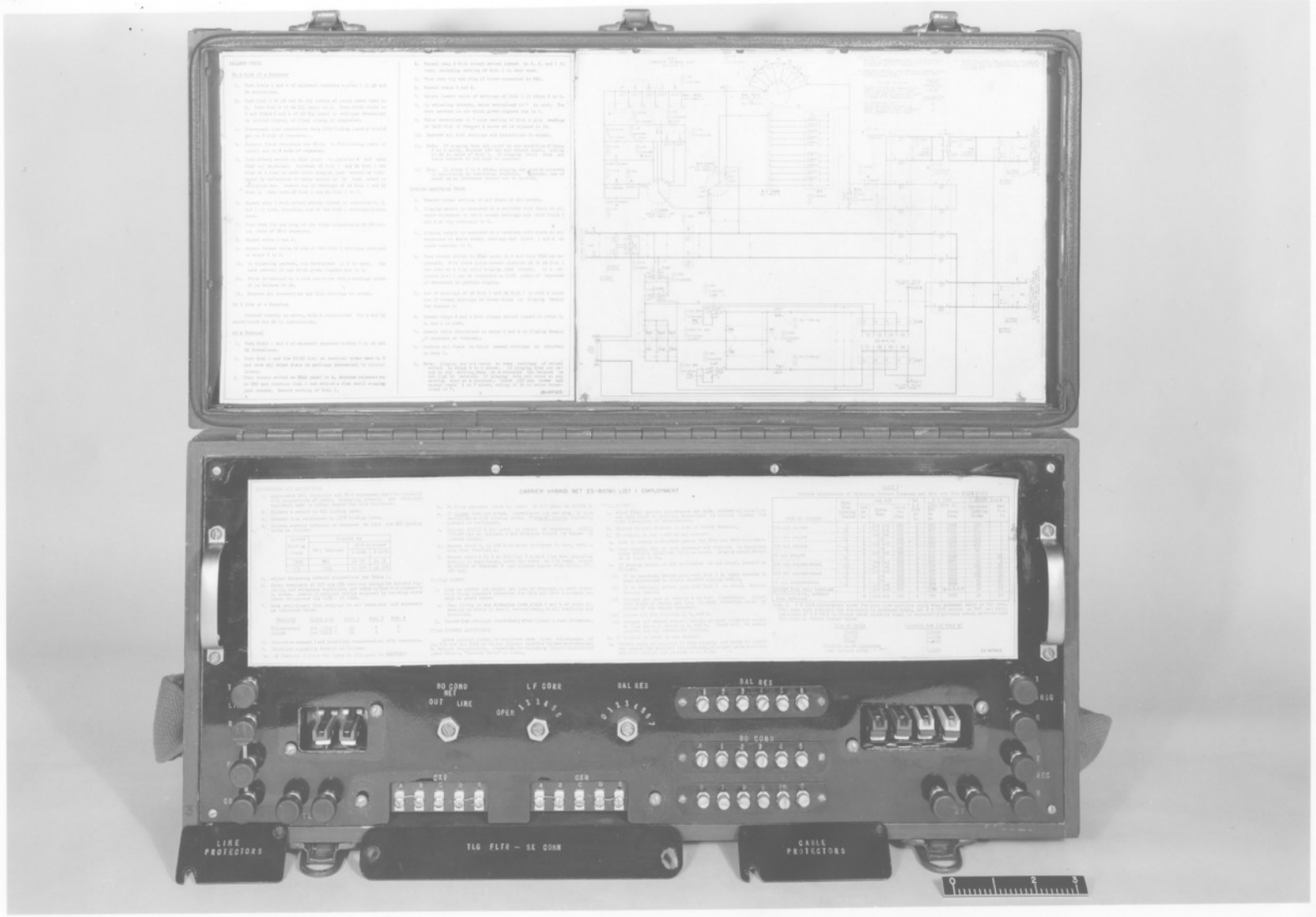
CARRIER HYBRID CF-7-A . For USE with SPIRAL-FOUR CARRIER SYSTEMS

Front View . Cover Open . Showing Control Panel

DATE 12-27-43 SIGNAL CORPS GROUND SIGNAL AGENCY NO. SCGSA 10307

Incl. 4

UNCLASSIFIED



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CARRIER HYBRID CF-7-A . For USE with SPIRAL-FOUR CARRIER SYSTEMS

Cover Open . Showing Face Plates of Control Panel Removed

DATE 12-27-43 SIGNAL CORPS GROUND SIGNAL AGENCY NO SCGSA 10308

VOICE-FREQUENCY REPEATERS AND AMPLIFYING CIRCUITS

A. Two-Wire Repeaters

1. Telephone Repeater EE-89-( )

a. A need for means of extending the talking range of field wire circuits was recognized by the Signal Corps at an early date and in December 1936 the SCTC in Meeting No. 145, 14 December 1936, recommended military characteristics for a two-wire voice-frequency telephone repeater. These military characteristics were approved by AGO 2 February 1937 and a project for this development established 21 June 1937. Construction of a service-test model of Telephone Repeater EE-89-T1 was started in March 1938 and service tests by The Signal Corps Board were initiated 15 July 1938. These tests were not completed until 10 November 1940 when The Signal Corps Board gave an unsatisfactory report on Telephone Repeater EE-89-T1 and development of this model was consequently dropped. Work was then initiated on a preliminary model of a 21-type repeater and contracts awarded to American Transformer Company, Newark, N. J. and the Daven Company, Newark, N. J. for development models of Telephone Repeaters EE-89-T2 and EE-89-T3, respectively.

b. Due to manufacturing difficulties the contract with American Transformer Company was terminated. The first development model of Telephone Repeater EE-89-T3 was submitted to Eatontown Signal Laboratory in October 1942 and approved 31 October 1942. Meanwhile, investigations had resulted in a compilation of information on the employment of this repeater on field wire circuits and service tests were initiated upon receipt of sufficient models.

c. Service-test reports on this repeater were favorable and standardization was recommended by SCTC in Meeting No. 262, 10 May 1943, and immediate procurement was recommended. Standardization was approved by ASF on 1 Jun 1943.

d. Many of the 300 development models of Telephone Repeater EE-89-T3 were shipped to theaters of operation but few reports as to their utilization have been received by Eatontown Signal Laboratory.

2. Repeater TP-14-( )

a. In May 1942 Eatontown Signal Laboratory was directed by CSigO to procure and test models of a two-wire 22-type repeater developed by Bell Telephone Laboratories, Inc. An order was placed for these repeaters and a subsequent order was placed with Federal Telephone and Radio Corporation for models of a similar repeater.

b. On 28 September 1942 the nomenclature Repeater TP-14-( ) was assigned to this equipment and preliminary military characteristics were set up which specifically required a 22-type repeater. The models purchased from Western Electric Company were designated Repeater TP-14-T1 and the models purchased from Federal Telephone and Radio Corporation were designated Repeater TP-14-T2.

c. Both Repeater TP-14-T1 and Repeater TP-14-T2 were service tested by the Signal Corps Board during the summer of 1943 and report of this service test is contained in Signal Corps Board Case No. 530.

d. On 5 July 1943 military characteristics for Telephone Repeater Set TC-14-( ), including Repeater TP-14-( ) as the major component were recommended by the SCTC which called for a combination two-wire,

four-wire repeater. Work is in progress at the present date on a repeater which will meet these new military characteristics.

B. Four-Wire Repeaters

1. Telephone Repeater EE-99-( )

a. Concurrently with the development of Telephone Repeater EE-89-( ) a four-wire repeater, Telephone Repeater EE-99, was developed. This repeater was designed to provide more stable circuits for greater distances than could be obtained with two wire repeaters.

b. Telephone Repeater EE-99-T1 was developed in this Laboratory for the purpose of investigating this type of repeater. In July 1941 an order was placed with International Telephone and Radio Manufacturing Corporation, Newark, N. J. (now Federal Telephone and Radio Corporation), for four four-wire repeaters based on a British design. These were known as Telephone Repeater EE-99- and were delivered in December 1943 but were found unsatisfactory. In the same month a contract for the development of Telephone Repeaters EE-99-T3 and EE-99-T4 was awarded to International Telephone and Radio Manufacturing Corporation. The "T4" model was similar electrically to the "T3" but was housed in a leather case. It was determined that minor modifications of the circuit were necessary and in February 1942, 601 Telephone Repeaters EE-99-T3 were ordered from International Telephone and Radio Manufacturing Corporation.

c. The first twenty models of Telephone Repeater EE-99-T3 were received by Eatontown Signal Laboratory in April 1942 and submitted to The Signal Corps Board for service test in May 1942. This service test was completed in June 1942 and the design changes recommended by The Signal Corps Board incorporated in Telephone Repeater EE-99-T5.

d. In September 1942, the parts list for Telephone Repeater Set TC-29-( ) (Voice Frequency) was prepared consisting of Telephone Repeater EE-99-( ) and associated items. Military characteristics and standardization for this set were recommended by SCTC in Meeting No. 234, 12 October 1942, and approved by SOS 26 October 1942.

e. In January 1943, the preproduction model of Telephone Repeater EE-99-A was approved and production of this item commenced. No changes in this equipment have been made since this date.

C. Amplifying Circuits

1. Receiving Amplifier EE-118-( ) (Telephone)

a. On 14 December 1941, this Laboratory was directed to procure, for service test, models of a terminal amplifier for use on long lines. This amplifier was required to be small, attachable to a Telephone EE-8-( ) and to provide variable gain in the receiving path. Nomenclature assigned to this equipment was Receiving Amplifier EE-118-( ) (Telephone).

b. Fifty models known as Receiving Amplifier EE-118-T1 (Telephone) were procured from the Sonotone Corporation and turned over to The Signal Corps Board for service test in August 1942. The report of this service test is contained in Signal Corps Board Case No. 504 which recommended that development of this type receiving amplifier be discontinued. This recommendation was approved by CSigO and the project canceled.

2. Telephone TP-9-( )

Among the devices proposed at an early date for use on long point-to-point wire circuits and long loops from switchboards was a telephone set possessing both transmitting and receiving gain. In December 1942, a letter of intent was placed with Federal Telephone and Radio Corporation for the procurement of ten development models of such a device to be known

as Telephone TP-9-( ). The first four models known as Telephone TP-9-T1 were delivered in July 1943 and service tested by The Signal Corps Board in connection with Signal Corps Board Case No. 530. Recommendations of The Signal Corps Board were incorporated in subsequent models known as Telephone TP-9-T2 two of which were delivered in December 1943 and are undergoing tests in Eatontown Signal Laboratory. Development of this item is incomplete at this date.

6 Incl.-
Incl. 1 - Photograph No. SCL-4119
Incl. 2 - Photograph No. SCGSS-9126
Incl. 3 - Photograph No. SCGSS-8671
Incl. 4 - Photograph No. SCGSS-8095
Incl. 5 - Photograph No. SCGDL-4831
Incl. 6 - Photograph No. SCGSA-10288

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TELEPHONE REPEATER EE-89-T3

DATE 6-1-42 - SIGNAL CORPS LABORATORIES - FORT MONMOUTH - N. J. - NO. SCL- 4119

Incl. 1

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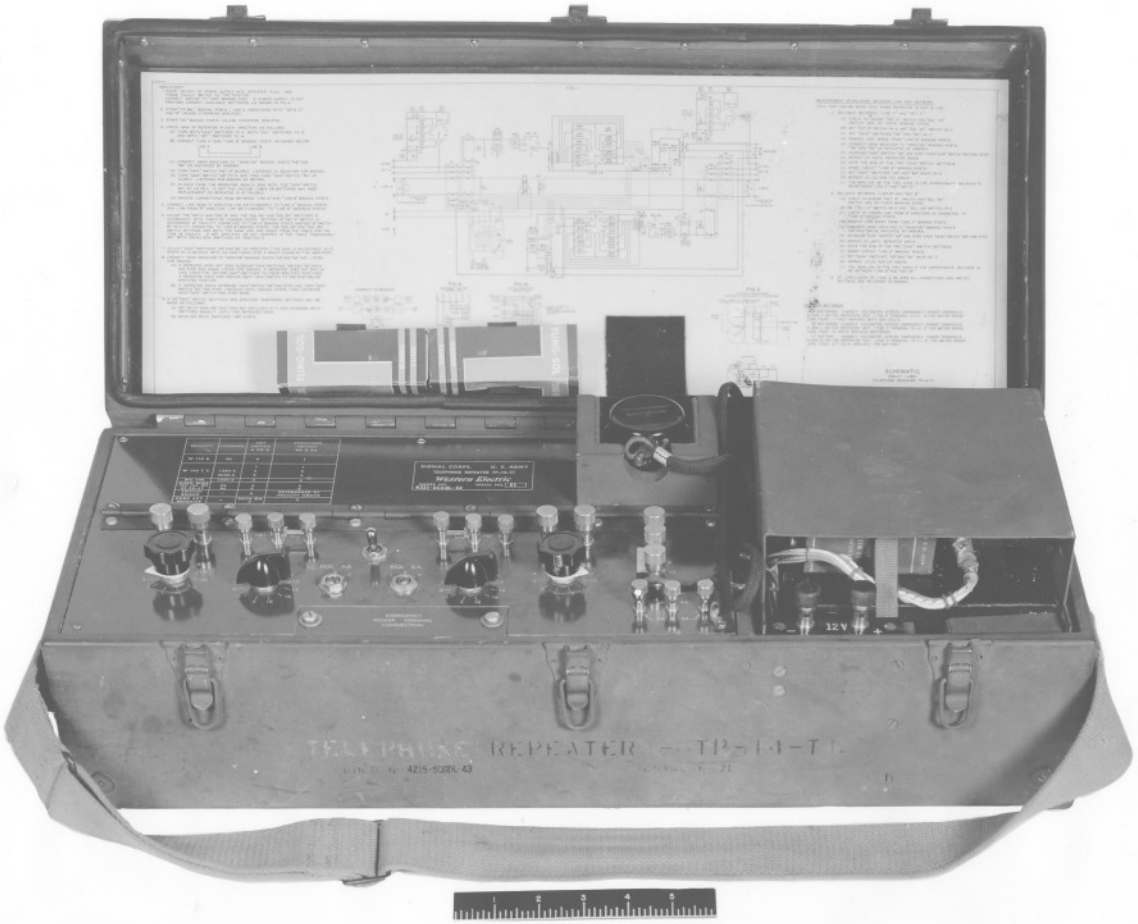

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Incl 2

REPEATER TP-14-T1 . PART of REPEATER SET TC-14-( )

Front View . Cover Open . Showing Control Panel and Circuit Label

DATE 8-16-43 SIGNAL CORPS GROUND SIGNAL SERVICE NO. SCGSS 9126

TELEPHONE REPEATER TP-14-T2

Prepared for Operation from 12-Volt Storage Battery or A. C. Lines

DATE 6-30-43 SIGNAL CORPS GROUND SIGNAL SERVICE NO. SCGSS 8671

Incl 3

UNCLASSIFIED

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TELEPHONE REPEATER EE-99-T5 . PART of TELEPHONE REPEATER SET TC-29-( ) (Voice Frequency)

Covers Open . Showing Batteries

DATE 4-17-43 SIGNAL CORPS GROUND SIGNAL SERVICE NO. SCGSS 8095

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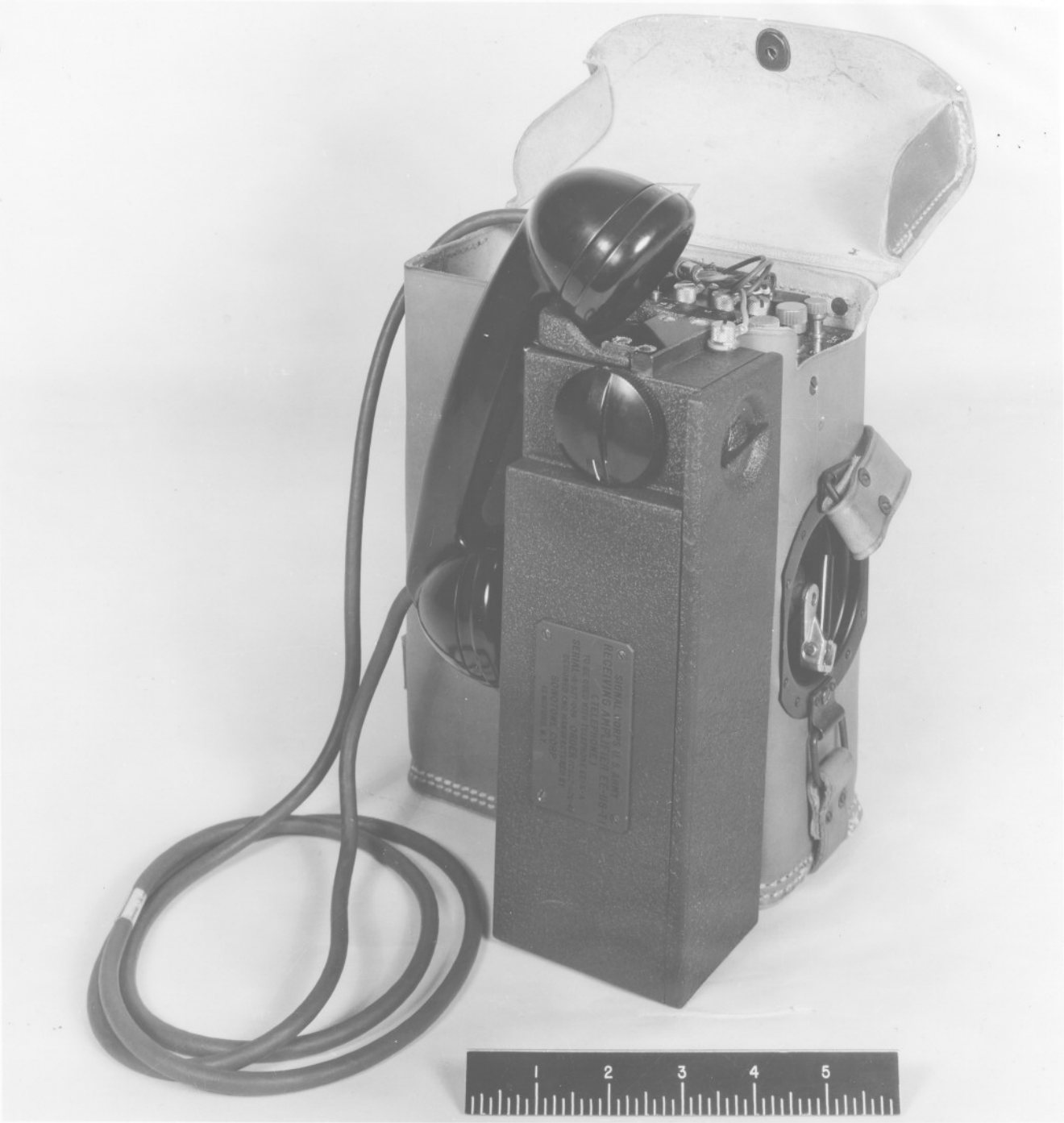

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RECEIVING AMPLIFIER EE-118-T1 . For USE with TELEPHONE EE-8-A

Connection Arrangement

DATE 7-21-42 - SIGNAL CORPS GENERAL DEVELOPMENT LABORATORY - NO. SCGDL-4831

Dial 5

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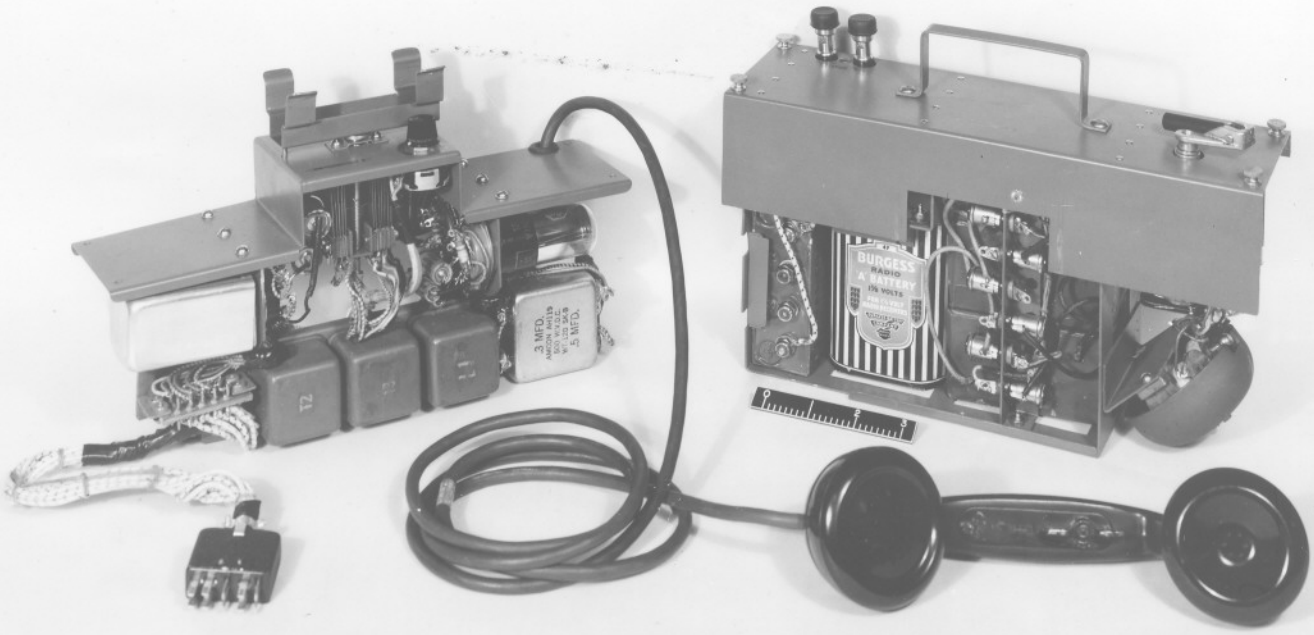

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TELEPHONE TP-9-T2 . For USE with FIELD WIRE LINES

Unassembled

DATE 12-27-43 **SIGNAL CORPS GROUND SIGNAL AGENCY** NO. SCGSA 10288

WIRE W-110

A. Introduction.

1. No effort was made until 1926 to develop a superior type of field wire, even though it had long been recognized that there was a great need for improving the then standard field Wires W-40 and W-44. A 7-strand wire (later designated Wire W-110), intermediate in weight between Wires W-40 and W-44, was designed by the Research and Development Division, OCSigO. Following the usual routine service tests of small lots of this 7-strand wire and the service test of 1000 miles of this type of wire in the Eighth Corps Area, it was concluded that this wire was superior to Wires W-40 and W-44 from the standpoint of weight, size, tensile strength and ease of procurement.

B. Wire W-110.

1. Accordingly, Wire W-110 (5 steel and 2 copper strands, 30% rubber insulation, copper impregnated braid, weight 25#/1000') was standardized by AGO in February 1931 and at the same time Wires W-40 and W-44 were reclassified as limited standard. Wire W-110-A (same as Wire W-110, except conductor composed of 4 steel and 3 copper strands and a compound to meet specification requirements) was proposed but never standardized.

2. In order to overcome transmission losses several types of experimental wire which differed radically from Wire W-110 were obtained from the Simplex Wire and Cable Company and the American Brass Company in 1931 and 1932. The lot of wire obtained from the Simplex Wire and Cable Company showed improved electrical characteristics but the mechanical

characteristics were inferior to standard type Wire W-110. Investigations were continued and in 1936 procurement specifications were revised to permit a reduction in tensile strength of the individual conductors from 200 lbs. to 145 lbs. This change in tensile strength permitted a reduction in the D-C resistance of the wire and hence reduced the attenuation.

C. Wire W-110-B.

1. Since transmission losses in Wire W-110 were still greater than desired, additional investigations were conducted. As a result, a questionnaire on tentative Specification 71-478-C was submitted to various manufacturers. A change recommended to improve transmission was the use of 4 steel and 3 copper strands in place of 5 steel and 2 copper. Nomenclature W-110-B was assigned to wire with this construction and with other minor changes. This was standardized in 1937. Tests made in 1938 on samples of Wire W-110-B, obtained from various contractors, indicated that the transmission loss of Wire W-110-B is considerably less than that of Wire W-110.

2. In 1942 the following changes were made and incorporated in specifications:

a. Use of concentric-lay strands.

b. Optical use of knitted covering in place of braided covering.

c. Alternate construction using 5 strands of copperweld and 2 of copper instead of 4 steel and 3 copper.

D. Synthetic Insulation.

1. In 1938 some tests were conducted on Guayule (natural rubber derived from a North American weed) and a number of synthetic insulations including Neoprene, Okoseal, Thiokol, Anaconda and Okite, but none of these compounds were found satisfactory as a substitute for rubber in Wire W-110-B insulation.

2. Early in 1942, requests for information as to amounts of crude, reclaimed, and snythetic rubbers used in the insulation of Wire W-110-B was sent by this Laboratory to all suppliers. After study of the returned questionnaires, a memorandum report, dated 28 March 1942, was submitted to the CSigO, noting considerable variation in rubber content reported by manufacturers and recommended that an immediate limit of 18 pounds per twisted-pair mile be set on Wire W-110-B with a further reduction to 15 pounds per twisted-pair mile in 60 days. A letter from the CSigO, dated June 1942, rejected this recommendation and directed this Laboratory to arrange for further study of the problem by manufacturers who could not meet these requirements.

3. Investigation of a number of snythetic insulations on Wire W-110-B was carried on throughout 1943. These included Synthinol (Vinylite A-452), Vinylite A 1010 and Vinylite A 1030 from the Rome Cable Corporation; Koroseal 2046, Plastex, and Vinylite VE-5901 from Simplex Wire and Cable Corporation and several Ethyl Cellulose compounds supplied by the Hercules Powder Company. A Memorandum for File, dated 5 January 1943, "Synthetic Thermoplastic Insulation on Field Wire W-110-A" and another, dated 20 August 1943, "Investigation of Polyvinyl Chlorides as Insulation on U. S. Army Field Wire W-110-B," concluded that no polyvinyl chloride or chloride-acetate insulation tested could be considered a satisfactory substitute for the standard rubber and braid construction. The physical properties of none of these materials are satisfactory over the temperature range from -40° F. to ±160° F. expected for U. S. Army field use, and the electrical properties are unstable with temperature change. It was concluded that the main hope for substitution of rubber insulation on Wire W-110-B lies in development of thermoset materials such as Buna S.

E. Investigation of Buna S. Insulation.

1. In April 1942 a program for the investigation of the thermosetting rubber substitutes Buna S and Butyl rubber in Wire W-110-B insulation was initiated. Five major wire companies participated in the program of testing Buna S insulation for Wire W-110-B, but Butyl insulation on this type of wire was not available for tests.

2. Investigations of Buna S insulations are to be found in the following reports:

a. ESL Engineer Memorandum No. 6, "Preliminary Investigation of Buna S as a Synthetic Thermosetting Substitute for Natural Rubber in U. S. Army Field Wire W-110-B Insulation." This report dated 19 July 1943 concluded that GRS Buna S mixed with rubber and reclaimed rubber appear somewhat superior to other Buna S compounds. However, there is a necessity for further development of GRS Buna S rubbers as partial or total substitutes for crude rubber in Wire W-110-B insulation.

b. ESL Engineering Memorandum No. 18, "Investigation of 15 Types of Buna S Insulating Compounds as Substitutes for Crude Rubber Compounds for insulation on Wire W-110-B," dated 22 October 1943. During the testing program covered by this memorandum, the rubber situation became so critical as to preclude the use of any crude rubber in U. S. Army Signal Corps wires after 1 January 1944. In general, the results of the tests conducted indicated that a suitable compound can be applied to Wire W-110-B using all GRS Buna S as the snythetic rubberlike material, after further development by the industry.

3. These investigations indicate that, at present, Buna S is the

most acceptable insulation for Wire W-110-B and that GRS - Buna S compounds appear to be superior to other Buna S compounds. As a result of these investigations, Specification 71-478-E for Buna S insulated Wire W-110-B was issued 18 November 1943.

See Report No. 1.

WIRE W-143

A. Introduction.

The need for a field wire with a greater talking range than that of Wire W-110-B proved necessary for present methods of warfare. Accordingly a project for this development was initiated 30 September 1941 and nomenclature "Wire W-143" was assigned 10 December 1941.

B. Development and Service Tests.

1. Development contracts were placed in March 1942 with the U. S. Rubber Company. Tentative Specifications SCL-688 on Wire W-143-T5, and SCL-689 on Wire W-143-T6, were released on 31 December 1942.

2. In March 1943 a report on the physical and electrical characteristics of Wires W-143-T1, -T2, -T3, and -T4 was forwarded to CSigO. In accordance with a recommendation from CSigO, based on this report, no further action was to be taken on this matter until service tests of Wires W-143-T5 and -T6 were completed.

3. After the completion of service tests it was decided, in June 1943, that future development work would be confined to Wire W-143-T5 since that wire offered the best qualities for field use.

C. Standardization.

1. Military Characteristics and Standardization of Wire W-143-T5 as Wire W-143 was recommended at SCTC Meeting No. 269, 28 June 1943, and approved by ASF on 14 July 1943.

2. Specification No. 71-3012 dated 20 December 1943, was followed by a first amendment covering Buna S insulated wire on 30 December 1943.

3. This wire has a twin-parallel construction with cotton braid overall. Each conductor consists of 7 strands medium hard drawn copper

SECRET

equivalent to No. 15 AWG with synthetic rubber insulation, and carbon-impregnated paper tape.

D. Further Development.

Originally Wire W-143 had been intended for voice frequency and carrier frequency. It is now being used for voice frequency only. Development of Wire W-143 for carrier frequency use is, however, still

WIRE W-130.

A. Introduction.

1. In order to provide a lightweight, twisted-pair, assault wire for telephone and telegraph communications of the Infantry in forward areas, investigations were initiated in 1933 in an attempt to solve this problem. SCL Engineering Report No. 313, dated 25 October 1933, reported results of tests made on two preliminary designs of lightweight, twisted-pair, assault wire. One type of wire kinked very badly and the other type had excessive transmission losses. Investigations, with negative results, continued between 1933 and 1936. On 17 December 1936, a conference was held at OCSigO, with representatives from Research and Development, War Plans and Training, Supply, Storage and Issue, and Procurement Planning, to lay plans for further development of a lightweight field wire. Military Characteristics for Wire W-130 were recommended by SCTC Meeting No. 146, 11 January 1937 and approved by AGO on 15 March 1937.

B. Service Test.

1. Orders were placed with several wire manufacturers for various quantities of Wires W-130-T1, -T2, -T3, -T4, and -T5.

2. As a result of extended service tests, standardization of Wire W-130-T1 was recommended by the Infantry Board and standardization of Wire W-130-T3 was recommended by Field Artillery Board. SCL Engineering Report No. 718, summarizing tests of 6 types of Wire W-130, concluded that none of the types of insulation tested was entirely satisfactory, but that latex (dip process) rubber insulation used on Wire W-130-T1 was most acceptable, even though it had poor abrasion resistance, and that the concentric-strand types of conductor used in Wires W-130-T1 and -T4 were the most satisfactory.

C. Standardization.

1. In 1942 Wire W-130-T1 (dipped rubber insulation, no braid) was standardized as Wire W-130. Specification 71-925, dated June 1942, was prepared.

2. In view of impending shortage of natural rubber, extensive investigations of synthetic compounds as insulations were conducted. As a result in July 1942 Specification 71-925 was revised to include Wire W-130-A which uses Vinylite VE-590 insulation applied by an extrusion process.

1 Incl. -
Incl. 1 - Photograph No. SCL-71

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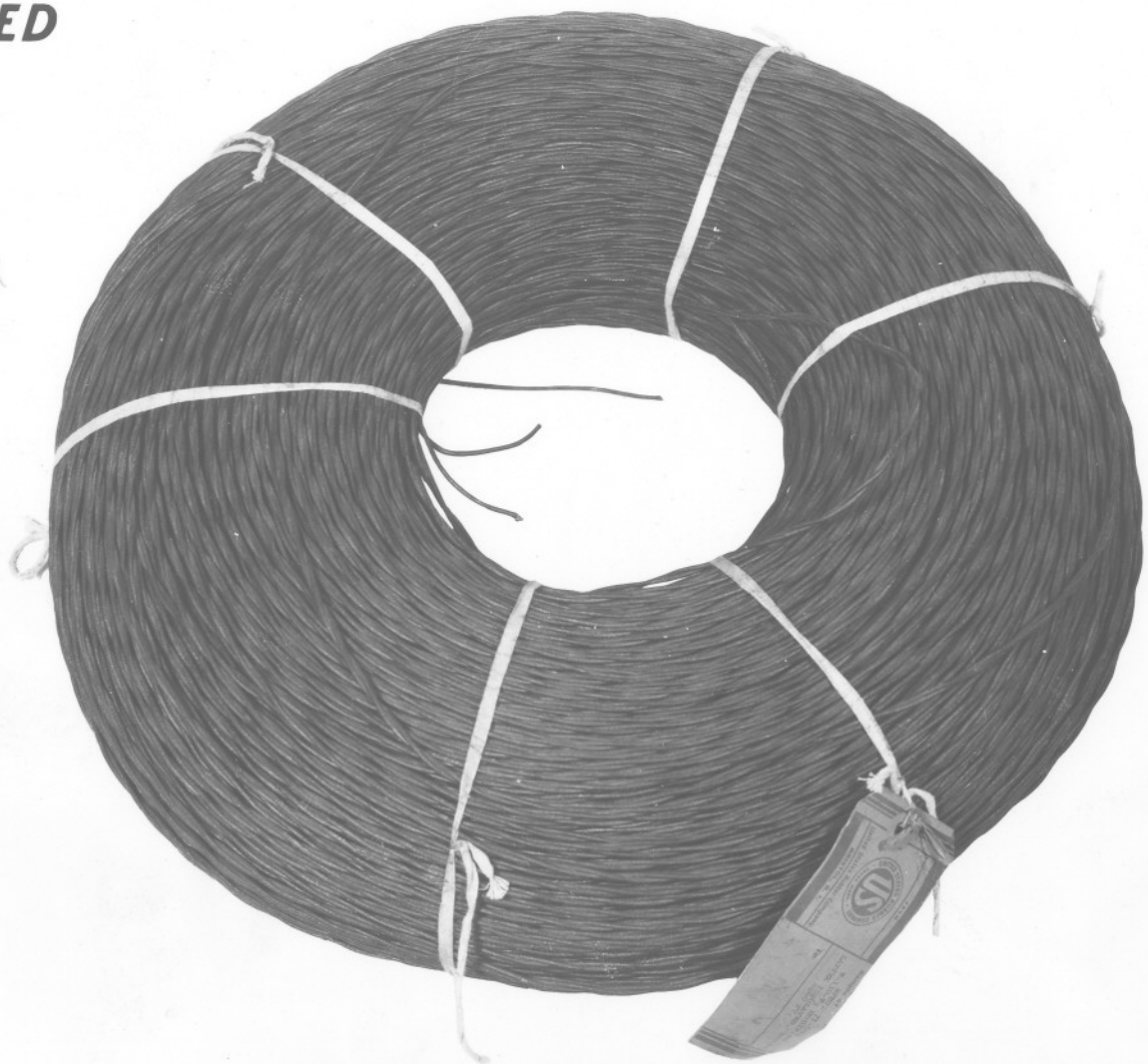

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WIRE W-130

Twisted Pair Assault Wire . Weight 30 Lbs. per Mile