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HISTORY OF CONVERTER M-134-C

VOLUME 3

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SECTION II

ASAM 1

1. NOMENCLATURE. - ASAM 1; cipher unit, ASAM 1A; special cipher unit ASAM 1B. Old nomenclature, Converter* M-134-C (short title: SIGABA), which includes the cipher unit (short title: SIGIVI). When Converter M-134-C was used with SIGIVI in Chest CH-76, it was given the special designation Converter M-134-D (short title: SIGRINO). The Navy designation for the machine is CSP 888/889. When used with special adapters (special cipher units), the machine is called the Combined Cipher Machine and makes possible communication among the Army, Navy, and the British:

a. CCM Mark I is the designation given to Converter M-134-C with special cipher unit (short title: SIGAMUG) and to CSP 888/889 with special cipher unit CSP 1600.

* This comment applies to sections on Converter M-134; M-134-A, & the original nomenclature has been restored in these sections in the master copy.

There was a footnote suggested in the previous copy to cover the use of the word Converter

Byron rec'd

Power consumption
to be expressed
throughout in
amperes.

Do we
mean current
drawn?

Converted to watts dissipated
ms

b. CCM Mark II is CSP 1700, which is physically similar and cryptographically identical to CCM Mark I and also to ASAM 5 (which see). It was used to a limited extent during World War II where the issue of ASAM 1 was inadvisable.

c. CCM Mark III is the designation given to the British Type X Cipher Machine when used with a special cipher unit, the "Type X Adapter." CCM Mark III is intercommunicable with CCM Marks I and II.

6. DESCRIPTION. - Electromechanical cipher machine (see figure 1a).

7. CLASSIFICATION. - The machine is classified CONFIDENTIAL. Rotors are classified SECRET.

8. STATUS. - In use, Category A. (Standard 19 February 1937, SCTC Meeting No. 146.)

Definition of Cat A and B also

9. CLASS OF USERS.[1] - I, II, III.

10. OPERATION. - Keyboard.

11. METHOD. - Off line (non-teletype). Authorized for all classifications of traffic.

12. OUTPUT. - Printed tape.

13. SPEED. - 45 to 50 words per minute.

14. POWER SUPPLY. - A. c. or d. c. power may be used.

a. A. c. - 105-125 volt (60 cycle); power consumption 2 amperes. An induction motor is required. Power consumption 230 W.

b. D. c. - 105-125 volt; ~~power consumption~~ current drain 2 amperes. A compound motor is required. Power consumption

c. If normal a. c. or d. c. power fails, the unit may be operated by hand if 24-volt d. c. is connected to operate the magnets. Power consumption is then 3 amperes. 72 W

[1] See ASAG 22, "The Crypto-communications Plan."

11. DIMENSIONS.

	Width	Depth	Height	Cubic Displacement
a. In operation:	15"	19½"	12"	2.1'
b. Packed in carrying case:	17 1/8"	23"	15½"	3.5'
c. Packed for long term storage:	19½"	27½"	18"	5.6'
d. CH-76 (upper section)	21 7/8"	32½"	22"	9.05'
e. CH-76 (lower section)	21 7/8"	32½"	21½"[2]	10.1'

12. WEIGHT.

a. In operation: 93½ lbs.

b. Packed in carrying case: 133½ lbs.

c. Packed for long term storage: 195 lbs.

d. CH-76 (upper section) empty: ~~210~~ 230 lbs.

e. CH-76 (lower section) empty: ~~207~~ 208 lbs.

13. ASSOCIATED EQUIPMENT.

a. One each per ASAM 1: ASAM 1A; rotors, set of ten per box; ASA-191 Cleaning Kit (for operators); place finder or gumming table.

b. Issued as needed: ASAM 1B; 108697 Tender Kit (for maintenance personnel); tandem cable; Chest CH-76.

c. For information concerning the pluggable rotor, see paragraph 19c.

14. ASSOCIATED DOCUMENTS.[3]

a. SIGBRE-1, "General Instructions for Converter M-134-C."

b. SIGZF-3, "Crypto-Operating Instructions for Converter M-134-C."

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2. One inch less if shipped assembled with upper half.

3. Because of the method of implementation used for the Nomenclature Plan adopted 6 February 1948, many cryptographic documents have not yet been converted from short titles to new nomenclature.

c. SIGKKK-2, "Maintenance Instructions for Converter M-134-C."

d. SIGDUEN-1, "Operating Instructions for Combined Cipher Machines."

e. SIGRAVO-1, "Supplement No. 1 to 'Operating Instructions for Combined Cipher Machines (SIGDUEN-1)'."

15 19. PATENT INFORMATION. - Secret Patent Application Serial No. 70,412 (covering principle of using rotors in cascade formation to produce irregular sequence of keying characters) was filed 23 March 1936 by the Chief Signal Officer on behalf of the Principal Cryptanalyst, U. S. Army (W. F. Friedman), and his ~~Chief~~ Assistant (F. B. Rowlett), jointly. For further information, see Appendix A, ~~Introductory~~ Historical Background of Converters M-134 and M-134-A and ASAM 1.

16 20. PROCUREMENT.

a. Summary of Procurement.

(See chart next page)

16a

Contract Number	Manufacturer	Contract Date	Cost		Completion		Quantity (by Register No.
			Contract Total	Per Unit ASAM 1	Schedule	Actual	
Navy Cont. Nos. 74515 Req-79-OCSigO-40	Teletype Corporation	11 Jun 40	$201,087.63	$1,843.66		Mar to Nov 41	1-85
Req-9-OCSigO-41	Teletype Corporation	12 Jul 40	$297,213.08	$1,367.03		Jan 42	86-234
Req-56-OCSigO-41	Teletype Corporation	11 Oct 40	$144.216.88	$1,367.03		Mar Apr 42	235-322
DP 42-4272 1235-Chic-42 W-287-SC-3844	Teletype Corporation	13 Nov 41	$104,502.50	$1,713.00		Aug 42	323-367
DP 42-S-77 4688-Chic-42 W-287-SC-4758	Teletype Corporation	15 Aug 42	$410,171.92	$1,245.00		Sep 42 to Jan 43	368-607
DP 42-S-105 1266-Phil-1-43-24 W-2124-SC-3395	Teletype Corporation	13 Nov 42	$1,371,495.23	$1,205.80	31 Mar 43	29 Feb 44	608-1367
RDR 43-III-1662-2706 ON 29218-Phil-43-24 W-2124-SC-11260	Teletype Corporation	5 May 43	$855,799.22	$1,205.80	31 Mar 44	30 Mar 44	1368-1867
RDR 43-III-3538 2639-Phil-44-24 W-36-039-SC-437	Teletype Corporation	7 Aug 43	$484,280.03	$1,205.80	30 Jun 44	30 Jun 44	1868-2155
PR 44-680 PO 12851-Phil-4424 W36-039-SC-4083	Teletype Corporation	23 Nov 43	$2,060,802.96	$1,206.60	31 Dec 44	1 Oct 45	2156-3316[4]

4. 14 machines, register numbers 3356 through 3369, were manufactured and distributed in January and February 1945, These were not included in the 3316 Converter Total.

b. Equipment Included in Contract Total. - The difference in cost, as given above under "Contract Total" and "Per Unit," is due to the inclusion in the contract of varying quantities of the following items of equipment: Rotor sets in metal containers at $65.93 each; tender kits at $213.34; spare parts kits at $39.40 each; gumming tables at $12.87 each; spare cipher units, with index rotors only, at $187.68 each; cord with plugs for operating two machines in tandem, at $82.00 each.

c. Status as of 1 January 1949.

(1) Number procured..... _____

(2) In use by holders[5]..... _____

(3) In reserve..... _____

(4) Destroyed[6]..... _____

(5) Total..... _____ .. _____

5. Record of holders maintained by AS-82.

6. Of this number, _____ have been converted to ASAM 5 and _____ to ASAM 6.

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CHAPTER XI. DEVELOPMENT OF CONVERTER M-134-C

For detailed description and photographs, see Tabs A, B, C, D, E, F, G, H, I, J, K, L, M, N, O, P.

A. General

Converter M-134-C is an electromechanical, transportable, cipher machine which has an extremely high degree of cryptographic security and an adequate speed of 45 to 50 words per minute. It was the "backbone" of Army and Navy joint and individual cryptographic communications during World War II. Its excellent electromechanical operation and its high cryptographic security can be considered as a culmination of many trials, errors, and struggles of the finest cryptographic technicians and engineers of the Army and Navy. The development of Converter M-134-C may be said to have begun in the 1920's when the cryptanalysts of the Army and Navy began to concentrate on making cryptography consonant with the machine age. All of the machines discussed in the preceding chapters, Volumes 1 and 2, of this history are forerunners of Converter M-134-C. The exact place which each had in the direct line of cryptographic development is explained in Chapter I and in the separate chapters devoted to each model in turn (consult index). In the text of this history the emphasis has been exclusively on Army developments. Certain Navy developments are in a separate line of development which culminated in Converter M-134-C, or as the Navy designates the same machine, ECM Mark II; these Navy developments are explained in the Navy "History of Invention and Development of the Mark II ECM", Tab Q.

B. Invention of "Stepping Maze"

Shortly before 15 June 1935, during the interval when preliminary models of Converter M-134 were being built (see Chapter), Mr. Frank B. Rowlett, principal assistant to Mr. Friedman,[1] conceived the idea which constitutes the basis of the "stepping maze" in Converter M-134-C.[2] His concept was based upon the principle of sending an electrical impulse through a rotor maze in order to generate a long irregular sequence of characters which could then be used for various purposes such as keying. Mr. Rowlett and Mr. Friedman then jointly developed the idea for this key generator, making it suitable for replacing the tape-control mechanism of Converter M-134. No model incorporating their ideas was built at this time,[3] however, because the Chief Signal Officer was committed to the tape-control type embodied in Converter M-134. Despite Mr. Friedman's urgent recommendations that the new method of controlling the enciphering rotors (Rowlett-Friedman "stepping maze") be substituted for tape-control, the Chief Signal Officer was reluctant to make a change after so much word has been done in the direction of tape-control. Therefore, Army contracts were placed for Converter M-134 (see Chapter) and consideration of the Rowlett-Friedman stepping maze was dropped.

1. Mr. Friedman was principal cryptanalyst of Signal Intelligence Service, U.S. Army.
2. For cryptographic explanation of the Friedman-Rowlett stepping maze, see Volume 1, Chapter I, pages
3. See Section , page .

C. Disclosure of Friedman-Rowlett Stepping Maze to the Navy

In October 1935, Mr. Friedman and Lieutenant Wenger, assistant to Commander MacLaran, OIC of the Code and Signal Section, Navy Department, had a general discussion of cipher machines. In the course thereof Wenger expressed considerable dissatisfaction with the Mark I ECM[1] and asked Friedman whether the Signal Corps had any "good" ideas along these lines. Friedman indicated that there were several ideas which the Signal Corps was not exploiting but which he was not at liberty to disclose; since they had been placed in the secret category. Friedman further indicated that if Wenger so desired, permission to disclose them to the Navy would be requested. Wenger asked that this be done. Accordingly, Friedman requested and was granted permission by his superiors to disclose the details of the Friedman-Rowlett patent application to representatives of the Navy Department. Therefore, on 21 October 1935, at a conference in Friedman's office, the details were disclosed to Commander MacLaran and Lieutenant Wenger, who were shown the drawings that formed the basis of the patent application Serial No. 70,412.[2] On 31 October 1935, a second and similar disclosure was made to Commander MacLaran, Lieutenant Wenger, and the latter's assistant, Leiutenant Harper. A third disclosure was made on 1 November 1935 to Lieutenant Wood and Dugan, also of the Code and Signal Section. Friedman and Rowlett were told very little as to the Navy Department's reaction to the disclosures.

1. For further details concerning the Mark I ECM, see "History of Invention and Development of Mark II ECM", Tab Q.
2. See Section , page .

D. Development by the Navy of the Friedman-Rowlett Stepping Maze

After the disclosures in 1935 of the Friedman-Rowlett patent application to the Navy (as explained above in Section C), the principles lay dormant in both the Army and Navy until the winter of 1936-1937, when the Navy was preparing initial specifications for the ECM Mark II. At this time the Navy's Lieutenant Wenger[1] told the new OIC, Commander Safford, of the Navy Department's Code and Signal Section, about the Friedman-Rowlett idea for electrical control. Lieutenant Wenger stated that the unused concept had interesting possibilities and produced from his safe a single sheet of cross section paper containing three elementary wiring diagrams,[2] showing the means by which electrical control of an ECM could be achieved through a rotor maze. Captain Safford immediately recognized that such electrical control was the answer to many unsolved problems and "therefore had to be incorporated in the new machine".[3]

The Navy then went ahead with their development of the Friedman-Rowlett disclosure without informing the original inventors or any of the personnel of the Army Signal Intelligence Service. The fact that the development of the Friedman-Rowlett concept for electrical control was pursued unbeknownst to the Army Signal Intelligence Service became

1. Assistant to the OIC of the Code and Signal Section, Navy Department.
2. According to Captain Safford's memory, this paper was signed by Harper, Wenger, Wood, Friedman, and Rowlett. It has been lost since the summer of 1940. See page 15 of Tab Q.
3. "History of Invention and Development of the ECM Mark II, page 15, see Tab Q.

the basis for future misunderstandings between the two services. The reason that the Signal Intelligence Service was not informed by the Navy was based on the following circumstances. The Navy had not been consulted concerning the advisability of printing Mr. Friedman's technical papers, entitled "Analysis of a Mechanico-Electrical Cryptograph, Part I and Part II".[1] These papers were printed at the Government Printing Office toward which agency the Navy Department entertained serious apprehensions in regard to security. Therefore, the Director of Navy Communications, considering it an indiscretion for theSignal Corps to have allowed the printing of these secret papers by GPO, issued an order that the Signal Corps was not to be shown the Mark I ECM[2] or any of its details. Therefore not until shortly after January 1940, when the first pilot model of ECM Mark II was delivered, was the secrecy order revoked and the Signal Corps made cognizant of what had been done with their ideas.

E. Disclosure to the Army of Development

On 3 February 1940, the Director of Naval Communications, Admiral Noyes, invited the Chief Signal Officer, General Mauborgne, Mr. Friedman, Captain Cook, and other Signal Corps representatives to inspect a pilot model[3] of the ECM Mark II. On that occasion Captain Safford acknowledged

1. See Volume 1, Chapter .
2. For development of Mark I ECM see Navy "History of Invention and Development of ECM Mark II", Tab Q.
3. For details concerning building of this pilot model, see "History of Invention and Development of ECM Mark II", Tab Q.

to Mr. Friedman, in the presence of General Mauborgne and Admiral Noyes, the Navy's use of the Friedman-Rowlett invention.

Later a conference was called by Commander Safford. In attendance were Mr. Reiber and Zenner of Teletype Corporation, Mr. Friedman of the Signal Corps, Commander Safford, Lieutenant Zern of Naval Communications, and possibly others. At the conference the blue prints of ECM Mark II were carefully examined and a general discussion of cryptographic features followed. Four experimental changes to the Friedman-Rowlett circuit had been made by Commander Safford and Lieutenant Seiler. These four changes were discussed and the following decisions made.

> "a. "Index Maze," which replaced the plugboard in the Friedman-Rowlett invention - Retained. The "Index Maze" accomplished the same cryptographic result as the plugboard but was much more convenient to the operator.
>
> b. Grouping of end contacts in the "Stepping Maze" and in the "Index Maze," which replaced the arrangements of the Friedman-Rowlett circuit - Retained. These groupings together with the ten circuits through the "Index Maze" gave 49 times as many stepping combinations as was possible with the Friedman-Rowlett invention (5,855 against 120).
>
> c. Subdivision of "Stepping Maze" into two parts - Unanimous decision to return to the original Friedman-Rowlett "Stepping Maze." Friedman protested the subdivision as an unnecessary complication. Reiber and Zenner did not like it from the viewpoint of design and construction.
>
> d. Stepping order for the "Stepping Maze" proposed by the Navy was 3-1-5, the other two wheels being dead to simplify construction. The stepping order was changed to 3-4-2 upon Friedman's recommendation."[1]

1. See "History and Invention of ECM Mark II", page 16, Tab Q.

With the above-listed exceptions "the Mark II ECM, as developed by the Navy and Teletype using the Friedman-Rowlett Stepping Maze was satisfactory to and accepted by the Army. Washington Navy Yard sketch RW 68F201, dated 24 April 1940, used as a basis for specifications of the production model, is the earliest-dated drawing showing the "Stepping Maze" and associated circuits exactly in their present form.

The joint Army-Navy SIGABA system became effective 1 July 1941. Therefore the two services had a common high security enciphering machine in effect before the Pearl Harbor attack.

F. SIGAMUG and SIGHEK

Due to the fact that Converter M-134-C or ECM Mark II was designed with a removable cipher basket, it presented great possibilities for use of an interchangeable cipher basket operating of a different cryptographic principle. Such a cipher basket was designed in order to make possible the conversion, at will, of Converter M-134-C into an equivalent of the Combined Cipher Machine. The history of this special cipher unit (short title: SIGAMUG) is given in the "History of the Combined Cipher Machine". For a photograph of the special combined cipher unit (short title: SIGAMUG), see Tab N.

After Converter M-134-C had been put into service, Major Leo Rosen, Chief, Development Section, Signal Security Branch, conceived, about 9 May 1942, a pluggable rotor which could be inserted into one of the positions of the cipher unit for emergency use. The pluggable rotor

(short title: SIGHEK) was distributed to all Army and Navy holders. On May 19, 1943 Contract W 2123-SC-12464 was placed with L. C. Smith and Corona Typewriter Co. for 7,000 SIGHEKS at $27.00 each. The cost of the Army SIGHEKS was $189,000.00.

SIGHEK was distributed for emergency use but no need for it ever arose. on 2 July 1948 it was requested that action be initiated to place on the agenda of the ASA Technical Committee a request to declare SIGHEK obsolete. For further history of the Army pluggable rotor (short title: SIGHEK), see "History of Rotors". For photograph, see Tab P. For method of use, see "Instructions for Using the Pluggable Rotor"(short title: SIGLUR-1), 1 February 1945.

G. Evaluation

"31. Electric control of the ECM by means of the Friedman-Rowlett "Stepping Maze" is the essential feature that places the Mark II ECM in a class by itself as regards security. Those who have participated in the development of the Mark II ECM have always acknowledged the contributions of the Signal Corps. The "Index Maze" and grouping of end contacts add to the security afforded by the "Stepping Maze," but would be worthless without it. The importance of electric control can best be estimated by a consideration of what the Mark II ECM would have been if Friedman and Rowlett had not been permitted to disclose their invention to the Navy. Although the "Stepping Maze" appears obvious, now that it is in use, no one in the Navy thought of it in a period of 15 years, and no foreign machine employs it. Therefore, the Navy would have continued the development of the older methods and the new ECM would have used the mechanical stepping control found in CSP 903 or CSP 1700. We would have had a secure machine, superior to anything in use by foreign nations, but definitely inferior to our present ECM. This hypothetical machine (as well as CSP 1700) would defy attempts at solution until such time as machine and code wheels were captured. After this, each day's keys would

resist solution for a long time. "Short-cut" solutions would be impossible, due to the erratic stepping of the code wheels, but a trial-and-error solution would be within the range of possibility. We could not make the flat statement, as we do for the Mark II ECM, that solution would be utterly impossible. In other words, the machine would be adequate to take us through World War II but, because we had stopped short of the ultimate step, there would always be the desire to develop a new machine and scrap the old one. Rowlett is entitled to full credit for his discovery of the principle of the key generator as embodied in the "Stepping Maze," which adds so much to the excellence of the Mark I[1] ECM, and Friedman and Rowlett jointly are entitled to full credit for their joint invention of methods of applying and reducing the principle to practical form.

32. The Signal Corps' acceptance of the Mark II ECM for Army as well as Joint Army-Navy use reflects credit on all who made that decision....."[1]

H. Patent

CHAPTER XII. PROCUREMENT OF CONVERTER M-134-C

A. General

Converters M-134-C were procured by the Army on nine separate contracts at a total cost of almost six million dollars. This six million dollars bought for the Army three thousand three hundred and thirty[1] SIGABAs including their cipher baskets (SIGIVIs), completely wired index rotors, unwired rotors for the control and alphabet mazes, necessary maintenance parts, and accessory equipment. This cost total does not include separate rotor contracts of which there were several. Nor does it include the cost of wiring the alphabet and control rotors. This wiring was done at Army Security Agency under conditions of utmost secrecy.

All manufacturing of Converter M-134-C and its Navy equivalent, ECM Mark II, was done by secret contracts with the Teletype Corporation (1400 Wrightwood Avenue, Chicago, Illinois) which aided the Navy in the mechanical and electrical development of the converter.

B. Early Procurement and Testing

For their first three hundred and twenty two converters, the Army did not deal directly with the manufacturer but placed their orders through the Navy Department. The Navy, which was ordering many of the

1. For explanation of this figure (3330) see Procurement Chart on opposite page, expecially note indicated by ***.

PROCUREMENT CHART

FOR

CONVERTER M-134-C

(over)

PROCUREMENT OF CONVERTERS M-134-C

	Manufacturer	No. of Converters	Contract	Date of Contract	Per Unit Cost	Total Cost* of Contract	Date of Completion	Serial Nos.	Cumulative Totals
M-134-C	Teletype Corp.	85	Navy Contract Nos. 74515 REQ 79-OCSigO-40	19 Jun 40	$1,843.66	$ 201,087.63*	17 Mar 41 (1st 10 machines)	1-85	85
M-134-C	Teletype Corp.	149	Navy Contract 77973 REQ 9-OCSigO-41	12 Jul 40	$1,367.03	$ 297,213.08*		86-212 301-322	234
M-134-C	Teletype Corp.	88	Navy Contract 74973 REQ 56 OCSigO-41	11 Oct 40	$1,367.03	$ 144,216.88*		213-300	322
M-134-C	Teletype Corp.	45	DP 42-4272 1235-CHI-42 W-287-SC-3844	13 Nov 41	$1,713.00	$ 104,502.50*	13 Nov 41	323-367	367
M-134-C	Teletype Corp.	240	DP 42-S-77 4688-CHI-42 W-287-SC-4758	15 Aug 42	$1,245.00	$ 410,171.92*	9 Jan 43	368-607	607
M-134-C	Teletype Corp.	760	DP 42-S-105 1266-PHIL-43-24 W-2124-SC-3395	13 Nov 42	$1,205.80	$1,371,495.23*	29 Feb 44	608-1367	1367
M-134-C	Teletype Corp.	500	MDR 43-III-1662 & 2706 ON 2[illegible]218-PHIL-43-24 W-2124-SC-14260	5 May 43	$1,205.80	$ 855,799.22*	30 Apr 44	1368-1867	1867
M-134-C	Teletype Corp.	288	MPR 43-III-3538 2639-PHIL-44-24 W-36-039-SC-437	7 Aug 43	$1,205.80	$ 484,280.03*	30 Jun 44	1868-2155	2155
M-134-C	Teletype Corp.	1161**	PR 44-680 PO 12851-PHIL-44-24 W-36-039-SC-40[illegible]3	23 Nov 43	$1,206.60	$2,060,802.96*	1 Oct 45	2156-3316	3316***

*Including associated equipment. These figures are all approximate. Sufficient contract data is not available in this Agency to determine exactly the final cost of the contracts. This is also true of the per unit cost figures.

**This contract when drawn up callee for 1200 converters. In accordance with termination at option of Government clause, the contract was terminated 15 Aug 45 with the last shipment of converters receipted for 1 Oct 45.

***Somewhere along the line 14 converters bearing register Nos. 3356-3369, which were distributed in January and February 1945 were manufactured. These are not included in the total 3316 converters. Also, Contract W-36-039-SC-18830, PO32627-PHILA-45-24, dated 15 Mar 45, for 112 converters @ $1,228.01 and total cost of contract $144,246.62 to be delivered by 31 Oct 45, was cancelled 15 Aug 45.

new converters for its own use, included in its orders a sufficient number to supply Army requirements. Three Army requisitions were placed with Navy for these 322 converters and the Navy obtained them from Teletype Corporation on two contracts. The Army requisitions and Navy contracts were as follows: Requisition 79-OCSigO-40 dated 11 June 1940 was placed for 85 converters, which were obtained from Teletype Corporation by Navy on Contract No. 74515 dated 19 June 1940 (total cost: $201,087.63).[1] Requisition 9-OCSigO-41 was placed with Navy on 12 July 1940 for 149 converters (total cost: $297,213.08)[1] and Requisition 56-OCSigO-41 was placed with Navy on 11 Oct. 1940 for 88 converters (total cost: $114,216.88). Both these requisitions were fulfilled by the Navy's Contract No. 77973, dated 21 Octiber 1940.

The first ten of the 85 machines ordered on the first requisition were delivered and accepted by Signal Intelligence Service on 17 March 1941. Delivery was then suspended for 90 days in order that these ten machines could be tested. Although this test bore much resemblance to an ordinary service test, Converter M-134-C was considered a modification of Converter M-134-A[2] and therefore did not have to go through the regular

1. For explanation see Procurement Chart on opposite page.
2. In fact, the new converter was called Converter M-134-C in order to establish it as a modification of Converter M-134-A, thereby eliminating the long delays encountered in the established approval channels (approval of military characteristics by SCTC, etc.). Information taken from note written by Mr. Friedman; filed in M-134-C Procurement (Aug 43-45); WDGAS-80.

channels of service testing[1] and subsequent standardization as outlined in AR 850-25. The test of the 10 machines resulted in a request for very minor modifications[2] which were easily made[3] by the manufacturer. Delivery was then resumed.

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1. From Proposed Plan for Handling the 10 M-134-Cs to be delivered in February 1941: (actual delivery 17 Mar 41): The purpose of the test is... to permit opportunity for any modification and/or improvement in the machine before final delivery in quantity, and should be construed as a service test in the meaning of AR 850-25, inasmuch as Converter M-134-C is a modification of an existing article of equipment (M-134-A). --Filed Folder "M-134-C, Procurement thru 1942.
2. Letter to Mr. Reiber of Teletype Corporation, from Paul W. Albert, 1st Lt. S.C. "In reports of service test on Converter M-134-C we have noted several failures in operation and suggested modifications in design which are proposed as a means of remedying these defects. We should like to have you consider the practicability of these modifications and would appreciate your views. The critical comments include the following: 1. Converter rotor pawl falling out of adjustment. Suggested remedy: Addition of a second locking nut on the pawl adjacent or use of a split or self-locking nut instead of the present nut. 2. Spring pile-ups on main operating switch falling out of adjustment. Suggested remedy: Addition of a stiffner to spring pile-ups. 3. Present five ampere fuses will not permit operation of two machines in parallel. Suggested remedy: Substitution of ten ampere fuses for the present five ampere fuses. We understand that it is doubtful if any changes can be made in the machines to be delivered under the first contract since it is desired that nothing delay their delivery. But we would like consideration of all these changes on the second contract. At the same time we would like to have the matter of plywood cases reconsidered."
3. Answer to letter of footnote 1 from Reiber of Teletype Corporation (11 June 41) announces the following very simple remedies: Item 1. We have changed the design of the screw so that it is flat on the end to increase area of contact. Item 2. More rigid inspection should correct this item. Item 3. We will change to 10 ampere fuses. We will change to plywood on future contracts; cases are already made on both contracts already placed.

C. Quantity Procurement

Delivery of converters on the first contract was begun at the rate of 50 per month for both Army and Navy but Teletype Corporation, with a little coercive persuasion,[1] almost immediately raised the delivery rate to 100 per month. The Army, which after the first 322 negotiated separate contracts for its own converters, received 20 per month while the Navy was receiving 80. Through the years the delivery rate was increased to 300 per month.[2] (These figures constitute the combined Army-Navy delivery rate, the number received by the respective services being prorated on a percentage basis.)

1. From "History of Invention and Development of Mark II ECM" written by Capt. L.F. Safford, U.S.N., page 27: "The first contract called for delivery at the rate of 50 ECMs per month, beginning June 1941, in accordance with an earlier agreement. Teletype reported inability to better this schedule so the I.B.M. Co. was approached and tentatively offered the second contract- the machine to be a Chinese copy of the machine made by Teletype. Mr. Walter Lemmon, on behalf of I.B.M. agreed to do this, if Teletype called our bluff. Teletype was then given an ultimatum - expedite delivery or share future contracts. Within 48 hours we received word that: a. A.T.&T. had made the Western Electric Plant at Hawthorne, Illinois, available for manufacture of ECM parts or units. b. Assembly and test would be undertaken at the Teletype Plant at Chicago, Illinois, on a two-shift (and if necessary a three-shift) basis. c. Delivery would commence in January 1941, unless unforeseen delay occurred, and an output of 100 machines per month could be guaranteed by May 1941. d. Due to increased labor consts for this schedule, it would be necessary to increase the contract by 5%. These conditions were agreed to, the second contract was placed, and the Navy felt happier. There was a slight delay in deliveries at first but by December 1941 Teletype was ahead of schedule. At the date of writing (Oct 1943), the output has been increased to 300 ECMs per month: the "war effort" of Teletype's Production Department has been praiseworthy. Machines have been prorated between Navy and Army on a percentage basis except when one service had urgent need of machines and the other agreed to relinquish some of its quota. With no difference except the nameplate, it was a simple matter to make the switch."
2. Ibid.

After the first 322 SIGABAs had been ordered by the Army from Teletype Corporation through the Navy Department, the Army began to place its own contracts directly. In all, seven more contracts were placed over a two-year period for a remainder of 3008 Converters M-134-C:

On 13 November 1941, Contract W-287-sc-3844 (DP 42-4272, Order 1235-Chi-42) was placed for 45 converters at a total cost of $104,502.50.[1]

On 15 August 1942, Contract W-287-sc-4758 (DP 42-S-77, Order 4688-Chi-42) was placed for 240 converters at a total cost of $410,171.92.[1]

On 13 November 1942, Contract W-2124-sc-3395 (DP 42-S-105, Order 1266-Phil-42-24) was placed for 760 converters at a total cost of $1,371,495.23.[1]

On 5 May 1943, Contract W-2123-sc-14260 (RPR 43-III-1662 and 2706, Order 29218-Phil-43-24) was placed for 500 converters at a total cost of $855,799.22.[1]

On 7 August 1943, Contract W-36-039-sc-437 (RPR 43-III-3538, Order 2639-Phil-44-24) was placed for 288 converters at a total cost of $484,280.03.[1]

On 23 November 1943, Contract W-36-039-sc-4083 (PR 44-680, PO 12851-Phil-44-24) for 1161 converters at a total cost of $2,060,802,96.[1]

A comparison[1] of the estimated grand totals of Army and Navy expenditures and number bought is as follows: (The Army total is somewhat different from the one given above because the Navy estimated[1] these totals; it is nevertheless a good basis for comparing the two.)

1. Cost approximate.

Quantity[1]	Item	Total Cost	Average Cost
6,750	Mark II ECMs with 3 sets of Code Wheels per machine and Tender Spares	$10,176,000	$1,507.55 per machine
20 sets	Spare Parts Kits for Major ECM Repair Shops	$ 1,008,700	$50,435.00
51,250	Spare Wheel Sets (10 per set in metal box)	$ 3,515,300	$ 68.59 per set
	Tools and Special Equipment for Repair Facilities	$ 5,627,000	$ 1,700.00
	NAVY TOTAL	$14,782,000	
3,310	U.S. Army ECMs with Spare Wheel Sets and Spare Parts (Estimated cost)	$ 5,627,000	$ 1,700.00 per machine estimated
10,060	GRANT TOTAL ECMs (Navy-Army)	$20,409,000	(Estimated)

1. This chart is copied from "History of Invention and Development of Mark II ECM" written by Captain L. F. Safford, U.S.N., page 28.

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CHAPTER XIII. DISTRIBUTION AND USE

CHAPTER XIV. CRYPTOGRAPHIC SECURITY

A. General

Converter M-134-C is the most cryptographically secure means of encipherment used during World War II. Until the latter part of 1943, the following was the official security evaluation of Converter M-134-C made by Army Security Agency:

The Converter M-134-C is, to the knowledge of the cryptanalytic technicians of SSD, the most secure electro-mechanical cryptograph that is now in use. If the rules for cryptographing messages are followed to the letter, the messages... are secure from any known cryptanalytic attack.[1]

In the latter part of 1943, Analysis Section of what is now Methods Branch began an intensive security study of Converter M-134-C. This study resulted in revised conclusions, a summary of which follows:

Conditions permitting recovery of cryptographic elements are as follows:

1. At least 10 messages in depth or flagrant misuse of the indicator system are necessary before elements of the machine can be reconstructed.

2. Under proper operating conditions, cryptanalytic recovery of daily keying elements to allow the reading of traffic is impractical, even if all the rotors of a set, all procedures for use, and the wiring of the machine are known. By "proper operating conditions," it is meant that the machine is functioning correctly, established operating procedures are strictly observed, and that the literal plain texts of one or more messages are not available.

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1. Statement made to Assistant Chief of Staff, G-2, 17 May 1943.

3. To establish the daily cryptographic set-up of the machine by the exhaustive trial method, the number of assumptions which must be made equals 20x18x16x14x12x10x8x6x4x2 rotor arrangements, times 10^2 index settings. This would require that rotor wirings be known.[1]

The detailed reports of security studies done by Analysis Section, Methods Branch, Security Division are available in the files of that Section. A list of these reports follows:

Volume I

1. Historical Survey of the Work Done by the Machine Analysis Unit on the Converter M-134-C (SIGABA)..... 2220
2. Technical Survey of the Converter M-134-C..... 1220
3. Report of Analysis of a Five Wheel Cryptograph with Erratic Stepping (Parts One and Two)..... 1220.1

Volume II

1. Report of Analysis of a Five Wheel Cryptograph with Erratic Stepping (Parts Three and Four)..... 1220.1
2. Five Messages in Depth..... 1220.2
3. Identification of One Rotor with Matched Plain and Cipher Text..... 1220.3
4. Reconstruction of Rotors from Non-Random Indicators in M-134-C..... 1220.4
5. Solution of Two Identical Messages Having CW5 Off..... 1220.5
6. Ten Messages in Depth..... 1220.6
7. Comparison of Army and Navy Indicator Systems, M-134-C..... 2220.6
8. Traffic Study on M-134-C..... 2220.7

1. From "Historical and Cryptologic Summary of Cryptosystems, VI: Literal Cryptomechanisms". Filed CSGAS-83.

Volume III

B. Significant Changes in the Keying Instructions for Converter M-134-C

The keying instructions for Converter M-134-C describe the policies and procedures for assembling and aligning the rotors. The official War Department keying instructions, which have been successively in effect through the years, are as follows:

From July 1941 - June 1945: "Keying Instructions for Converter M-134-C", (short title: SIGQZF).

From June 1945 - 1 Nov. 1946: "Operating Instructions for Converter M-134-C" (short title: SIGQZF-2).

From 1 Nov. 1946 - - - - - : "Operating Instructions for Converter M-134-C" (short title: SIGQZF-3).

The rotors of Converter M-134-C, the function of which is explained in Volume 1, Chapter I, pages 6 through 12, are used in three rotor banks of the cipher unit, (short title: SIGIVI) (see Tab M). The three rotor banks of the cipher unit, SIGIVI, are the alphabet rotors (see Tab D), the stepping control rotors (see Tab D), and the index rotors (see Tab D). A general expression of the policy on reassembly and realignment of rotors is that all through the years the rotors were reassembled once a day and realigned before the encipherment of every message. This statement is not entirely accurate even in the early days of use, but it is an excellent point of reference to keep in mind when reading the deviations from this general policy. A detailed description of the keying procedures authorized successively by SIGQZF, SIGQZF-2, and SIGQZF-2 is given in Appendix I. The important changes in policies concerning assembly and alignment of alphabet, control, and index rotors are pointed out in the paragraphs which follow.

According to the first keying instructions, SIGQZF (July 1941 - June 1945), the rotors of all three rotor banks (index, control, and cipher rotors) are reassembled daily (see sample Table No. 2 from SIGQZF, following page). The rotor alignment for the index rotors, which is given in the rotor assembly table, (see sample Table No. 2 from SIGQZF, following page), remains the same throughout the day. The rotor

SAMPLE KEY LISTS

FROM

"Keying Instructions for Converter M-134-C" (short title: SIGQZF)

"Operating Instructions for Converter M-134-C" (short title: SIGQZF-2)

(For sample key list from SIGQZF-3, see page .)

(over)

SAMPLE KEY LISTS FOR SIGQZF, SIGQZF-2, SIGQZF-3 FOR COMPARISON

SAMPLE KEY LIST FROM SIGQZF
Type used from July 1941 thru June 1945

TABLE NO. 2

J A N U A R Y

DAILY ROTOR ASSEMBLY

DAY OF MONTH	INDEX (FRONT) ALIGNMENT	CONTROL (MIDDLE)	CIPHER (REAR)	INITIAL ALIGNMENT
1	58 10 45 22 36	3 1 0 5 6	9 2 7 4R 8	J U D P X
2	33 21 17 55 48	0 4R 8 2 1	6 3R 5 9 7	S E E C A
3	19 39 22 59 47	6 7 0 2 9R	5R 4 1 8 3	C E F W R

SAMPLE KEY LIST FROM SIGQZF-2
Type used from June 1945 thru 1 November 1946

TABLE I - DAILY ROTOR ASSEMBLY AND CHECK GROUP

DAY OF MONTH	INDEX (FRONT) ALIGNMENT SECRET	ASSEMBLY		26-30 CHECK GROUP
		CONTROL (MIDDLE)	CIPHER (REAR)	
1	15 20 39 48 51	9 5R 1 7 3	6 0 4 8 2	G M X P C
2	12 23 32 42 54	5 0 3 7 9	1 6R 8 2 4	A K O L D
3	19 29 34 47 50	1 4 7R 0 3	6 9 2 8 5	M W H P I

(continued opposite page)

TABLE II - DAILY ALIGNMENT

DAY OF MONTH	SECRET		CONFIDENTIAL		RESTRICTED	
	INDEX (FRONT) ALIGNMENT	INITIAL ALIGN-MENT (CONTROL AND CIPHER)	INDEX (FRONT) ALIGNMENT	INITIAL ALIGN-MENT (CONTROL AND CIPHER)	INDEX (FRONT) ALIGNMENT	INITIAL ALIGN-MENT (CONTROL AND CIPHER)
1	USE SAME IN-	E N F X F	19 26 33 46 50	T X A G M	18 26 38 44 56	W I L V D
2	DEX (FRONT)	B S G U T	11 29 37 43 58	F B N V D	12 23 31 42 59	P N F X L
3	ALIGNMENT AS SHOWN IN TABLE I (PAGE 2)	Q I V N Y	15 22 38 49 58	S E Z J C	14 20 39 48 52	I Q A D U

alignment for the control and cipher rotors, which is given in the rotor assembly table (see sample Table No. 2 from SIGQZF, preceding page), remains the same throughout the day and is the alignment used to derive the message rotor alignment each time a message is enciphered during that day.

According to SIGQZF-2 (June 1945 - 1 Nov. 1946), the control and cipher rotors are reassembled daily, according to Table No. 1 of the key list (see sample table, preceding page), but the index rotors are never reassembled, SIGQZF-2 does not state that the index rotors are never reassembled, probably because a hang over of old style key lists might still be effective after distribution of SIGQZF-2. However, the new SIGQZF-2 only gives instructions for and examples of index rotor alignments. Obviously realignment (without reassembly) of the index rotors is the new policy even though it is not expressly stated. By the time SIGQZF-3 is published on 1 November 1946, this policy, which actually became effective with SIGQZF-2 in June 1945, is expressly stated: "The index rotors are always used in a fixed order in the five rotor positions (10-19, 20-29, 30-39, etc.)". The policy for realignment of the rotors of all three rotor banks (index, control, and cipher) is also changed in SIGQZF-2. According to SIGQZF (July 1941 - June 1945), the rotor alignment for the index rotors (see sample Table No. 2 from SIGQZF, previous page) remains the same throughout the day and the alignment of the control and cipher rotors (see sample Table No. 2 from SIGQZF), previous page) used to derive the message rotor alignment each time a

message is enciphered remains the same throughout the day. According to SIGQZF-2 (June 1945), the initial alignments for the rotors of all three rotor banks are changed during the day according to the classification of the message (see sample Tables 1 and 2 from SIGQZF-2, page). The alignment of the index rotors is the same for all SECRET messages on any one day (see sample Table 1 from SIGQZF, page) but is different from the alignments for CONFIDENTIAL and RESTRICTED messages (see sample Table 2 from SIGQZF-2, page); the alignment of the index rotors is the same on any one day for all CONFIDENTIAL messages but is different from the alignments for SECRET and RESTRICTED messages; etc. The alignment of the control and cipher rotors, used to derive the message rotor alignment for the control and cipher rotors, is also changed according to the classification of the message. For SECRET messages, one alignment for the control and cipher rotors is used throughout the day to determine the message rotor alignment (see sample Table 2 from SIGQZF-2, page); for CONFIDENTIAL messages another alignment for the control and cipher rotors is used throughout the day to determine the message rotor alignment (see sample Table 2 from SIGQZF-2, page); for RESTRICTED messages, still another alignment is used for the control and cipher rotors to determine the message rotor alignment (see sample Table 2 from SIGQZF-2, page).

According to SIGQZF-3, (1 Nov. 1946) the policy for daily reassembly of the control and cipher rotors is the same as in SIGQZF-2 (see sample

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SAMPLE KEY LIST FROM SIGQZF-3
Type used from 1 November 1946

DAY OF MONTH	ROTOR ARRANGEMENT (FOR ALL CLASSIFICATIONS)		SECRET	
	STEPPING CONTROL (MIDDLE)	ALPHABET (REAR)	INDEX (FRONT) ALIGNMENT	26-30 CHECK GROUP
1	ØR 4 6 2R 7	1 8 5 9 3R	1Ø 23 31 49 5Ø	R N H V C
2	2 3R 9R 1 5	6 4R 8 7 Ø	14 25 33 46 59	S E M N O

DAY OF MONTH	CONFIDENTIAL		RESTRICTED	
	INDEX (FRONT) ALIGNMENT	26-30 CHECK GROUP	INDEX (FRONT) ALIGNMENT	26-30 CHECK GROUP
1	12 28 31 44 53	P W V M T	17 25 36 43 58	M C S D T
2	15 2Ø 32 46 56	E H E W B	1Ø 27 34 42 56	R S T H H

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table, preceding page). The policy for the fixed assembly of the index rotors and realignment of the index rotors during the day according to the classification of the message is also the same (see sample Tables 1 and 2, preceding page). There is no longer any necessity, however, for a daily rotor alignment of the control and cipher rotors by which to determine the message rotor alignment. According to SIGQZF-3, the message rotor alignment is determined in an entirely new way, which eliminates the need for a daily rotor alignment of the control and cipher rotors.

According to SIGQZF and SIGQZF-2, the message rotor alignment[1] (the alignment on the control and cipher rotors at the beginning of encipherment of a message) is derived as follows: A group of any five letters, except Z selected at random is used as the message keying element. It will hereinafter be termed the internal message indicator... Suppose the five letters selected.. are XARPG. After the control, cipher, and index rotors are assembled and aligned..., the five letters selected at random will be enciphered and the cipher resultant printed on the tape. This cipher resultant will hereinafter be termed the external message indicator and is transmitted with the message. The control rotors and the cipher rotors are then turned by hand and aligned to the internal message indicator (XARPG in this example) by the operator. NEVER align

1. Identified as the "internal message indicator" in SIGQZF and SIGQZF-2.

the rotors to the external message indicator (the letters printed on the tape), but always to the internal message indicator.

According to SIGQZF-3, the message rotor alignment is derived as follows:

1. Select a group of any five letters at random (message indicator).
2. Zeroize the converter.
3. Leave the controller at "R", and then pressing down the "Blank and "Repeat" keys simultaneously until the letter "O" in the stepping control and alphabet rotors comes to rest at the reference mark.
4. Strike the numeral key, 1, the number of times required to align the 1st stepping control rotor (next to the left end plate) to the 1st letter of the message indicator.
5. Align the 2nd stepping control rotor by striking the numerical key, 2, the 3rd by striking the numeral key, 3, etc. until all five stepping control rotors are aligned to the 5 letters of the message indicator.
6. If any rotor is stepped past the correct letter or if the rotors are not aligned in proper sequence, the entire process must be repeated from the zeroize position.
7. After the stepping control rotors have been aligned, check the alignment of the alphabet rotors to insure that all five are not aligned to "O".

CHAPTER XV. PHYSICAL SAFEGUARDING OF CONVERTER M-134-C[1]

A. General

Since Converter M-134-C was used by both the Army and Navy, any safeguarding requirement followed by one and violated by the other would have been meaningless. Therefore, on 26 June 1942 a very important agreement between the two services was drawn up in order to nullify this possibility. This agreement, a copy of which follows,[2] formed the basis of many of the specific Army regulations concerning physical safeguarding of Converter M-134-C.

ARMY-NAVY JOINT POLICY CONCERNING DISTRIBUTION AND DISCLOSURE OF CRYPTOGRAPHIC DESIGN OF THE ECM-M134C

"It is mutually agreed that the ECM-M-134C will not be placed ashore in foreign territory except at such places where armed personnel of U.S. forces are stationed in sufficient numbers to properly safeguard the physical security of the machine.

"The Army or Navy may make the machine available to the Allies of the United States if the machine is accompanied by a Liaison Officer and Communication Group. It will be the duty of Liaison Officer to prevent the viewing of the machine or its operation or associated equipment by other than authorized personnel of U.S. armed forces.

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1. The "History of Converter M-134-C" is, very likely, the only history of cryptographic equipment to contain a special chapter on physical safeguarding. Most other items of cryptographic equipment are considered adequately protected by general rules which apply to safegaurding all cryptographic equipment, special rules being neither abundant enough nor significant enough to sponsor a whole chapter. The opposite is true in the case of SIGABA. "Since the cryptographic principle and design of Converter M-134-C is in the sole possession of the United States and it is considered the best cryptographic device of its type...", its physical protection constituted a unique problem which was solved by means of special rules which applied to it alone.
2. See also Tab S for photostatic copy of the agreement with signatures attached.

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"The U. S. Army and Navy mutually agree that they will regard as secret information to be divulged only to the armed forces of the U. S. or to any U. S. citizen required to possess this information in the interests of the United States, any details concerning the ECM-M134C including rotors, wiring diagrams, keys, keying instructions and operating instructions.

"If at any time either the Army or the Navy considers it necessary to deviate in any way from this policy, the one shall fully inform the other of the facts and circumstances and the change in policy, if any, shall be by joint agreement."

/s/ Frank W. Bullock
Frank W. Bullock
Colonel, Signal Corps

/s/ Joseph R. Redman
Captain, U. S. N.
Director of Naval Communications

The official War Department regulations which have their basis in the above-quoted joint Army-Navy agreement are as follows: (All the letters here listed are included in Tab S.)

1. "Policy concerning distribution and disclosure of cryptographic design of Converters M-134, M-134A, M-134C", SPSIC 461 Codes, 24 August 1942.

2. "Policy concerning distribution and disclosure of cryptographic design of Converters M-134, M-134A, M-134C", AG 413.51(1 Jul 44) OB-S-B-M, 3 July 1944.

3. "Policy concerning distribution and disclosure of cryptographic design of Converters M-134, M-134A, M-134C", (change letter), AG 413.51 (26 Jul 44) OB-S-B-M, 28 July 1944.

4. "Policy concerning distribution and disclosure of cryptographic design of Converter M-134-C", AG 413.51 (11 Oct 44) OB-S-B-M, 12 October 1944.[1]

5. "Policy concerning distribution and disclosure of cryptographic design of Converter M-134-C", AG 413.51 (15 Jun 45) OB-S-B-M, 17 June 1945.

1. Letter, AG 413.51 (11 Oct 44) OB-S-B-M, 12 Oct 44 was rescinded by Letter AGAO-S 312.1 (15 Dec 47) CSGID, "Recission of Certain AG Letters", 19 Dec. 1947.

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6. Paragraphs 11, 15, and 17 of "General Instructions for Converter M-134-C", (short title: SIGBRE-1), AG 311.5 (21 Feb 45) OB-S-B, authenticated 7 May 1945; published June 1945.

(All of these publications except the last two have been superseded by the one following it in the list.[1]) The next three sections of this text are devoted to showing in what respects the first three paragraphs of the joint Army-Navy agreement (see pages) remain the same and in what way they are elaborated and made more specific in the War Department publications listed in the paragraph above. The first paragraph of the joint Army-Navy agreement, which deals with the subject, "Safeguarding Converter M-134-C in Foreign Countries", is traced through these six publications in Section B. The second paragraph of the joint Army-Navy agreement, which deals with the subject, "Liaison Teams", is traced through the six publications in Section C. The third paragraph, which deals with "Revealing the Details of Converter M-134-C", is traced through the six publications in Section D. The special rules on physical safeguarding of SIGABA which do not have the joint Army-Navy agreement as their direct source are discussed in Section E, "Twenty-Four Hour Armed Guard for SIGABA"; Section F, "Transportation of Converter M-134-C in Aircraft"; and Section G, "Chest 76".

1. Letter AG 413.51 (11 Oct 44) OB-S-B-M, 12 Oct 44 was recinded by Letter AGAO-S 312.1 (15 Dec 47) CSGID", Recission of Certain AG Letters", 19 Dec. 1947.

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B. Safeguarding Converter M-134-C in Foreign Countries

The first paragraph of the joint Army-Navy policy (see pages) was first brought to the attention of Army users by the above-listed SPSIC letter of 24 August 1942 (Tab S). This letter quotes the first paragraph of the joint Army-Navy agreement and then adds a specific statement of policy[1] concerning who, in the Army, is to make the decision as to what constitutes "...sufficient numbers to properly safeguard the physical security of the machine...."[2] The person so authorized by this SPSIC letter was "...the commanding officer of the highest echelon present...."[1] The next letter on the subject (Letter AG 413.51 (1 Jul 44) OB-S-B-M, 3 July 1944, see list in paragraph above and Tab S) expressed in the same policy in almost[3] the same words. The rescinding AG letter of 12 October 1944 (AG 413.51 (11 Oct 44) OB-S-B-M, see list in paragraph above and Tab S) expressed the same policy in the same words with the following addition: "This policy also applies to operation and maintenance instructions, rotors, wiring diagrams, and any similar associated material for use with Converter M-134-C".

1. Letter, SPSIC 461 Codes, Signed by order of the Chief Signal Officer, Frank W. Bullock, Col., S.C., 24 Aug 1942. The first par. of this letter read as follows: (cf. 1st par. joint Army-Navy agreement, page) "1. It is the policy of the War Department that Converters M-134, M-134A, M-134C will not be placed ashore in foreign territory except at such places where armed personnel of the U.S. forces are stationed in numbers deemed sufficient by the commanding officer of the highest echelon present to properly safeguard the physical security of the machines...."
2. Joint Army-Navy Agreement, "Army-Navy Joint Policy Concerning Distribution and Disclosure of Cryptographic Design of the ECM-M-134C", 26 June 1942.
3. Same except that the last seven words are changed from "insure the physical security of the machines" to "properly safeguard the physical security of the machines".

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On 17 June 1945, a more specific Army policy was published concerning the placing of SIGABA shore in foreign territories. The new AG letter (Tab S), still merely a clarification of the original policy of the Army-Navy agreement was published because it was anticipated that upon the cessation of hostilities in Europe, there would be an increase in the number of requests for authorization to use Converter M-134-C in neutral nations, in liberated and occupied countries, and in U. S. possessions and territories overseas. The new letter restates the general policy of the joint Army-Navy agreement and then adds a new requirement for insurance of "immediate and complete destruction in the event of imminent capture or subjection to physical compromise". The new elaboration of the general joint Army-Navy policy for placing SIGABA ashore in foreign territory does not, as does the previous AG letters (see page for list), give the "commanding officer of the highest echelon present" blanket authority to approve issuance but instead provides that the operational conditions will determine the authority for approving requests for installation and use of Converter M-134-C. The operational conditions and authority to be used with each condition are stipulated in the letter in question (AG Letter 413.51 (15 Jun 45) OB-S-B-M, 17 June 1945) as follows:

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Operational Condition	Authority
U. S. Army units engaged in tactical operations in foreign territory	Commander of the highest echelon of U. S. Armed forces present during tactical operation.
U. S. Army units in liberated and occupied countries under control of U. S. armed forces or in U. S. or Allied territories and possessions within the territorial limits of a theater or area of operations, department or defence commands.	U. S. commander of the theater, area, department, or defense command concerned.
U. S. Army units in neutral nations or in liberated or occupied countries not under control of U. S. armed forces,[1] or in Allied nations not within the territorial limits of a theater or area of operations, department, or defense command.	WAR DEPARTMENT

The War Department document, "General Instructions for Converter M-134-C" (short title: SIGBRE-1), June 1945, gives, in par. 17 (Tab S),

1. An example of a request for WD approval and its answer which fits this category is quoted below: Message, From Allied Force Hq., Caserta, Italy; To: WD, Action G-2, Info ASF. "Understand new policy governing distribution of SIGABA in foreign countries requires WD approval issue to U.S. units in territory not under U.S. Forces. Request approval issue to Hq. U.S. Occupational Forces, Austria which will be located in Vienna. Not yet known but is anticipated to be at least regimental combat team in addition to Hq. personnel and service troops. Geographical location of Hq and its position relative to troops of other nations not yet certain. One each signal operations battalion will operate signal center including code room on 24 hour basis. Signal section staff includes capable and experienced signal intelligence service personnel. Chests CH 76 and incendiaries available for each SIGABA. Also request confirmation that SIGCUM may be installed at same location. Answer: To: CG, Allied Force Hq., Caserta, Italy. From: WARTWO "Installation SIGABA and SIGCUM in Vienna reur FX 97796 is approved under security conditions outlined". Messages filed in Holder File 2368.

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the same policy as that defined in the above-mentioned AG letter. (SIGBRE is currently in effect - August 1949.)

The 17 June 1945 AG letter and SIGBRE both state the additional requirement that units requesting approval for SIGABA installation "inform the approving authority[1] as to the volume, nature, and scope of the unit's communication requirements, the number and type of U.S. troops stationed at the proposed installation to insure its continued physical security, and the measures and means to be employed to effect its immediate and complete destruction in an emergency."

C. Liaison Teams

The second paragraph of the joint Army-Navy agreement[2] remained the same as the original in all the Army instructions published through the years with the obviously necessary exception that the War Department (see quotation below), rather than the "Army or Navy" (see second par. of joint Army-Navy agreement, page), was substituted as the authority. The policy stated in the second paragraph of this joint Army-Navy agreement is found in SPSIC letter (signed by order of the CSO: Frank W. Bullock, Col., S.C.), 24 Aug. 1942; in AG letter 413.51 (1 Jul 44) OB-S-B-M, 3 July 1944; in AG letter 413.51 (11 Oct 44) OB-S-B-M, 12 Oct. 1944; in AG letter 413.51 (15 Jun 45) OB-S-B-M, 17 June 1945; and in par. 15c of "General Instructions for Converter M-134-C" (short title: SIGBRE-1), June 1945, as follows:

1. See footnote 1, preceding page.
2. See page .

The War Department may make Converter M-134-C available to the Allies of the United States provided that it is accompanied by a liaison officer and Communication Group. It will be the duty of the liaison officer to prevent the viewing of the converter or its operation or the viewing of associated equipment and documents, by anyone other than authorized personnel of the U. S. armed forces.

The policy for the formation of liaison teams proved to be very workable. Because the most extensive side-by-side fighting with forces of an Allied Nation was done with British troops, liaison teams for British-U.S. Army communication at Corps and Division level, before distribution of the Combined Cipher Machine, provided the most extensive use of liaison teams with SIGABA. The period before distribution of the CCM was during the phase of the war in which the Mediterranean Theater of Operations was particularly important. Liaison teams were also used in the later period of the war - that of the invasion of Europe by the Allied Expeditionary Forces, but to a lesser extent, because by this time use of CCM had greatly decreased the need.

In the Mediterranean Theater of Operations, SIGABA liaison teams were chiefly organized and dispatched by the 849th Signal Intelligence Service. Although this statement sounds like the iteration of an administrative detail, it is not, for 849th SIS looms important in supplying the cryptographic needs of their theater in much more than a routine way. (For explanation of a plan which made for an adaptable means of supplying cryptographic needs in the Mediterranean Theater,

see the letter quoted in footnote 1 below. This letter especially deals with plans for use of liaison teams.)

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1. The large part played by 849th SIS in the use of liaison teams is shown by the following excerpts:
   Letter, "Tables of Organization and Tables of Equipment for Cryptographic Teams", To: AG, WD thru channels, From T. J. Davis, Brig. Gen, AG (for the CG), 30 Oct. 43. Folder Tables of Organization and Equipment.
   "...The principle has been developed that a U. S. cryptographic team must be attached to each British Corps and Army engaged in combined operations. In the very near future one will be attached to the French Expeditionary Corps and it is possible that later similar arrangements will have to be made with Italian forces. In addition there are a number of special groups requiring cipher facilities and others will certainly be formed in the future. The following teams are now in operation.

DESIGNATION	LOCATION	NO. OF SIGABAs
U. S. Cryptographic Team #1	British 8th Army	4
U. S. Cryptographic Team #2	15th Army Group	5
U. S. Cryptographic Team #3	British 13 Corps	2
U. S. Cryptographic Team #4	AFHQ A.A.E.	3
U. S. Cryptographic Team #5	AFHQ Advance CP	3
U. S. Cryptographic Team #6	British 5 Corps	2
U. S. Cryptographic Team #7	British 10 Corps	3
U. S. Cryptographic Team #9	Allied Military Mission (Brindisi)	2
U. S. Cryptographic Team #10	"Fable" Group (Sardinia)	Manual system only

The organization and equipment of these teams has presented a very difficult series of problems. The grades and ratings, and approximately 60% of the authorized personnel of the Signal Cryptographic Detachment, AFHQ have been assigned to the 849th Signal Intelligence Service; but this detachment has no authorized table of equipment, nor has the Table of Equipment of the 849th been increased to allow for the addition of more than 100% to the original strength of the organization consequently it has been necessary:

a. To estimate as accurately as possible the personnel and equipment necessary for the functioning of each team.

b. To obtain as much of the necessary equipment as possible without being able to show any regularly authoritative basis of issue.

(Continued on next page.)

(Continuation of footnote 1 from preceding page.)

In some cases essential equipment proved to be absolutely unobtainable under these conditions. In others, necessary equipment was lent to the teams from the slender resources of the 849th Signal Intelligence Service, and efforst were later made, frequently without success, to replace it.

c. To cope with the continuous supply problems of teams in an anomalous technical position at a considerable distance from their organization. For instance, some types of supplies cannot be drawn by the team in that area because it can show no basis.

3. ...Experience over the past five months indicates however that while minor adjustments are cometimes required, only 3 basic types of teams are necessary, as follows:

a. Type 1. One officer, 4 enlisted men, 2 SIGABAs. Designed primarily for a British Corps serving under a British Army, when the bulk of communications would be handled by a British cipher unit. Has also been used when AFHQ Command Post was operating in several echelons.

b. Type 2. 2 officers, 15 enlisted men, 4 SIGABAs. Designed primarily for a British or French Corps serving under a U.S. Army when it must handle the bulk of communications and be capable of operating in 2 echelons. Can also be used to advantage at such Hq as the AFHQ Advance Administrative Echelon and Allied Military Mission (the teams now operating at these 2 hqs will certainly have to be increased).

c. Type 3. 4 officers, 25 enlisted men, 6 SIGABAs. Designed for Army Group and British Army hqs. Must be capable of handling a considerable amount of traffic in 2 or even 3 echelons.

4. It is recommended that the types of cryptographic teams described in par. 3 above be activated from currently operating teams of the 849th Signal Intelligence Service. Such action would not only make for more efficient operation of existing teams but would permit more rapid organization of subsequent teams as they are required in this theater. Completion of this program would involve the approval of the proposed tables of equipment (included as Incls. 1a, 2a, and 3a) indication of designating nomenclature and permission to AFHQ upon application to activate future teams as needed.

5. It is believed that the policy currently in effect of having all cryptographic teams in this theater sections of the 849th Signal Intelligence Service attached to the hq. they serve should be continued under the proposed new programs. The constantly changing proportions of the general communication picture make it imperative that all cryptographic personnel not organically a part of permanent signal units be subjected to the control of a central agency, so that teams may be shifted as needs require, and personnel reabsorbed into the cryptographic pool upon the completion of a given mission.

6. Attention is invited to the fact that the proposed activation of these teams as officially recognized units involves no immediate

(Continued on next page.)

The use of liaison teams as provided by the 849th Signal Intelligence Service in the Mediterranean Theater of Operations, is explained by means of the quotation given below:

1. A crypt team, as opposed to an organized code room which operates in standard U. S. Army Headquarters, is a specially created independent unit to serve as a means of maintaining direct cipher communication between Allied field units. Operations in the Mediterranean Theater were such that direct, rapid, and secure cipher communications were necessary between Army units of various nations. The crypt team was the obvious and workable solution to this problem.

(Continuation of footnote 1 from preceding pages.)

shipments of personnel or supplies from the U. S. and no shipments at any time that would not be required in any case under the present rather informal program. The chief advantages of regulating the status of the teams would be to make it possible to draw, from supplies already available in this theater, sufficient equipment to enable them to function at maximum efficiency and to expedite the organization and equipment of new teams as the need arises.

7. If the general plan outlined in this communication is approved, this hq. requests authorization for the immediate activation of the following number and type of units. a. 2 crypt teams, type 1; b. 2 crypt teams, type 2; and c. 2 crypt teams, type 3. All of these except one Type 2 team now being organized for the French expeditionary Corps are already in operation as detachments of the 849th SIS. Result of letter: Quotation from Operational History of 849th SIS, MTO, Dec. 1943 - Sept. 45: "...allottment of grades and ratings amounting to 29 officers and 322 EM were assigned to 849th which was thereby given the responsibility of furnishing all teams for liaison with the British as well as meeting any other demands which might arise for temporary or irregular headquarters having no assigned cryptographic personnel. It was also decided that the detachment could be used as a replacement pool, transferring code clerks to fill TO vacancies and training new ones as required...."

2. During its two and one half years of operation, the 849th SIS dispatched approximately eighteen different cryptographic teams which served under conditions varying from the luxury of presidential conferences to the mud of the Anzio beachhead. The size of the teams varied from one officer and five enlisted men to four officers and twenty-seven enlisted men. While the problems met by the different teams varied with the headquarters to which each was assigned there was one underlying problem common to all, in addition to their cryptographic work. This was the problem of existence as a small detached, independent unit. The history of Team #7 which went ashore at Salerno with the British X Corps and later worked in the quiet of Rome is presented as a history of a typical U. S. Cryptographic Team in the Mediterranean Theater of Operations.[1]

The introduction of the Combined Cipher Machine for secret communication between British and American Army units materially decreased the need for liaison teams although it was still necessary to keep them at 15 Army Group, Allied Commission, and OSS.[2] It was also necessary to provide teams for other headquarters instituted on short notice.[3]

In the invasion of Europe by the Allied Expeditionary Forces, which began June 6, 1944, extensive plans were made by the War Department for the use of liaison teams. That the plans for such use was much more extensive than the actual use, is evidenced by a program instituted at Camp Crowder, Missouri,[4] in the fall of 1943. Several

1. For this quotation and the history of Crypt Team 7 referred to in the quotation, see "Operational History of 849th Signal Intelligence Service, MTO, Dec. 1942-Sept. 1945, pp. 195-200. Filed in Historical Unit.
2. "Operational History of 849th Signal Intelligence Service", op. cit. page 131.
3. Ibid.
4. Lt. Michael Burke, who provided all the information concerning the Camp Crowder program, said that members of the other teams who were accidentally met overseas were found to be functioning in other capacities, frequently with the original team completely broken up.

cryptographic language teams were trained at Camp Crowder for the specific purpose of making SIGABA available to our Allies in accordance with the established policy. French, Italian, Russian, Dutch, and Scandinavian teams,[1] each consisting of 18 men and 3 officers were organized. The only teams known to function for their intended purpose[2] were the French Teams. These were the 7th and 5th Signal Center Detachments. The 5th Signal Center Detachment or Communications team had several assignments. It was first attached to French Base 190 at Sete where American supplies were received. The function of the attached team was to send reports on supplies from the French to the American Delta Base Section at Marseille. As its second assignment it was attached to the First French Corps for lateral communication between it and an American Corps. Third, it was attached to the French Third Algerian Infantry Division which was placed under the American 6th Corps and flanked on one side by the 14th American Armored Division and on the other by the 36th American Infantry Division. The attached cryptographic team provided both lateral and rear intercommunication in this set up. The assignment of the 7th Signal Center Team was with the French 2nd Armored Division which was the division which first entered Paris. It provided the same type of service as that described above.

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1. A Chinese team was also trained for the Pacific area. It was never used.
2. Lt. Michael Burke, who provided all the information concerning the Camp Crowder program, said that members of the other teams accidentally met overseas, were functioning in other capacities, frequently with the original team completely broken up.

The reason that the other language teams were not utilized can only be supposed. Probably, the expected need for some of the teams did not materialize. Other teams could not be used because of the security considerations which developed in the particular situation involved. The records show only two instances of requests for liaison teams other than the British and French uses discussed above. Both of these known occurences were only a few months before the war's end in March 1945. One of these requests was for a liaison team to be attached to an Italian Division,[1] the other was for a special liaison mission with the Russian Ground Forces.[2] Both requests were refused for security reasons.

1. Message from CGSOS Mediterranean to U.S. SPSIC from Schucraft, March 1945. Filed Holder 2368 AFHQ. "Within 10 days an Italian Division is to enter line as part of U.S. Corps in 5th Army. Strong bid for U.S. team with SIGABA has been received here. Request prompt definition of policy as to issue of machine in this case." Answer from Corderman to Schucraft: "Since problem cited in LA 175 involves communications for combat troops in your theater, believe decision must rest with theater commander who is responsible for physical security of SIGABA (For Schucraft from Corderman SPSIC - 8A AL 189). Consider hazard comparable to case of Brazilian Forces, presume that special detail will be furnished in addition to crypt team. Answer from: CGSDS Mediterranean to USA Army Rear Echelon, Caserta, Italy, to: Signal Security Agency, Corderman from Schucraft: On security grounds request for crypt team at Italian gruppe (sic) under 5th Army has been disapproved."
2. Message from Hq. Communications ETO, U.S. Army, Paris, France; To: SSA (For Corderman from Bicher). "Present arrangements for provision of cryptographic communications with Russian Ground Forces include the employment of special liaison missions. Have you any restrictions which should be imposed on the type of cryptographic material supplied to these missions? This inquiry particularly applies to SIGABA and Combined Cipher Machine." Answer from OCSigO (initialed S.P. Collins, Col., S.C.), 5 March 1945. "Policy of G-2 is that SIGABA and CCM not rpt not to be sent with special liaison missions to Russian Ground Forces. (Reurad P 478 of 22 Feb for Bicher from Corderman SPSIC US 473). Presently approved are SIGTOT, one-time pads, or strip systems.

D. Revealing the Details of Converter M-134-C

The third paragraph of the joint Army-Navy agreement (see page) emphasizes by mere statement that the details of Converter M-134-C is SECRET information. It also states that these details can be revealed "only to the armed forces of the U. S. or to any U. S. citizen required to possess this information in the interests of the United States". This general statement leaves much room for the requirements to be made more specific. The Army makes them so by means of an SPSIC letter.[1] This letter reiterates the general policy set forth in paragraph 3 of the joint Army-Navy agreement and adds that the details in question can be revealed "ONLY to properly accredited officers of the armed forces of the United States actually engaged in cryptographic work or specifically authorized U. S. citizens, of unquestioned loyalty whose cryptographic duties necessitate a knowledge of these details." (Underlining supplied.)

This statement concerning citizens of "unquestioned loyalty" is, of course, subject to interpretation. The interpretation which the War Department intends is well defined in certain AG letters called "Clearance of Personnel for Cryptographic Duties". Since these letters deal with all cryptographic personnel, with no special requirements for SIGABA operators, the regulations set forth therein will not be discussed in detail here. The general statement of policy for determining loyalty remained the same through the years. The detailed regulations for accomplishing it became

1. SPSIC letter, 461 Codes, Subject: "Policy concerning distribution and disclosure of cryptographic design of Converter M-134, M-134A, and M-134-C," 24 Aug. 1942.

more and more specific. The AG letters on the subject are as follows: (Each letter was superseded by the next letter. The last one listed is currently in effect.)

1. "Policy with respect to qualifications of personnel engaged in duties connected with the prescribed cryptographic systems", AG 311.5 (3-28-41) M-B-M, 3 April 1941.

2. "Clearance of Personnel for Cryptographic Duties", AG 311.5 (16 Dec. 43) OB-S-B-M, 24 Dec. 1944.

3. "Clearance of Personnel for Cryptographic Duties", AG 311.5 (31 Mar. 44) OB-S-B, 5 April 1944.

4. "Clearance of Personnel for Cryptographic Duties", AG 311.5 (29 Sept. 44) OB-I-B-M, 4 Oct. 1944.

5. "Clearance of Personnel for Cryptographic Duties", AG 311.5 (12 Mar. 45) OB-I-B-M, 21 Mar. 1945.

6. "Clearance of Personnel for Cryptographic Duties", AG 311.5 (16 Sept.46)

The second publication by the War Department of a more specific version of paragraph 3 of the joint Army-Navy agreement (see pages) was in AG letter 413.51 (1 July 44) OB-S-B-M, 3 July 1944. This letter adds a paragraph which was taken for granted only in the SPSIC letter discussed above. The addition was as follows:

> ...4. Under no circumstances will United States personnel be granted access to these machines unless authorized in accordance with the policy of the War Department governing clearance of cryptographic personnel.

In the next AG letter 413.51 (26 July 44) OB-S-B-M, 28 July 1944, one addition to what went before was made. The policy on revealing details of Converters M-134, M-134A, M-134C was amended to read "...divulged ONLY to properly accredited officers or enlisted personnel of the armed

forces of the United States..." instead of "divulged ONLY to properly accredited officers of the armed forces of the United States..."

The next two AG letters dealing with the subject made no changes in this particular paragraph. These two AG letters, which were the last two, can be identified as follows: AG letter 413.5 (11 Oct. 44) OB-S-B-M, subject: "Policy Concerning Distribution and Disclosure of Cryptographic Design of Converter M-134-C", 12 October 1944 and AG letter 413.5 (15 Jun. 45) OB-S-B-M, same subject, 17 June 1945.

The treatment of this subject in the document "General Instructions for Converter M-134-C" (short title: SIGBRE) is as follows:

> ...15. ACCESS TO AND SAFEGUARDING OF INFORMATION PERTAINING TO CONVERTER M-134-C.
>
> a. Only persons who are authorized in accordance with the policy of the War Department governing clearance of cryptographic personnel (see par. 11) will have access to Converter M-134-C, associated material, or information pertaining thereto.

The paragraph 11 referred to cites the current AG letter on clearance of personnel for cryptographic duties.

E. Twenty-Four Hour Armed Guard for SIGABA

The unwritten, sometimes even unspoken, law of the initiated to regard the cryptographic principles of SIGABA with especial respect makes it difficult to believe that there has not always existed a written, official rule that SIGABA be constantly under 24-hour armed guard unless it is in a permanent or semipermanent code room which is itself thus protected. However, it was not until June 1945, with the

publication of "General Instructions for Converter M-134-C" (short title: SIGBRE-1), that such a written War Department rule for protection by 24-hour armed guard was officially adopted and promulgated.[1]

The nearest thing to a War Department rule requiring a 24-hour armed guard was a statement of policy issued on 6 March 1944. This statement of policy was in answer to a request by an inspection officer who presented the problem as follows:

> "It is the belief of the undersigned that the policy of the War Department is to require units in maneuver areas to keep their SIGABAs under constant armed guard, even if the machines are kept locked in their CH 76s. If this policy is to be enforced, it will probably be necessary to show written authority to some units..."[2]

The answer received was the first written official statement of policy on the subject. It was as follows:

> ....While there is no specific regulation requiring an armed guard for SIGABA (underlining supplied) when locked in a CH-76 it is the opinion of the Chief Signal Officer that an armed guard should be provided for this equipment at any time when there is not a secure permanent or semi-permanent code room available.[3]

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1. Compare this discussion of a 24-hour armed guard for SIGABA with the discussion of rules for 24-hour armed guard in Section of Chapter , "The Colmar Case", page . The ETO rules brought to attention there are not as definite a statement as that published in SIGBRE-1.
2. Letter, Subject: "Physical Security of Cryptographic Material in the Field", To: Chief Signal Officer, SPSIC, From: Robert S. Taylor, 1st Lt., S.C., 6 March 1944.
3. 1st Ind., (SPSIC 141.7, 6 Mar 44, signed For the CSO: Frank E. Stoner, Brig. Gen. U. S. Army, Chief, Army Communications Service, Russel H. Horton, Capt., S.C., To: SO, 4th Army Director, Hq. Leesville, La.; From: ASF, OCSigO, Washington, D. C., 22 March 1944.

During the period before the publication in June 1945 of the War Department rule requiring 24-hour armed guard, there existed a feeling of extreme respect for the security of the SIGABA. This feeling, in many cases, produced unusually secure conditions which probably often included a 24-hour armed guard. At the same time, the lack of an actual rule allowed the fact that many SIGABAs were protected by individual invention[1] rather than by an unalterable stipulation for a 24-hour armed guard.

When a War Department rule finally appeared in "General Instructions for Converter M-134-C" (short title: SIGBRE-1), June 1945, it was phrased as follows:[2]

> ...A twenty-four hour armed guard should be provided for Converter M-134-C and associated material at any time when it is not in a secure permanent or semipermanent code room, even if it is locked in a CH-76 or other type of three-combination safe. All code rooms in which it is installed must be under twenty-four hour armed guard....

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1. From a report by 1st Lt. Robert S. Taylor who was on temporary inspection duty with the Signal Section, Fourth Army Director Headquarters, Leesville, La., 6 March 1944:
   a. On 5 March 1944 it was noted that the XVIII Corps had four SIGABAs in a one and one-half ton truck at its command post in the Fourth Army Maneuver Area. The cryptographic officer of the Signal Section, XVIII Corps, told the undersigned that the chests and safes holding the machines contained large amounts of high explosives which would be discharged if the containers were forced, and stated that all personnel in the vicinity were responsible for seeing that the truck was not moved by unauthorized personnel. However, no one person was stationed as a guard. At night the executive officer of the Signal Section had been sleeping in the immediate vicinity of the truck, and Signal Section personnel were on twenty-four hour duty near-by. At all times a loaded carbine was kept in the Signal Section tent, a few yards from the truck. Lt. Col. Williams, Sig. Officer of the XVIII Corps, believed that the set-up was very secure, and pointed out that there is nothing in writing requiring an armed guard for the SIGABA.
2. Compare the rules discussed in Section of Chapter , "The Colmar Case", pages . The rule above is obviously an outgrowth of a lack in the wording of the rules in existence at the time of the Colmar loss.

TOP SECRET

In May 1946, the Army Security Agency reemphasized the requirement for a twenty-four hour armed guard when it received two requests from Headquarters, Army Air Forces for reconsideration of the policy. In answers from the Army Security Agency and Director of Intelligence, the requirement was not only upheld[1] and reiterated but a fine point concerning what constituted a 24-hour armed guard was made clearer. This fine point concerned whether military station guards could be considered as sufficient protection. The answer from the Director of Intelligence stated that armed station guard sare "not sufficient protection because many persons who are not cleared to view the SIGABA are properly permitted to pass these guards".[2]

The only other official rules for maintaining constant guard over the SIGABA appear in the transportation instructions for overseas shipment.

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1. Letter, "Policy on Storage of Converter M-134-C", To: CG, AAF, Wash., D.C., Attn: Chief, Security Section, Air Communications Office; From: George A. Bicher, Col., S.C., 9 May 1946. "...2. This Agency does not consider that cessation of hostilities justifies any relaxation in security regulations pertaining to cryptographic materiel and has noted with alarm a tendency towards such relaxation during recent months as has been evidenced by an increase in the number of physical and cryptographic compromises. 3. Since the cryptographic principle and design of Converter M-134-C is in the sole possession of the United States and it is considered to be the best cryptographic device of its type, it is not advisable to jeopardize its use or storage under unsatisfactory security conditions. It is considered that eliminating the necessity for a 24-hour armed guard, regardless of geographical location, even if the converter were stored in a CH-76 in a locked code room, would result in such a condition, and that no justification exists for undergoing such a risk...."
2. Letter, "Policy on Storage of SIGABA", To: CG, Army Air Forces, From: Director of Intelligence, no date but answers letter dated 29 May 1946.

TOP SECRET

These rules, which were published in AG letter on 12 July 1944[1] (see Tab S) and restated in SIGBRE-1 in June 1945,[2] required that an armed guard be maintained during transportation by rail, ship, or air. The instructions concerning transportation by rail required that "even though the chests or packages containing the cryptographic material and equipment are transported in a sealed car, it will be necessary to maintain an armed guard at all times...."[3]

F. Transportation of Converter M-134-C in Aircraft

On 30 March 1943, an SPSIC letter[4] was published which stated that the Chief Signal Officer desired that SIGABA rotors never be transported by aircraft over enemy territory or over water from which the recovery of the rotors by the enemy would be possible. This letter stated that although it was appreciated that transmission of secret documents by aircraft was permitted by Army Regulations,[5] that the Signal Officers were urgently requested "to exercise the utmost discretion before deciding to take this action. The world-wide dislocation of communications that would result from the compromise of the rotors of SIGABA must be considered in almost every case to outweigh the temporary advantage to be gained by transmission by aircraft."[6]

1. AG Letter, 311.5 (12 Jul 44) OB-S-SPSIC-M, "Instructions for Proper Packing and Handling of SIGABA and All Other Cryptographic Material for Overseas Shipment", 12 July 1944. Rescinded by AGAO-S 312.1 (15 Dec 49) CSGID dated 19 Dec 1947. Policy restated in SIGBRE-1.
2. "General Instructions for Converter M-134-C" (short title: SIGBRE-1) June 1945.
3. Same as footnote 1.
4. SPSIC letter, subject: "Proper Safeguarding of SIGABA Equipment, 30 Mar 43.
5. AR 380-5, Change No. 1, Par. 19, Feb. 20, 1943.
6. Same as footnote 4.

The above-stated policy laid down certain stringent conditions for transmission of SIGABA rotors by aircraft but did not say anything about operation of SIGABA in an aircraft on the ground. In November 1944, just such a problem arose. An aircraft was equipped with a radio set[1] to serve as an airborne command post for the Chief of Air Staff, Far East Forces. For flights by the Chief of Air Staff, a SIGABA was kept on board the aircraft in a locked container. At the destination, the aircraft was used on the ground as a command post and the SIGABA was operated in the aircraft.[2] A letter signed for the commander-in-chief by the Assistant Adjustnt General of the Southwest Pacific Area, General Headquarters, directed the Commander, Allied Air Forces to discontinue using the SIGABA in this manner, giving the reason that it was "unnecessary and contrary to the policy of this headquarters whereby transportation of SIGABA or associated equipment may not be by air except in rear area remote from enemy forces or in cases of genuine emergency."[3] When this use of SIGABA in an aircraft came to the attention of the Army Security Agency, the policies of the above-mentioned SPSIC letter[4] were published in an AG letter[5] which added the following:

> ...UNDER NO CIRCUMSTANCES WILL THE CONVERTER M-134-C BE OPERATED IN AN AIRCRAFT....

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1. SCR-399.
2. Letter, AG 380.01 (19 Nov 44) S, Subject: "Security of the SIGABA", Signed: H. W. Allen, Col., A.G.D., for the Commander-in-Chief, To: ASF, Wash. 25, D.C., 19 November 1944.
3. Ibid.
4. See footnote 4, previous page.
5. Letter, AG 311.5 (28 Nov. 44) OB-S-B-M, Subject: "Policy Concerning Transportation of Converter," 1 December 1944.

C. Chest CH-76

Chest CH-76 is a special safe designed for housing Converter M-134-C. It is a two-section safe with an upper and lower section. The upper section, which is mounted on and secured to the lower section, contains a sliding shelf for holding the converter. The lower section is used for storing associated material of the converter.[1] When the first AG letter on issue of SIGABA equipment[2] was published on 9 December 1941, a statement was included to the effect that it was "contemplated issuing a safe, specially designed for housing the converter to tactical units at a later date...."[3]

The AG letter which announced the issue of such a safe (CH 76) was published on 17 February 1945 (see Tab).[4] This letter[4] established the following policy:

> ...Except in the case of nontactical units within the continental Unites States, Converter M-134-C and its associated material will always be housed in Chest CH-76 unless authorized to the contrary. Requests for such authorization will be forwarded through channels to the Chief Signal Officer, Room 3C340, The Pentagon, Washington 25, D. C., Attention: SPSIC.

In an amendment[5] published 3 April 1945 (see Tab S), the method of authorization for deviating from the rule of <u>always</u> housing a SIGABA in

1. For a complete description of CH-76, see "General Instructions for Converter M-134-C (short title: SIGBRE-1), June 1945.
2. Letter, AG 311.5 (12-5-41) MC-M, Subject: "Issue of Cryptographic Equipment", 9 Dec. 1941.
3. Ibid.
4. Letter, AG 428 (14 Feb 45) OB-S-B-M, Subject: "Policy Concerning the Use of Chest CH-76", 17 February 1945.
5. Letter, AG 428 (31 Mar 45) OB-S-B-M, Subject: "Policy Concerning the Use of Chest CH-76", 3 April 1945.

a Chest CH-76 was changed. The approving authority of the old letter[1] (17 Feb 1945) was the Chief Signal Officer. In the amendment[2] it became instead "the commander of the theater, department, or base concerned".[3]

The document, "General Instructions for Converter M-134-C" (short title: SIGBRE-1), June 1945, reiterated the policy given in the AG letter of 17 February 1945[4] as it was amended by the AG letter of 3 April 1945.[5]

1. Same as footnote 4, previous page.
2. Same as footnote 5, previous page.
3. Same as footnote 4, previous page.
4. Same as footnote 4, previous page.
5. Same as footnote 5, previous page.

CHAPTER XVI. THE COLMAR COMPROMISE

A. General

Perhaps the most exciting incident at Arlington Hall Station during the war occurred on February 10, 1945, at about 10:00 o'clock at night, when the officer in charge of the War Department Code Center called Colonel Allsopp[1] at his quarters to tell him that an extremely important message concerning a serious compromise had just been received. Colonel Allsopp went immediately to Arlington Hall Message Center to receive the communication, after notifying Colonel Kuhn and Major Chittenden to meet him there. Upon their arrival, the following dramatic words began to appear on the teletype:[2]

> Parked truck belonging to two eight infantry division containing following documents stolen in Colmar France: SIGABA, SIGIVI, SIGTRIG, SIGYHUG, SIGAMUG, SIGLYIS-17, -18, and -19, SIGCLOE-17, -18, -19, SIGPJRL, SIGONSN, SIGSDMG, SIGTEMP-18, -19, SIGESG-2 and 3, SIGMAK, SIGKKK-1, CSP 1601A, SIGSPIL-2, SIGUHR-2, SIGQZF, SIGRED-2, SIGNAN-2, SIGCOM-2, SIGWHY-1, SIGGAN, CCBP 0125-9, 10, and 11, CCBP 0126-9, 10, and 11, CCBP 0122-A15, CCBP 0124-1, CCBP 0129-1 and 2, CCBP 0121-A10, ETWAS-15 (For SPSIC Cite SOSSC signed Eisenhower (War 5799E 96921)) Use of all systems listed has been suspended in this theater and every possible action taken to restore security. CCBP 0131 has been distributed to all holders of SIGAMUG and is now being used by American forces to encipher all radio transmissions. Secure landlines and courier being used in most cases. Full investigation of loss being made by Sixth Army Group. Will keep you informed of developments and action taken.

The fact that SIGABA itself was lost along with its rotor basket, SIGIVI, and rotor basket, SIGAMUG, is immediately apparent from even the most

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1. Chief, Security Division, AHS.
2. SIGTOT message.

cusory examination of the list. This information is so overwhelming that the full import of the other things which were lost is likely to be overshadowed. However, an analysis of the listshows that all of the material[1] for operating Cryptonet 22 (the Theater-wide cryptonet for the European Theater of Operations, including the rotors (SIGTRIG), was in the lost truck. Further analysis shows that a set of rotors (CCBP 0111: SIGYHUG), distributed to all holders of the Combined Cipher Machine, was lost. This distribution alone involved 8500 sets of rotors. Although the universal combined system (CCBP 0101) based on these rotors was not in the lost truck, it was affected by the loss of the rotors. The system based on SIGYHUG rotors which was in the lost truck was Limited Combined System 514,[2] distributed to specific U. S. Army and British holders. The only other specific systems were a combined strip stand-by,[3] a combined authentication system,[4] and the combined field code with subtractor tables.[5] Also included in the truck were all the

1. Rotors (SIGTRIG, Reg. No. 276); rotor assembly tables (Editions 17, 18, 19) for System 2201 (SIGLYIS-17, -18, -19); Alphabet strip system 2222 (including keylists: SIGCLOE-17, -18, -19 and alphabet sets: SIGPJRL for 2222-17, SIGONSN for 2222-18, and SIGSDMF for 2222-19), Key lists for double transposition system 2242 (SIGTEMP-18 and -19).
2. Rotor assembly tables for system 514 (SIGESG-2, SIGESG-3) and rotors for this system: SIGYHUG were in the truck.
3. Strip key lists CCBP 0125-9, -10, -11; Strips: CCBP 0126-9, -10, -11.
4. SIGGAN (Authentication System No. 2) and CCBP 0122-A15 (Combined Authentication System, Area A only).
5. CCBP 0121-A10 (Subtractor Tables for use with Combined Field Code, Area A only)

keying, operating, and maintenance instructions[1] for the equipment involved. Last but not least, ETWAS-15, the holder list of theater systems for ETO, and SIGMAK, the holder list of the Combined Cipher Machine, were in the lost truck.

The most important question at the moment of loss was whether or not this truck had fallen into enemy hands. As soon as the loss was discovered, everybody concerned (from those directly responsible in the 28th Division to the high officials of Arlington Hall Station) did everything possible to find it. Even so, it was missing over a month (from the night of Feb. 5-6 until 12 March when part of the material was found; the remainder was discovered on 21 March. (See Section C, pages through .)) During that time it was necessary to ACT AS IF IT HAD FALLEN INTO ENEMY HANDS. This element divides the problem into two distinct parts: (1) the problem of finding the truck and (2) the problem of dealing with the consequences of having to assume complete compromise of this material.

B. How it Happened

For photostatic copies of the ETOUSA rules with which the man who lost the truck should have been familiar, see Tab T.
For photographs of Converter M-134-C after it was found, see Tab U.

According to the literary outline established in the above paragraphs,

1. "Maintenance Instructions for the Converter M-134-C" (SIGKKK-1), "Instructions for the Combined Cipher Machine "(CSP 1601A), and CCBP 0124-1, "Cryptonet 22, Basic Document" (SIGSPIC-2), "Instructions for Using Strip Cipher Devices (SIGUHR-2), "Keying Instructions for Converter M-134-C" (SIGQZF), "Instructions for Using Double Transposition Cipher System" (SIGRED-2), "Cryptographic Communications, 1943" (SIGNAN-2), "Supplement No. 1 to SIGNAN-2" (SIGCOM-2); "Supplement No. 2 to SIGNAN-2" (SIGWHY-1).

the next subjects which should be dealt with are (1) finding the truck and (2) dealing with the consequences of the loss. However, if we follow the logic of common sense, at this point, instead of the logic of literary outline, we will find ourselves next confronted with a desire to know how this valuable truck came to be lost in the first place.

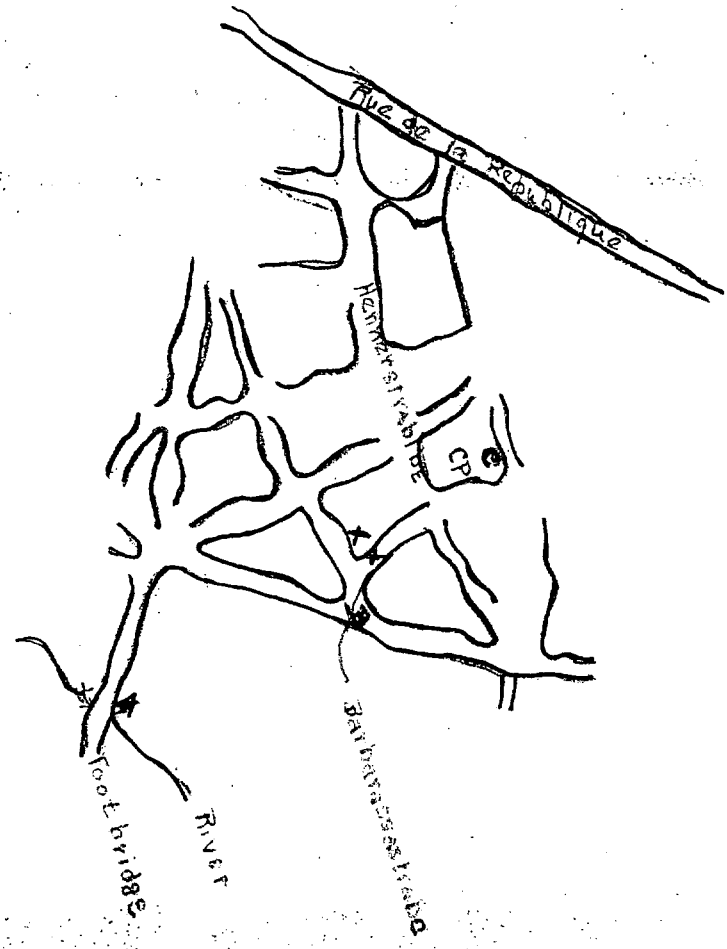
In early February 1945 the 28th Infantry Division in France was moving its location forward very rapidly. The established procedure for movement of a division command post is for a skeleton staff to organize a forward echelon, go ahead of the main echelon, and set up at the new location in order that preparations can be made for the arrival of the main body of the division command post. Very shortly after the preparations were completed, the main echelon moves up to the new location. Little or no time is lost in the activity of the main echelon because of the advance preparations made by the forward echelon.

In this history we are concerned with the role that the communications group plays in such a move, for the truck in question (the one containing the SIGABA and much other valuable and secret equipment)[1] was lost during just such a move. The normal procedure for moving forward a cryptographic team was as follows: The message center chief with part of the cryptographic team and equipment would move ahead with the skeleton forward echelon and set up cryptographic communications in the new location. While the forward echelon was being established, the assistant

1. For list of equipment in lost truck, see pages and .

~~TOP SECRET~~

~~TOP SECRET~~



A Where abandoned 1 ton trailer was located

B Position of vehicle when parked

C Location of CP Division.

~~TOP SECRET~~

message center chief remained behind at the old command post location with the rest of the team and maintained communications. When the new message center had been set up at the new location, the rest of the team moved up with the main echelon and its attached Signal Company to the new location. When the second helf of the team arrived, it went into reserve in preparation for the next move at which time it would move ahead and leave the other half temporarily behind with the main echelon. Usually the second half of the cryptographic team moved up right along with the main echelon and the division command post's attached Signal Company arranged a guarded truck park for the vehicles coming in the new location.

With this description as a background we are now ready to consider the specific conditions under which the truck in question was lost.

On 4 and 5 February 1945, the command post of the 28th Infantry Division was being transferred from Kayersburg, France to Colmar. On 4 Feb., Lt. Viets, the message center chief of the 28th Division Signal Company, proceeded to Colmar from Kayersburg with the advance section of his cryptographic team and equipment in order to set up a message center at Colmar. When he arrived, there were no billets ready for or even allotted to the Signal Company. So his men found a house on Barbarassastrabe (see map opposite), got permission to occupy it, and set up their message center.

The next day, on 5 Feb., Warrant Officer Moody, the assistant message center chief, left Kayersburg for Colmar with the second half of

the cryptographic team and a spare set of cryptographic equipment.[1] The spare equipment rode in a 2½-ton truck driven by a Private Thompson. Attached to the truck was a trailer containing a couple of power units, a command post tent, a broom, and other personal equipment. The men belonging to this second half of the cryptographic team rode either in the truck containing the spare equipment or in a 1½-ton truck which followed. Warrant Officer Moody, the assistant message center chief, rode in the 1½-ton truck which followed.

When the two trucks arrived at Colmar at approximately 4:30 the afternoon of 5 Feb., the men did just as they were in the habit of doing on other moves or transfers from one location to another. The normal procedure upon arrival seemed to consist of finding out by means of informal questions what everyone else was doing and then proceeding to do likewise.[2] On every other occasion (so far as is known) this procedure had afforded sufficient protection for the vehicle because a truck park guard had usually been established by the Signal Company before their arrival and informal questions had resulted in their being directed into it. On most other occasions it was also true that the men bringing in the second half of the spare equipment took it into the message-center building. But this

1. For list of equipment, see pages and .
2. Question asked to WOJG Moody by Lt. Col. Peterson, Inspector General, 28th Infantry Division: Did you report to Lt. Viets, head of the section on your arrival? Answer: Yes sir. Question: Did you receive instructions from him as to where you would park your vehicles or where you would set up your section that night? Answer: The only instructions about parking the vehicle was that any street except the CP street was O.K. I had only received that but it was not from Lt. Viets. Who did you hear that from? Generally we came in late and usually we find out from somebody and that is the answer we got. We saw other vehicles parked in the same area.

time the Division was moving forward so fast that two unusual things happened: (1) the second half of the team arrived at the new command post location (in this case, Colmar) ahead of the Signal Company which usually established the truck park and (2) the second half of the team did not take their newly-arrived equipment into the message-center building as usual[1] because they planned to move ahead the very next morning. Specifically, the following situation developed: Upon arrival at about 4:30 in the afternoon of 5 February, Warrant Officer Moody reported to Lt. Viets, head of the section. He received no instructions from Lt. Viets, as to where to park the vehicles. When Moody came out of the message center building he saw the truck parked beside the curb along with any number of vehicles already parked there. Of course, the driver, Private Thompson, was the man who actually parked the vehicle. Private Thompson said that he "hollered and asked one of the sergeants where to park the truck". The sergeant called back, "Pull it up a little bit further along the curb". Although Provate Thompson testified that he did not remember who the sergeant was, further testimony in the investigation brought out the fact that the sergeant was Frank Tetarus, T3, trick chief and crypto-

1. Interview during investigation of Colmar Compromise between Inspector General of 28th Infantry Division (Lt. Col. Herman T. Peterson) and Sergeant Tetarus: Q. Do you ordinarily park a truck with cryptographic equipment in it without a guard? A. Well, most times as I can remember we have taken the cryptographic machines into the building immediately upon arriving. This time we left them out in anticipation of the jump in the morning. Q. You say most times, how many times have you left the equipment in the truck overnight? A. Well, at the last area we were in we had the cryptographic material in the truck for certain hours, we were having trouble with them at the time which necessitated them being repaired. Q. On how many occasions have you left cryptographic equipment in the truck overnight? A. I couldn't make a definite answer on that, Sir. An approximate answer that is quite definite after our run thru France, was in the last month. (Sic) About three times, that is approximately.

graphic technician, who also arrived with the second half of the team on 5 Feb. Sergeant Tetarus testified that when he arrived with the team, he immediately went into the Division message center and asked the officer-in-charge, Lt. Viets, where to put the truck. He also asked about quarters for the men. Sergeant Tetarus testified that Lt. Viets told him "that the billets were No. 16 and to park the vehicle that I had near the house." (Sergeant Tetarus' testimony was later corroborated by Lt. Viets.)[1]

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1. Interview during investigation of Colmar Compromise between Herman A. Peterson, Lt. Col., IGD, Inspector General, 28th Infantry Division and Lt. Viets (Recall of Viets): "Q. From the information given by witnesses it is alleged that instructions were given to them by you to park the vehicle on this street next to the billet. Is that correct?
   A. That is correct.
   Q. Did you realize when you instructed the vehicle to be parked on that street that vehicle would be without guard?
   A. No, I did not actually because I thought that some area would be given to the Signal Company for parking of their vehicles. I certainly did not think that the vehicles would be left overnight, but when it later became apparent to me that that was the procedure and that way everyone was parked everywhere they could, mainly along the streets.
   Q. Did you have any information at anytime that there would be a guard provided for these vehicles?
   A. I thought a guard would be provided, I knew there would be a guard provided if they were put in a central area.
   Q. It is my understanding in the past that the 28th Sig. Co. had provided their own guard and their own motor pool?
   A. That is correct.
   Q. Then what officer of the 28th Sig. Co. would have been responsible for providing the guard for that parking area?
   A. The motor officer, if he were here.
   Q. Do you know whether he was here?
   A. No, he was not here.
   Q. Well then, if he were not here it was questionable then whether a guard would be provided?
   A. That is correct.
   Q. Then you were not certain whether a guard had been provided. Did you realize that this truck would be left on the street unguarded with the cryptographic material in the truck?
   A. No, I did not look at it that way, because as I said before, we had always parked Sig. Co. vehicles together near our billets or bivouac area."

The next morning (Feb. 6) Sergeant Hillman[1] and Corporal Brookins[1] went out about 9:00 A.M. to find the truck in order to make some needed repairs. When they arrived at the spot where the truck had been parked the night before, the truck was gone. Sergeant Hillman immediately reported the matter to Lt. Viets and then looked up the driver and asked him if he moved the truck. Receiving a negative answer, he proceeded on his own with Corporal Brookins to look for it. Their sole success was in finding the trailer, containing only unclassified material, which had been attached to the truck. They found the trailer on a dead-end road. Lt. Viets notified the Provost Marshall and the Division Signal Officer, Lt. Col. Clarence T. Hullett.

C. Finding the Truck

To find the truck, two procedures were established. First, everybody looked for it and second, while the search was being conducted, the persons considered responsible were interviewed (see Section E, pages) in order to unearth clues, to establish evidence for court martial, and to institute procedures to prevent recurrence.

The search for the truck was very elaborate. Patrols of MP's were established to search roads, barns, and sheds in Colmar and surrounding villages. MP road blocks and special patrols were placed throughout the division sector. Teams of CIC agents searched Colmar systematically,

1. Both Hillman and Brookins were on the cryptographic team. Hillman had come in with the lost truck and Brookins had arrived the day before with the forward echelon.

block by block. Later this search was extended to an area with a radius of approximately twelve miles of Colmar. All subordinate units were directed to search their own units and submit a report. CIC established a network of informants throughout the Colmar sector. CIC also enlisted the aid of French units[1] in helping with the search and examining their own units. Since these detailed measures[2] failed to produce results, SHAEF was requested to conduct a complete theater search for the vehicle.[3]

1. Memo for Col. Harrison from David G. Erskine, Col. GSC., G-2 (CI) 8 Feb. 1945:..."I then proceeded to the First French Army last night and talked to the Chief of Staff and asked him to put out instructions that all units in the First French Army will check each vehicle and the Division commander concerned will presently certify that this has been done. In addition I told them that I would like to place CIC personnel with the French Divisions to assist in identifying the missing property as well as to help direct the search, in conjunction with the SM and SA. First French Army sent their cable, which I wrote, on this matter out at 2 A.M....this morning....." Folder: Compromise & Loss Cryptomaterial-ETO (Colmar Incident) Investigation.
2. All of the measures taken to recover the truck are NOT listed in this paragraph. Rather, an attempt is made to give a general conception of the elaborate search conducted. For a detailed listing of the steps taken, see Tab 8. "Steps Taken Toward Recovery of Missing 28th Division Signal Truck containing Classified Documents and Devices" in Folder: Compromise & Loss Cryptomaterial - ETO (Colmar Incident) Investigation.
3. The following units took measures from 7 Feb. to 20 Feb. 1945: 28th Infantry Division, XXI Corps, First French Army, Seventh Army, 6th Army Group, SHAEF. Measures were taken subsequent to 20 Feb. 1945 by 6th Army Group and SHAEF. Directives were sent out by the above units to subordinate units instituting a complete search for the missing vehicle, alerting Military Police and memorandums and radios were sent enlisting the aid of the FBI, CIC, and G-2, SOLOC. Negative reports were filed by all of the above units. As of 4 March the following units were also engaged in conducting an extensive search of all Alsace. Securite Militaire, Regulatrice Routiere (French Road Control, 1st French Army), CIC, Gendarmie - where available, Eau et Forets (Waters and Forests), Ponts et Chaussees (Bridges and Highways), Railroads, Canal Authorities, Postal Authorities, Potassium mines, Police Speciale, (Detective Agency), Renseignements Generaux (Civilian Detective Agency, Douaniers (Custom guards). All of the above were coordinated by Surete Nationale throughout France.

Finally, on 12 March 1945, the top half of the Chest 76 containing the SIGABA, the SIGIVI, the U. S. instructional documents, the combined key lists, and the rotors for the local theater SIGABA system,[1] were found submerged in the Greesen River, a mountain stream near Seiestat, France, by a searching party from the Second French Corps. (For photographs of the top half of CH 76, as the mud-covered SIGABA is being removed from it, see Tab U.) On 21 March, the other half of the Chest 76, containing the remainder of the material, was found in the same spot. Presumably, the safes had not been tampered with and the material was, therefore, uncompromised.[2] The only actual damage was from water and mud. However, the necessity for assuming compromise during the period in which the safes were lost caused unimaginable trouble (Section D).

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1. These rotors had been replaced with reserve set within a week after the compromise.
2. Letter, Subject: "Report of Loss of SIGABA No. 235", To: Chief Signal Officer, Wash. 25, D.C., Attention: Signal Security Agency, Signed for the Chief Signal Officer: George A. Bicher, Col. S. C., OCSigO, Hq. ETO: "...2. In summation, the forward command post of the 28th Infantry Division, while in Colmar, France, had stolen from it one two and one-half ton truck containing a complete SIGRINO and associated cryptographic material. An intense search was conducted to recover this truck and SIGABA, and finally in the bed of a mountain stream there was found the upper half of CH-76 and a field safe containing SIGABA and some of the cryptographic documents concerned. Later in the same spot there was recovered the bottom half of the CH-76. A careful study was made while opening these safes and this lead to the unconfirmed belief of this headquarters that this truck had been stolen for the value of the truck itself, and that the actual thieves had no knowledge that this truck did contain cryptographic equipment. Further, the condition of the contents of these safes indicates that no unauthorized persons opened or in any way had access to the cryptographic material contained therein. It is probable that the safes containing the cryptographic material was dropped in this stream as a method of disposal and without the purpose of hiding this material.

D. Consequences of the Assumed Compromise

The assumed compromise of the basic worldwide combined rotors CCBP 0111 (SIGYHUG) seriously affected three important systems based upon these rotors, namely, the worldwide Combined Cipher Machine system (CCBP 0101), the European Area Combined system (CCBP 0131), and the Special Limited Combined system (514-ESG). Although the keylists for CCBP 0101 and CCBP 0131 were not in the lost truck, the rotors on which they were based (CCBP 0111: SIGYHUG) were. Editions 2 and 3 of System 514, in addition to the 0111 rotors on which they were based, were in the lost truck. The SIGABA material in the stolen truck was the SIGABA itself and all of the current material for European Theater Cryptonet 22 (including rotors: SIGTRIG and three editions of the rotor assembly tables: System 2201 (SIGLYIS-17, -18, -19).

A significant result of the assumed compromise of all this important material was demonstration of a serious lack in the emergency plan for the Combined Communications Machine.[1] No reserve rotors were held for the CCM

1. "....2. The recent compromise of rotors used with the general worldwide Combined Cipher Machine system made it apparent that there was an imperative need for all rotors of the Combined Cipher Machine to have a reserve set of rotors on hand at all times to provide for any emergency. Although a combined strip cipher system has been provided for this purpose, it would be highly impracticable to employ a strip system for any length of time in place of the Combined Cipher Machine in view of the heavy traffic sent in Combined Cipher Machine systems and the comparative slowness of strips. Lacking any other alternative, it was found necessary to continue using possibly compromised rotors...." Memorandum for Secretary, Combined Communications Board; signed H. C. Ingles, Subject "Plan for Reserve Rotors for Combined Cipher Machine Systems", 23 Feb. 1945.

systems and the strip standbys proved highly unsatisfactory[1] in meeting the emergency. The efficacy of having reserve rotors ready for distribution was shown by the fact that the lost SIGTRIG rotors of Cryptonet 22[2] were replaced within a week of SIGDHRD,[3] distributed from European Theater Headquarters. Such an easy solution for the lost CCM rotors was not in sight. No reserve rotors existed and even though a vigorous emergency wiring program, which included all five combined services, was immediately instituted, it still required months to wire and distribute 8500 new rotor sets to replace the lost worldwide combined rotors, CCBP 0111 (SIGYHUG). The only thing which could conceivably be called good about the necessity for this replacement was that the emergency wiring program did not stop when replacement was effected but continued until reserve rotors also were provided.

The emergency wiring program was set up as follows: Three new rotor sets were to be wired— namely, CCBP 0211, CCBP 0311, and CCBP 0213. The first and most important rotors to be wired were the new CCBP 0211 (SIGILUT) rotors, which were to act as the replacement for the lost worldwide combined rotors CCBP 0111 (SIGYHUG). The second rotors to be wired — namely

1. Message from ETO to War Department: "...CCBP 0125 and 0129 in place of combined system 0101 and 0131 believed highly unsatisfactory..."
2. Cryptonet 22 was the European Theater cryptonet.
3. Message from: Hq., Communications Zone, ETO, U.S. Army, Paris, France. To: W.D. NR EX 97498. "For Signal Officer cite SOSSC signed Eisenhower EX 97498. Book message. Make following systems effective at 0001A 13 Feb.: SIGLYIS-20 using SIGDHRD rotors, SIGCLOE-20, SIGTEMP-20. Use day 13 keys as first settings in these systems all ETOUSA systems based on SIGTRIG rotors are to be immediately converted to SIGDHRD. Destroy all editions of systems SIGLYIS, SIGCLOE, and SIGTEMP up to and including edition 19. Inform all holders to retain SIGTRIG pending instructions as to disposal.

CCBP 0311 (SIGMRBY),[1] were reserves for the new worldwide CCBP 0211 rotors. The third rotors to be wired were the new CCBP 0213 rotors, which were to become reserves for the Pacific area CCM system, CCBP 0113.

When on 21 March 1945, the worldwide basic combined rotors, CCBP 0111 (SIGYHUG) were found,[2] the discovery brought about a change in the wiring program. However, it did not institute as great a change as finding the rotors might seem to suggest. The Working Committee of the Combined Codes and Ciphor Committee gave careful consideration to the effect of the recovery of the cryptographic material lost by the 28th Division.[3] First, all members agreed unanimously that the determination of compromise possibilities had to be left to competent authorities in ETO. Therefore, the committee accepted the recommendation made in message E 24223 to consider all the recovered combined material as uncompromised. Having arrived at this agreement, the committee then considered the effect of the recovery on the replacement program. It was agreed that inasmuch as all of the combined systems concerned had been removed and probably destroyed by most holders nothing would be gained by again disrupting the schedule of supersession. Therefore, the arrangements as modified by the recovery of the documents and rotors were as follows:

Worldwide rotors CCBP 0111 (SIGYHUG) were to be replaced by CCBP 0211 (SIGILUT) as scheduled. When CCBP 0111 rotors had been replaced completely,

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1. Navy short title: CSP 2811 (A).
2. See page .
3. All of the information in this paragraph is a paraphrase of "Report of Working Committee concerning Emergency Wiring Program", 31 March 1945; written by Tho. R. Chittenden, Major, S.C., Chairman.

they were to be placed on a reserve status and retained at field issuing offices (for U. S. Army-theater headquarters). By using CCBP 0111 as a reserve set of rotors, the extreme necessity for producing CCBP 0311 (the set to supersede CCBP 0211) was modified. However, the need for a reserve set for CCBP 0113, the Pacific area CCM system, was just as urgent as before. Therefore, it was unanimously concluded that each service should wire CCBP 0213; i.e., the set to supersede CCBP 0113, as soon as possible; and, that upon completion of these rotors, each service would immediately start production of CCBP 0311. Although CCBP 0111s were to be placed on reserve, it was the hope of the committee that they would not have to be called into use again, as this set had suffered from long usage, extremely heavy traffic, a weak indicator system, and a bad contour pattern.

Inasmuch as the suspected compromise had occurred within the U. S. Army, the responsibility for the disruption was keenly felt by the U.S. Army and an offer was made to assist the other four Combined Services in their emergency wiring program. This offer, extended in a memorandum from the Chief Signal Officer to the Secretary, Combined Communications Board, stated, "The United States Army is prepared to wire approximately 8,000 sets of rotors, either the first back-up set for the worldwide system or the back-up sets for such other systems as the Combined Communications Board may decide are of more value; providing the blanks for use by the U. S. Navy and the British Service are furnished the U. S. Army, and the complete plan as outlined above is approved and disseminated to the

interested services within a period of 30 days."[1] This offer, which was accepted, was exclusive of 1535 sets of CCBP 0211 which the U. S. Army wired for the British Services in order that CCBP 0211 could be placed into use by 1 May 1945 in the European theater.

In order to meet their committment to wire 8000 rotors for the British Services and the U. S. Navy, 200 enlisted men were assigned to the 2nd Signal Service Battalion at Arlington Hall Station for a period of 180 days (21 Feb to 19 Aug 1945). During the first 3½ weeks after the compromise all civilian personnel were diverted to the wiring of CCBP 0211 rotors. In these 3½ weeks, completion of the Army 0211 rotors put the rotor wiring section 1200 sets behind in their normal production schedule. By about 1 March the Army requirements for the emergency program were completed and the rotor wiring section (composed of the regular wiring personnel and the temporary detail) were ready to begin on the Army committment to wire 8000 rotors for the other services. At the same time the normal production schedule (total of 8640 during this period)[2] had to be maintained, the backlog of 1200 rotors had to be wired,[2] and the 8000 new rotors on the emergency program had to be wired by the last of August 1945.[2] This schedule, which was met, made a total of 17,840 rotors[2] wired between 21 Feb and 19 Aug.

1. Report on the Colmar Case, p. , filed in Folder, "Colmar Case", WDGAS-83.
2. Memorandum (draft; not used) for General Bissell, "Subject: Extension of Orders", signed W. Preston Corderman, 6 March 1945.

While the emergency wiring program was being carried out, it was necessary to find a way to resume temporary use of the compromised rotors or else to admit almost complete paralysis of combined communications. At a joint Codes and Ciphers Committee meeting held on the morning of 13 February 1945, it was decided that the almost complete paralysis could be reduced to partial paralysis by temporarily using the lost worldwide CCBP 0111 (SIGYHUG) rotors with certain well-defined restrictions. This decision was made before the rotors were found. The restrictions imposed on the use of the SIGYHUG rotors were as follows:

(1) Restrict their use to low echelon or tactical traffic.

(2) Restrict to 100 groups (later changed to 150, see footnote 1 on following page) the amount of traffic in any one rotor setting.

(3) Inform all users that planning type traffic must be passed in SIGABA or Type X when at all possible.

(4) Inform all users that all traffic passed using SIGYHUG was subject to being read cryptanalytically by the enemy.

This agreement was made at the joint Codes and Ciphers Committee meeting in order to present to the British a coordinated plan for retaining emergency Combined Cipher Machine communications in the European Area.

At 2:30 on the same day (13 Feb 1945), an emergency meeting of the Combined Codes and Ciphers Committee was held. At this meeting it was agreed that CCBP 0111 rotors should be placed back into effect with the restrictions[1] outlined in the paragraph above. Of course, the British members could only agree to send a "signal" containing these points and

1. Restrictions agreed upon at the Joint Codes and Ciphers Committee. See (1), (2), (3), (4) above.

recommending their adoption to the British Joint Communications Board in London. Such a message was drafted[1] and the meeting ended at 4:30.

At 5:30 o'clock on the same day (13 Feb 1945) a SIGSALY conference was held between the British and American representatives of the Combined Codes and Ciphers Committee in Washington and the representatives of the British Joint Communications Board in London. During this SIGSALY conference, it was agreed that the CCM should be placed back in general usage in ETO, MED, and Atlantic areas with CCBP 0111 rotors and using CCBP systems 0101, 0131, 0132 and all limited Navy combined systems based on rotors 0111. Special limited Combined system 514[2] was not to be placed back into effect until later because the British in London were not certain of the distribution of edition 4, editions 2 and 3 having been compromised in the lost truck.

Accordingly, at 7:30 on the same day (13 Feb 1945), messages were drafted[3] to inform all holders of the CCM of the decision to reinstate the CCM and certain systems. Before the messages could be sent, however, it was necessary to obtain a definite statement from Col. Bicher in Paris to the effect that CCBP 0101, 0131, and 0132 were not in the truck and had never been issued to the 28th Division. General Stoner had directed that

1. Message to BJCB: After consulting cryptanalysts U.S. suggest following emergency arrangements to meet urgent operational need of SHAEF. Change of indicators after every 150 groups. Forbid use in Pacific Area of systems based on 0111. Make fullest use of alternative channels in 0101, 0131, and BX 824 were held. Urge message of long term information and all operational planning be sent in intra systems where possible. Subject those provisions resume use in ETO MED and Atlantic of 0101, 0131, 0132, all limited combined naval and limited combined Army keylists. Do you agree. U.S. Army stopped using 0131 for intra use 12 Feb.
2. Used between U.S. Army and Air Forces and British Army and RAF.
3. The messages were drafted in Commander Smith's office by Lt. Col. K. Kuhn, Commander Smith, Commander Anderson, and Major T.R. Chittenden.

such a statement be gotten. Therefore, while the messages were being drafted, Colonel Kuhn arranged through the Classified Message Center for a SIGSALY conference with Colonel Bicher. At 9:30 that night (13 Feb 1945) the SIGSALY conference was held with Colonel Bicher and it was definitely determined that CCBP 0101, 0131, and 0132 had never been issued to the division at the time the truck was appropriated. Accordingly, per agreement, the messages were sent to U.S. Army and Navy holders of the CCM.

E. Fixing the Responsibility

Immediately after the loss of the secret cryptographic material[1] at Colmar, two investigations of the responsible personnel were conducted. The first, conducted on 6 and 7 Feb. 1945 (beginning the day after the truck was stolen) by Lt. Col. Herman A. Peterson,[2] IGD, Inspector General, 28th Division, was directed almost wholly toward attempting to gain leads as to possible whereabouts of the truck. The second, conducted on 27 February 1945 by Major General F. B. Prickett, Special Inspector, was also an attempt to establish clues for finding the truck, but was more particularly directed toward establishing the cause of the loss and toward fixing the responsibility. It was desired not only to court martial suspected individuals but to apply remedial action against the recurrence of serious compromise. The two investigations are interesting for different reasons. The first is valuable in establishing the facts of the case since it occurred the day after the loss at a time when the witnesses were still so appalled

1. See pages and for list.
2. Pursuant to VOCG, 6 Feb 1945.

by the incident that they tended to be completely spontaneous[1] and exact in their descriptions. By the time the second investigation occurred on 27 Feb., the witnesses had regained their self consciousness enough to make more frequent use of the phrase "I refuse to answer on the grounds that the answer may tend to incriminate me."[2] The second investigation, although lacking the spontanaeity of the first, was valuable for another reason. It established the facts concerning what rules on safeguarding of SIGABA had been promulgated.

The first investigation (6 and 7 Feb. 1945) by Lt. Col. Peterson took the form of obtaining sworn testimony from each of the persons who had anything at all to do with the truck on the day of its loss. The sworn testimony was given in answer to questions by Lt. Col. Peterson as to what their own actions were in handling the truck and the equipment. The persons interviewed by Lt. Col. Peterson were as follows (the list below gives a brief resume of the role played by each person involved in

1. During the first investigation, Lt. Col. Peterson asked Warrant Officer Moody: "Did it occur to you that the truck was missing? A. "No sir. It never entered my mind to even check the truck. Anything like a truck being missing never occurred to me at all."
2. This difference in the two investigations is most forcibly brought out by Col. Hullett's different answers to the same question. During the first investigation Lt. Col. Peterson asked Col. Hullett "Were you present here in this area when this second section (second section of cryptographic team) arrived? Answer by Col. Hullett: "I was." During the second investigation Major General Prickett asked Col. Hullett: "On the nights of 5-6 February, the Division Command Post was in Colmar. Were you on duty with the Command Post in Colmar?" Answer by Col. Hullett: "I refuse to answer that on the grounds that the answer might tend to incriminate me."

the losing of the truck; for a detailed account of this first investigation see Folder, "Compromise and Loss Cryptomaterial - ETO (Colmar Incident) Investigation", within the named folder see "Investigation of the Loss of Secret Cryptographic Systems by the 28th Signal Company Personnel, 9 Feb. 1945"):

1. Colonel Clarence T. Hullett, Signal Officer of the 28th Infantry Division.
   a. Was in the Colmar area on the night of the loss[1] and
   b. Was the man who had personally received supplementary SIGABA safeguarding instructions from ETOUSA.[2]

2. 1st Lt. Robert Viets - Message Center Officer, 28th Division Signal Company. - Told Sergeant Tetarus (who relayed the information to Pvt. Thompson) to park the truck in the spot from which it was taken.

3. Warrant Officer (JG) Edward K. Moody - Assistant Message Center officer, 28th Signal Company. Ranking officer who came in with the group that brought the truck to Colmar. He reported

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1. Question by Lt. Col. Peterson to Col. Hullett: Were you present here in this area when this section (second section of cryptographic team) arrived: Answer: I was. Q. Was any inquiry made as to where the trucks should be parked? Answer: Major Ballentine, my assistant, was with the advance echelon on this particular move and from the official report, he made every effort to obtain a suitable parking area through the Headquarters Commandant, Colonel Dugan, with little success, due to crowded conditions. I am not in any way blaming Colonel Dugan or Major Ballentine. Q. It seems, it appears that if a suitable place could not have been located, arrangements should have been made to guard the Signal Company vehicles that were left on the street. Do you know whether such arrangements were made? No Signal Company guard was established, however a military police guard and patrol system was known to exist in the immediate vicinity of the Command Post.
2. The ETOUSA instructions were addressed directly to the Division Signal Officer. See Tab T.

arrival to Lt. Viets, and saw where the truck was parked but he neither asked Viets where to park it or interfered with what Thompson did with it.[1]

4. Pvt. Mayron H. Thompson - Truck Driver, 28th Signal Company. - Drove lost truck and parked it in the spot from which it was taken at the direction of Sgt. Tetarus.[2]

5. Tec 3 Frank Tetarus - Message center trick chief, 28th Signal Company. - Told the driver (Thompson) to park the truck in the spot from which it was taken.[3]

6. Tec 4 Keneth A. Hillman - Cryptographic work, 28th Signal Company. - Found the truck missing on 6 Feb. when he went out to repair it. Also found trailer attached to truck.

7. Tec 5 Richard W. Brookins, 28th Signal Company. - Found the truck missing with Hillman on 6 Feb. when he went out to repair it. Also helped Hillman find trailer.

The second investigation, conducted by the special inspector, Major General Prickett, sought chiefly to determine what rules concerning the safety of SIGABA had been promulgated and how familiar each responsible individual was with these rules. (Copies of these rules appear in Tab T.) To arrive at this goal, Major General Prickett interviewed 10 individuals: six who were not interrogated during the first investigation and four who were. The new persons brought in to the second investigation were mainly

1. Question by Lt. Col. Peterson to WOJG Moody: "When you left the truck did you give any special instructions to the driver where you parked it? (SIC) Answer: No, I saw it parked there on the corner in front of the billets and it looked as good as any I could find, so I did not tell him anything."
2. Question by Lt. Col. Peterson to Pvt. Thompson: Were you given any instructions on where you were to park the vehicle? A. I hollered and asked one of the sergeants where to park the truck. He said, "Pull it up a little bit further along the curb." (The sergeant was later identified as Tetarus.)
3. Ibid.

the Division's high ranking officers who were not directly concerned with the loss of the truck but who were investigated because of the responsibility they bore by virtue of their positions.

The 10 persons interviewed by Major General Prickett were as follows:

1. Commanding General, 28th Infantry Division - Major General Norman D. Cota.
2. Chief of Staff, 28th Infantry Division - Colonel Jessee L. Gibney.
3. Assistant Chief of Staff, G-2, Headquarters, 28th Infantry Division - Lt. Col. Harry S. Messec
4. Division Signal Officer, 28th Infantry Division - Lt. Colonel Clarence T. Hullett.
5. Assistant Division Signal Officer, 28th Infantry Division - Major W. E. Ballentine.
6. Commanding Officer, 28th Signal Company. - Captain Ray C. Layman.
7. Message Center Officer and Cryptographic Security Officer, 28th Signal Company - 1st Lieutenant Robert E. Viets.
8. Assistant Message Center Officer, 28th Signal Company, - Warrant Officer JG Edward K. Moody.
9. Message Center Trick Chief, 28th Signal Company - Sergeant Frank W. Tetarus
10. Chief Clerk, 28th Signal Company - Spier D. Williams.

The pertinent statements of policy on physical safeguarding are contained in the following documents:

1. Paragraphs 30b, d, and e, 43 and 44a of AR 380-5, War Department, 15 March 1944. See Tab T for photostatic copy.

2. Letter, Subject: "Protection of Cryptographic Equipment during Transit in all Phases of Operation", To: Signal Communication and Signal Security Officers;[1] signed for the Chief Signal Officer by George A. Bicher, Col., S. C., 14 March 1944. See Tab T for photostatic copy.

3. Letter, Subject: "Code Room Physical Security in all Phases of Operation", To: Signal Communication and Signal Security Officer;[2] signed for the Chief Signal Officer by George A. Bicher, Col., S. C., 15 June 1944. See Tab T for photostatic copy.

4. Letter, Subject: "Security of SIGABA", To: Signal Security Officer, signed for the Chief Signal Officer: George A. Bicher, Colonel S. C., 6 July 1944. See Tab T for photostatic copy.

The following are the answers which the ten persons interviewed during the second investigation gave to the questions concerning their familiarity with these safeguarding rules (Tab T):

1. Major General Norman D. Dota, Commanding General, 28th Infantry Division. - Cota stated "I am familiar with AR 380-5, but evidently these instructions from ETOUSA were sent direct to the Signal Officer as I am not familiar with them."

2. Colonel Jesse L. Gibney, Chief of Staff, 28th Infantry Division. - Question by Prickett to Gibney: "Are you familiar with the provisions of AR 380-5 which states that cryptomaterial will be given the most secure storage available? Answer: I have read the regulation which you refer to. Question: I show you instructions issued by the Signal Officer, ETOUSA, addressed to the Signal Officer of the division on the general subject: Protection of Cryptographic Equipment. Had you seen these instructions? Answer: I had not. Question: You were not familiar with the provisions of these instructions which required placing of guards armed with automatic weapons over this equipment 24 hours a day. Answer: I am not.

1. Down to and including Division Headquarters in Army Ground Forces; Wing Headquarters in Army Air Forces; Ports and Depots in Services of Supply.
2. Ibid.

3. Lt. Colonel Harry S. Messec, Assistant Chief of Staff, G-2, Headquarters, 28th Infantry Division. - Question: Are you familiar with the provisions of AR 380-5, paragraph 44 which states that cryptographic material will be given the most secure storage available? Answer: Yes sir, I am. Question: I show you various instructions issued by CSO, ETOUSA, with regard to protection of cryptographic equipment and subsequently call your attention to one paragraph which states that guards armed with automatic weapons will be placed at the code room entrance of the vehicle 24 hours a day. Have you seen these instructions? Answer: To my knowledge, sir, I have not seen either the letter dated 14 Mar 44 nor the letter dated 6 July 1944. This letter dated 15 June I have seen only since the loss of the vehicle and the equipment. I did not see it before to my knowledge now. In each case all these letters are addressed to the Signal Officer or the Signal Security Officer.

4. Lt. Colonel Clarence T. Hullett, Division Signal Officer, 28th Infantry Division: - Question: I hand you AR 380-5, WD entitled "Safeguarding Military Information"....Are you familiar with the provisions of that regulation with respect to safeguarding cryptographic equipment? Answer: I am. Question: I hand you communications issued by the Office of the Chief Signal Officer, ETO, general subject: "Protection of Cryptographic Equipment" Were you familiar with the provisions of those communications on Feb. 5, 1945? Answer: At the present time, I refuse to answer on the ground that the answer may tend to incriminate me. I would have to read it all through first.

5. Major W. E. Ballentine, Assistant Division Signal Officer, 28th Infantry Division. - Question: I hand you some communications issued by the office of the Chief Signal Officer, ETO, on the general subject of security of cryptographic equipment. (Communications were handed to witness.) Have you seen copies of those communications? Answer: I have but not in the 28th Division. Question: Do you know whether copies of these communications were in the hands of the Division Signal Officer? Answer: That, I cannot say because so much of the records were burned prior to my arrival at Division. Question: When did you join the Division? Jan. 8, 1945...

6. Captain Ray C. Layman, Commanding Officer, 28th Signal Company. - Question: Do you have any specific duties with reference to safeguarding cryptographic equipment? Answer: No sir. Question: The personnel assigned to the message center are a part of your company. Answer: Yes sir. Question: I hand

you some communications (interrogator handed communications to the witness) issued by the Office of the CSO, ETO, on the general subject of security of cryptographic equipment. Have you ever seen copies of those communications before? Answer: I don't recall ever seeing these, Sir. I believe they did go directly to the Division message center officer. Question: Do you have any personal knowledge on which you base that statement. Answer: Well, sir, at the particular time these letters were issued I was not company commander, therefore, I was in no way connected with the receipt of these documents or in no way connected with the message center. Question: When did you become company commander of the 28th Signal Company? Answer: 29 September 1944. Question: Then you have never seen copies of these communications? Answer: No sir.

7. First Lieutenant Robert E. Viets, Message Center Officer and Cryptographic Security Officer, 28th Signal Company. Question: I hand you AR 380-5 and ask you if you were familiar on 5 Feb 1945 with par. 44a. Answer: Yes sir, I was familiar with that. Question: I hand you communications issued by the Office of the Chief Signal Officer, ETOUSA, subject: Protection of Cryptographic Equipment. Were you on 5 Feb. 1945 familiar with the contents of these communications? Answer: To my knowledge, sir, I have not seen the letter, "Security of SIGABA" dated 6 July 1944. Question: But you are familiar with all the rest of them? Answer: With the other two, yes.

8. Warrant Officer JG Edward K. Moody, Assistant Message Center Officer, 28th Signal Company. - Question: I hand you AR 380-5, WD, and call your attentiontto par. 44a. On 5 Feb. 1945 were you familiar with that particular paragraph? Answer: I believe I was, but later I checked up on it to refresh my memory on it. Question: I hand you letters from the CSO, ETOUSA, subject: Protection of Cryptographic Equipment. On 5 Feb were you familiar with the contents of these communications? Answer: I was reasonably familiar with them. I have seen them in the Signal Office at one time or another.

9. Sergeant Frank Tetarus, Message Center Trick Chief, 28th Signal Company. Question: Were you charged with any responsibility for storing or safeguarding the secret material. Answer: Yes sir. Question: Have any instructions been given you by Lt. Viets as to the necessity for safeguarding this cryptographic material? Answer: Well, sir, they were not formal. We were required to read AR 380-5 which states the rules of safety.

10. Tec Sergeant Spier D. Williams, Chief Clerk, 28th Signal Co. - Stated that the documents for message center usually came through his desk. He receipted for them, routed them to their proper destination, but did not necessarily look at them. He did not remember the pertinent letters but it was not likely that he would.

The especially pertinent statements of policy on physical safeguarding from AR 380-5 and CSO, ETOUSA letters are as follows: (For the complete policy from AR 380-5 and the complete ETOUSA letters, see Tab T.)

From AR 380-5: (See also Tab T.)

Par. 44. Precautions necessary to insure cryptographic security. - In order to insure cryptographic security the following principles must be observed:

a. Cryptographic material will be given the most secure storage available and will never be left unattended except when deposited in a three-combination safe or its equivalent.

From Letter dated 14 March 1944: (See also Tab T.)

...Cryptographic material and associated equipment is always highly vulnerable to capture by the enemy or compromise during transit irrespective of geographic locations. All responsible personnel operating in a static position must be constantly alert to protect cryptographic equipment from capture by the enemy and loss through careless handling...

Section B. Mobile Operation[1]

(2) In the event of a convoy move to a new headquarters, the code room vehicle should be located toward the front of the convoy to insure immediate cryptographic communications for the forward command post.

(3) Armed cryptographic personnel should occupy the vehicle immediately following the code room van or truck.

(4) Armed guards will protect the immediate area surrounding the mobile code room during temporary and overnight convoy halt.

E. Echelon Operations

(2) The safest and most expeditious means of transportation available will be employed in moving the SIGABA.

1. This paragraph does not cover the exact situation of the Colmar case because the truck was not being used as a mobile code room. However, the type of protection desired is evident.

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From Letter dated 6 July 1944: (For the complete letter, see Tab T.)

> ...8. The Signal Security Officer will be responsible for all security matters connected with this apparatus. He shall be familiar with the correct method of operating the equipment as outlined in the published instructions, and shall enforce the provisions of these documents as well as those of AR 380-5.

The officers whose positions vested them with the greatest responsibility for the Colmar incident were the Division Signal Officer (Colonel Hullett) and the Cryptographic Security Officer (Lt. Viets). Both testified that they considered they were complying with AR 380-5 by having the equipment locked in a 3-combination safe (Tab T for AR 380-5 rule) in spite of additional instructions issued by the Signal Officer, ETOUSA (Tab T). Although the lost cryptographic equipment was locked in a 3-combination safe, it was left unguarded in a mobile truck parked on a street of a city recently captured from the enemy.

The conclusions drawn in Lt. Colonel Peterson's report of the first investigation were as follows:

> ...V. Conclusions
>
> 14. That the security provided for cryptographic material of the 28th Signal Company was inadequate and not in compliance with the intent of Army Regulations 380-5 and provisions of secret letter instructions published by higher headquarters.
>
> 15. That Lt. Colonel Clarence Hullett, 28th Division Signal Officer, failed to fulfill his duties as Division Signal Officer by allowing a condition of negligence to exist in the 28th Signal Company which resulted in the loss of highly secret devices and documents. That no standing operating procedure had been prescribed which provided for the maximum security of this material at all times. The compromise of this secret data by enemy forces will result in grave damage to the secret communication system of the U. S. Army.

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16. That Lt. Robert Viets as cryptographic security officer, having full knowledge of the importance for security of cryptographic material, failed to exercise even ordinary security measures consistent with the known importance of the secret devices and codes.

The conclusions drawn in Major General Prickett's report of the second investigation were as follows:

...IV. CONCLUSIONS.

13. It is concluded that:

a. The security measures provided for cryptographic equipment of the 28th Infantry Division were totally inadequate and did not comply with the provisions of AR 380-5 and instructions issued by the Signal Officer, ETOUSA.

b. The lack of inspections, guards for vehicles, and specific instructions for security measures reflect unfavorably on the efficiency of the 28th Infantry Division.

c. Colonel Jesse L. Gibney, GSC, O-12216, Chief of Staff, G-2, 28th Infantry Division, failed to perform his duties as Chief of Staff.

d. Lt. Colonel Harry S. Messec, GSC, Assistant Chief of Staff, G-2, 28th Infantry Division, failed to perform his duties as G-2.

e. Lt. Colonel Clarence T. Hullett, 015088, 28th Division Signal Officer, 1st Lieut. Robert E. Viets, 01638724, 28th Division Cryptographic Security Officer, WOJG Edward K. Moody, W 2127012, Assistant Message Center Officer, 28th Signal Company, and T/3 Frank S. Tetarus, 36607814, Cryptographic Technician, 28th Signal Company, are guilty of gross neglect of duty.

f. The practice of the Chief Signal Officer, ETOUSA, in sending security instructions direct to Division Signal Officers and Division Security Officers is unsound from a command viewpoint.

g. Proper measures were and are being taken to recover the lost cryptographic equipment.

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The record of trial on Colonel Hullett[1] indicated that he was sentenced to dismissal, as confirmed by CG, ETO. On 6 November 1945 sentence was suspended during good behavior by action of Secretary of War Patterson. If offense under AWs should be committed subsequent to 6 November Hullett would be subject to punishment for second offense plus dismissal on original charges. No record in this agency is available on the trial of Viets, Moody, or Tetarus.

1. This information is contained in a note by Mark Rhoads on inside cover of Folder "Compromise and Loss Cryptomaterial-ETO (Colmar Incident) Investigation".

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CHAPTER XVII. MAINTENANCE OF CONVERTER M-134-C

A. General

Maintenance of large electro-mechanical converters in the field was a completely new problem in World War II. When the war began in December 1941, the Army had only about 100[1] converters in contrast to the 3030 which it would procure during the next two or more years. Therefore, placing contracts for the needed converters, prodding Teletype Corporation into bettering its delivery schedule, and distributing them to the users were the main problems that absorbed the attention of SIS.[2] What to do about fixing the converters when they broke down was a sadly neglected problem as far as advanced planning was concerned. The first maintenance school for SIGABA was held in March 1942, which date may not seem very belated since the U. S. had been in the war only about four months and the main quantity of SIGABAs had not yet been ordered. (See Chart, page .) But it was so late that the plans made and carried out by the War Department, for maintenance of converters never caught up to the need and SIGABA maintenance became a problem chiefly solved by ingenious emergency expediency in the overseas theaters.

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1. Information concerning the fact that SIS had received about 100 converters when the war started was remembered by Mr. Kenneth Kuhn, Chief, Maintenance Branch. A careful examination of the procurement figures (pages and , also Chart) reveals that the figure could not have been much less than 80 nor much more than 150.
2. Later expanded to ASA; see Chart, page .

B. Maintenance Training

During 1941 and early 1942 the attitude which prevailed in SIS[1] was that personnel trained in teletype maintenance could perform SIGABA maintenance by experimenting on their own with repairing SIGABAs. All SIGABA maintenance was performed by the personnel of SIS,[1] who, in accordance with prevailing mood, had acquired their experience catch-as-catch can. This attitude toward the maintenance problem is well summarized by the following letter (from OCSigO, WD to the Signal Officer, 2nd Army) written in July 1941:

> 1. The setting up of a special course of instruction on the maintenance of Converter Type M-134-C is believed to be impracticable at the present time for the following reasons.
>
> a. Of 322 converters now on order, only 10 have thus far been accepted despite the vital need for this device among various tactical organizations. Upon receipt of additional converters from the manufacturer it is intended to make them immediately available to using organizations and, consequently, converters for use in maintenance courses will be unavailable.
>
> b. Because of the similarity in some respects of the Converter M-134-C to standard Teletype instruments, it is believed that personnel who have been trained for Teletype maintenance can, with a little additional experience, provide the necessary field maintenance of converters.
>
> c. The storage and issue of Converters M-134-C is a responsibility of the SIS of this office and it is contemplated that all major repairs or unit replacements will be effected by the Signal Intelligence Service. While making such repairs serviceable converters will be exchanged for the unserviceable converters in the hands of the tactical organizations.

In March 1942, the first maintenance school was organized. Classes were held in the evenings in the Munitions Building, where the SIS[1] offices were then located. This first maintenance school for SIS personnel

1. Later expanded to ASA; see Chart, page .

only was all that existed in maintenance training until early 1943 when SIS[1] moved to its permanent location at Arlington Hall Station. The texts used in the first school were the manufacturer's texts. While the first school was being conducted at the Munitions Building, the first War Department maintenance instructions, namely, "Operating and Maintenance Instructions for Converter M-134-C (short title: SIGKKK), 1 Sept. 1942, were published.

In early 1943 the Maintenance School underwent a much-needed expansion. Letters were sent out to all holders of SIGABA inviting units to sent personnel to Washington for training in SIGABA maintenance. Signal Corps Inspectors at manufacturer's plant who had no training, but were inspecting the equipment, were brought to Arlington Hall Station and given the maintenance course. This training of inspectors resulted in their performing a much better job of accepting or rejecting the manufacturer's product. Under the new training program, the school expanded to the point that it overreached the capacity of Arlington Hall and was moved to Vint Hill Farms Station at Warrenton, Virginia in . The maintenance school was conducted at Vint Hill from until 1 May 1949, when it was moved to Carlyle Barracks, Pennsylvania. Direct technical liaison is authorized between Maintenance Branch at Arlington Hall and the Maintenance School at Vint Hill.

During the entire war SPSIC (later SPSIS) letters were periodically published and distributed to all holders of SIGABA, inviting units to send men to Washington for training in SIGABA maintenance. The length of the training period and the prerequisites for the trainees, in general increased as follows:

1. Later expanded to ASA; see Chart, page .

LETTER	LENGTH OF TRAINING PERIOD	PREREQUISITES FOR TRAINEES
1. Subject: "Trained Personnel for Maintenance of Converter M-134-C," 6 May 1943.	30 days[1]	(1) Men with previous teletype maintenance training. (2) Men familiar with circuit work and small tools. (3) Men who have used small tools, such as teletypewriter repairmen.
2. Subject: Same, 12 June 1943	35 days[1]	(1) Same as (1) above. (2) Men familiar with circuit work and small tools, such as telephone repairmen or installers. (3) Same as (3) above.
3. Subject: Same, 10 Dec. 1943	45 days[1]	(1) Same as (1) above. (2) Same as (2) above. (3) Men who have used small tools, such as typewriter repairmen, with a basic knowledge of electrical circuits.
4. Subject: Same, 5 Feb. 1944	55 days[1]	Personnel selected for this training must be qualified to perform the duties of teletypewriter mechanic (SSN-239).
5. Subject: Same, 6 June 1944	70 days[1]	Same as above.
6. Subject: Same, 15 Dec. 1944	8 weeks[1]	Much expanded statement of prerequisites: See Tab V.

(Continued on following page.)

1. This chart indicates that the time required to complete the maintenance course was, in general, increased. The reason for lengthening the training period was partly to better the SIGABA maintenance skills but was mainly so that the scope of the maintenance course could be increased to include Converter M-325 (short title: SIGFOY), Converter M-209, and Converter M/X 783/U (short title: SIGROD).

LETTER	LENGTH OF TRAINING PERIOD	PREREQUISITES FOR TRAINEES
7. Subject: Same, 26 May 1945	9 weeks[1]	See Tab V.
8. Paragraphs 28-31 of "General Instructions for Converter M-134-C" (short title: SIGBRE-1), June 1945.	Approxi-[1] mately 8 weeks	See Tab V.
9. Subject: "Trained Personnel for Maintenance of Converter M-134-C," 2 April 1946	8 weeks[1]	See Tab V.
10. Subject: Training of Personnel for Maintenance of Electro-mechanical Cryptographic Equipment, 9 Sept. 1948.	10 weeks[1]	See Tab V.

1. See footnote 1, previous page.

In reading about the SIGABA maintenance school (see above), one is impressed with the fact that the training of SIGABA repairmen was making steady progress. The school grew so large that it overreached the capacity of Arlington Hall; the length of the training period was, in general, gradually increased;[1] the prerequisites were made more stringent. But this is only one side of the picture. The other side is that while the maintenance school was expanding, the war was in progress and several hundred SIGABAs were already overseas. The first invitation to using units to send in men for training as repairmen was issued on 6 May 1943 at which time the North African invasion was just about over.

The effectiveness of the war-time maintenance school suffered from more than just the fact that it was behind schedule in the early war years. For after the school began to turn out trained repairmen in time to go overseas with some of the new SIGABAs,[2] many of the men did not arrive overseas in the capacity of cryptographic repairmen after all. The reason was that cryptographic repairmen did not appear on any of the Army's Tables of Organization and Equipment until 22 September 1944, when fixed and mobile cryptographic equipment repair teams[3] appeared on the

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1. See footnote 1, page .
2. The last and largest order was for 1165 SIGABAs, not placed until 23 Nov. 43 and not completed until 1 Oct. 45.
3. IL. - Mobile cryptographic equipment repair team. - Provides the required personnel, tools and spare parts for routine maintenance inspection and second and third echelon repair of electrical and mechanical cryptographic devices. This team is capable of maintaining all mechanical and electrical cryptographic equipment authorized for service of tactical organizations.
IM. - Fixed cryptographic equipment repair team. - Provides the required personnel, tools, and spare parts for maintenance and third echelon repair of all types of mechanical and electrical cryptographic devices. This team is intended to be used in rear areas of the theater to maintain cryptographic machines used in enciphering communicatinns for the theater headquarters and to augment the mobile cryptographic repair teams in repair of damaged equipment.

T/O & E of the Army's Signal Service Organization (T/O & E 11-500). Since there was no formal place for them on the T/O & E, there was no authority for preventing them from being transferred to other duties and just such unwise and unpreventable transfers many times occurred. Even though cryptographic repair teams appeared on T/O & E 11-500 on 22 Sept. 44, most units still do not carry cryptographic repairmen on their T/O & Es.

The fact that planning and training for repair of cryptographic equipment was far behind the need does not imply as much lack of foresight as at first it might purport. When the war began in December 1941, SIGABAs were being procured at a slow and leisurely rate. Only about 100[1] had been received and only 327 had even been ordered. It was natural that no extensive plans were made for repair of such a few converters. That a maintenance school was begun four months later is rapid accomplishment judged from the point of view of effort put to an emergency task but judged by results, it was too late.

C. Reports from Overseas Theaters on SIGABA Maintenance

ASA in the European, Mediterranean, and Pacific Theaters trained most of their own repairmen during the war. During the early months of the war, SIGADA repair in the overseas theaters was carried on by a few. Later the few repairmen available trained others.

1. See footnote 1, page .

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The way in which 849th Signal Intelligence Service (Mediterranean Theater) met the problems posed by SIGABA maintenance is well summarized by the following excerpt from the History of 849th Signal Intelligence Service:

From History of 849th SIS, p. 127:

> ...6. It was a fortunate coincidence that one of the enlisted men[1] from the Western Task Force who was assigned to the 849th was an excellent SIGABA repairman as well as a first rate all-round mechanic, since none of the EM originally assigned to the organization had ever seen the machine. For several months this man spent most of his time making on-the-spot repairs all over the theater, since what few machines there were could never be spared long enough to send them in to headquarters for overhauling. Between trips he managed to train two other men on the machine, after which a school was established in which additional men of this and other organizations were trained. Some months later SSA expressed grave doubts as to the practicability of attempting to train maintenance men under "combat conditions" and suggested that they be requisitioned (a process which experience shows requires an average time of approximately six months). Eventually enough SIGABAs reached the theater to make it possible to dispatch new or econditioned machines to units in trouble and pick up the old ones for thorough overhauling. However, by this time so many capable repairmen had been trained that such exchanges were very seldom necessary, and the principle function of the SIGABA repairmen continued to be that of training maintenance men, which they are still doing (1945) at the rate of about ten a month.

The difficulties encountered because of lack of equipment and trained repairmen in the China-Burma-India Theater is told in an excerpt from a field report:[2]

1. This man was one of the first graduates of the Maintenance School at Arlington Hall Station. The excerpt quoted here shows the need for the thorough training which the A.H.S. school provided.
2. Field Report on SIGABA, To: Chief, Signal Officer, From: Adam E. Dogan, 1st Lt., SC., Unit leader, S.C. Supply Survey Theater Unit, 3 Jan. 1944.

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...11. SIGABA machines have been maintained by one to three maintenance men for about 18 months in the entire CBI Theater. Four SIGABA maintenance men arrived one month ago. Three maintenance men arrived without tool kits to work on SIGABA machines. There are not enough tools available to equip these SIGABA maintenance men or the additional men who have been requisitioned from the U. S. Tools have been requisitioned for these men.

A detailed report of the SIGABA maintenance problems met by 849th Signal Intelligence Service is presented in the following excerpt from a History of Cipher Machine Maintenance Section:[1]

History of Cipher Machine Maintenance Section (Part II) of 849th SIS.

SIGABA

...1. GENERAL. Early in 1943 the Cipher Machine Maintenance Section inaugurated a school for the training of SIGABA maintenance personnel in the North African Theater. Newly trained personnel first served as the instructors for a ten day course, which has been repeated approximately every two weeks to the present date. During this period 7 officers and 193 enlisted men of both the Army and Navy were trained. The following paragraphs discuss the activities of the SIGABA personnel of the Cipher Machine Maintenance Section, and tell of the problems encountered.

...2. SIGABA MAINTENANCE COURSE. The program of the school is a condensed version of the course in SIGABA maintenance, offered by the Second Signal Service Regiment, Washington, D. C. New students are first processed and thoroughly checked for cryptographic clearance. The schedule of the ten day course provides three days for circuits, three days for mechanical adjustments and lubrication, and four days for troubles. The explanation in document SIGKKK-1 is followed in studying circuits. The student is shown how to follow the diagram in all positions of the control switches. All hit-or-miss methods in finding troubles are discouraged, and the apt pupil readily sees the value of a systematic use of the ohmeter in localizing the trouble to a definite portion of the complex wiring, the switches, or the mechanically activated contacts. Next the student is shown

1. This report was written by Theodore O. Metcalf, Capt., Signal Corps Cipher Machine Section, 849th SIS. His complete report (an excerpt of which is given here) is incorporated in the History of 849th SIS.

how to dismantle the entire machine, which is studied in sections in order to avoid confusion. He is taught to reassemble and adjust the unit, memorizing the measurements and critical spring tensions. An explanation of the proper way to clean, oil, and grease the machine is given at this time. The student is shown worn parts which have had to be replaced because of improper care of the unit. Tandem operation and operation with batteries are explained. Every difficulty that the instructor has experienced in field maintenance is brought to the students attention. Following this, a machine is assigned to each student, and a series of thirty-five troubles, one at a time, are placed on the unit. After the electrical or mechanical maladjustment is placed on the unit, the student is recalled into the room and timed until he has located and repaired the trouble. A record of this kind assists the instructor to observe the student's technique, although particular emphasis is placed on thoroughness rather than on speed.

...3. (a) ADDITIONAL ACTIVITIES OF THE SECTION. As a number of SIGABAs and the maintenance troubles arising therefrom increased, the need for a central agency for the supply of spare parts was soon recognized. This section assumed the responsibility of filling orders in the field, and in turn ordered parts for its supply from Washington.

(b) Adequate tools and equipment are not available in the field for the repair of SIGABA motors. Faulty motors are forwarded to this section for repair where they are exchanged for new or rebuilt motors, thereby eliminating any long delay at the operating unit.

...4. (a) MAIN DIFFICULTIES ENCOUNTERED. The most serious operational failures encountered in this theater are caused by faulty power supply. Voltage changes are frequent throughout the day and night. Voltage drop retards the make and break of a moving contact, inducing sparking, and thereby causing the part to become worn and pitted. The effect of faulty power supply on cipher machines and teletype units was observed early in the North African campaign, and many holders were influenced to use only power from army power units. These holders have experienced a minimum of failures due to electrical break-downs. Other holders using power generated locally have had considerable difficulty. The answer to this problem is not in the small power units of the individual machine, since these units will not stand up under constant operation. The better solution has proved to be the provision of large power units for continual operation with sufficient output to provide for the entire needs of a message center and code room.

(b) Additional difficulty was once encountered in keeping the machines clean due to the impalpable character of the dust in North Africa. This situation was improved materially when the CH-76 became available for issue to all holders.

(c) Numerous complaints were received that SIGABAs were causing interference with radio reception. To meet this obstacle a spark suppressor unit was developed and distributed to some of the holders. A detailed description and drawing of the unit was submitted to Washington for approval only to find that a similar unit had been devised there and had become available for distribution.

...5. CONCLUSION. It is the opinion of this section that the SIGABA is a most practical and efficient cipher device. Simplicity of operation, facility of maintenance, and its suitability to field conditions have made it invaluable in signal communications. Small mechanical refinements such as automatic ribbon reverses, hinged cover-lids, and copy holders would be welcome improvements from the operator's standpoint.

D. Replacement and Redesign of Parts

Another repair problem was obtaining necessary replacement parts. From 1942-45, procurement of replacement parts from the manufacturer was extremely difficult. Therefore, parts which wore out with little use constituted a desperate problem. Excessive trouble with any of the parts of the converters instigated work on redesign to eliminate the defects. This research on perfecting design of parts, on which defective reports had been received, became one of the chief functions of Maintenance Branch, Arlington Hall Station, during the war. Untold man hours of trial and error and testing were spent in order to perfect by redesign any parts reported as giving excess trouble. In order not to delay production of redesigned parts, Maintenance Branch, Arlington Hall, found it necessary

to assign an officer[1] to the manufacturer's plant from March 1943 to January 1946 for the purpose of answering the manufacturer's technical questions immediately.

During the African invasion, excessive trouble was encountered with the clutch-trip magnet contacts and replacement parts could not be obtained. Finally, in October 1943 the clutch-trip circuit and assembly was completely redesigned,[1] thereby eliminating the trouble. All converters delivered by the manufacturer after 1 January 1944 were equipped with this design change.[2]

During the war many suggestions and recommendations were received at Army Security Agency for an automatic ribbon reverse mechanism. It was impossible then to place emphasis on such a development. However, in early 1947, design of an automatic ribbon-reverse mechanism was begun and in January 1948, procurement was initiated. They were received in July 1948 and made available for field installation.

Listed below are the major design changes made by the manufacturer on the new SIGABAs coming off the assembly line after field use of the earlier machines had proved the changes desirable:

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1. Verbal information from Mr. K. Kuhn, Chief, Maintenance Branch, May 1949.
2. Change No. 1 to "Operating and Maintenance Instructions for Converter M-134-C" (short title: SIGKKK-1), 15 Nov. 1943, p. 2.

NOTE: The quantity figure in the right hand column is the number of units built which did not include the change. It is probable that a percentage of these units were subsequently modified in the field.

108778	Right hand main shaft bearing (Replaced 100271 bearing to permit easier removal of main shaft)	2,225
108787	Left hand main shaft bearing (Replaced 100577 bearing to permit ball bearing distortion)	Approx. 500
108319	Axial wick for main shaft (Added for improved lubrication)	1,821
100162	Typewheel shaft gear hub (Key added to prevent slippage)	2,569
108684	Typewheel shaft and hub (Replaced 100069 shaft and hub after the first 1,417 units, but hardened steel hubs not in effect until after 1,708)	1,708
108680	Typewheel shaft friction disc (Replaced 100086 disc. 108680 has two large flats. 100086 had small key.	1,417
100970 100971 100972	Typewheel friction clutch (These parts replaced the leaf type typewheel friction clutch parts 100088, 100089 and 76086.)	Approx. 100
108694 108695 108696	Reset lever (Replaced 100525) Trip lever (Replaced 100279) Non-repeat latch (Replaced 100262) (The above parts provided increased margin for the non-repeat mechanism)	Approx. 1,500
108681	Hold-down for motor plug (Added to prevent bounce-out of the plug.)	Approx. 1,300
100991	Insulator (Added under stepping magnets to prevent shorting of terminals)	Approx. 300
108776	Shield for clutch magnet (Added to prevent damage to magnet lead wires.)	2,467

100121	Print hammer insert (Top of insert widened to provide better printing.)	1,850
100236	Detent lever for rotor (Oil hole added)	1,367
108777	Receptacle (Added to left side of cover for booklet storage.)	2,075
100212	Clutch throwout lever (This part modified several times. 2360 represents the figure for units not having the final design.)	2,360
108310 108309	Stainless steel stepping mag. arm pivot Magnet bracket (Replaced 100266) (The original pivot, 100297, was replaced in all units after 370, but the final design of 108310 was not in units until after 2,823. In between, several different materials were tried. #108311 nut and 110743 lock washer are used to mount each 108310 pivot. The 108309 brackets will take all types of 108310 pivot.)	2,823 370
100100	Over centering arm for ribbon feed. Riveted design changed to an assembly consisting of #108873 arm and #108874 hardened, replaceable post.	Approx. 3,000
100117	Tape chute assembly (Reinforcing bands added to supplement spot welding.)	Approx. 3,000
108818	Tape chute assembly (This design, in which the reinforcing bands were integral, was released just as production of units stopped.)	No units had this
108817	Switch bracket and switch assembly (This design, which replaced the 100316 bracket and 91755 switch, was also released just as production of units stopped.)	No units had this

108967	Retaining ring for stop pins (This ring, which replaced 100081, had welded posts for the ribbon guide to provide more thread for the ribbon guide mtg. screws. The change was released just as unit production stopped.)	No units had this
100595	Controller switch casting and bearings (Because of wear of the top bearing, and seizure of the lower, the 100332 top plate was replaced with 108965 plate having an oilite bushing, and the lower bronze bushing 88178 was replaced with 108966 oilite bushing. These changes can be made in the field if proper facilities are available, or new style 100595 assemblies can be used to replace the old style.)	No units had this
	Clutch magnet contact assembly (The #108280 "let close" design replaced the original #100270 "push close" design and our records indicate that replacement of all 100270 assemblies was made. Later, a two-spring "let close" assembly, #108712, having riveted and hard-soldered contact points was released. Because of the complexity of the sequence of these changes, no accurate estimate of the number of units involved can be made. However, the replacement of the original #100270 assembly by the #108280 should provide satisfactory operation.	

E. Official War Department Maintenance Documents

Through the years, two types of written official maintenance instructions were provided by the War Department. One type was the detailed document for guidance of the skilled maintenance man. The other type consisted of certain pages in the operating or keying instructions which instructed the operator in making minor repairs and in care of the converter.

The detailed maintenance manuals for the skilled operator were as follows:

1. "Operating and Maintenance Instructions for Converter M-134-C" (short title: SIGKKK), 1 Sept. 1942.

2. "Operating and Maintenance Instructions for Converter M-134-C" (short title: SIGKKK-1), 15 Nov. 1943.

3. "Operating and Maintenance Instructions for Converter M-134-C" (short title: SIGKKK-2), June 1945.

"Preventive maintenance" instructions for the operator appeared in the earliest official document on the use of SIGABA, namely "Operating Instructions for Converter M-134-C (short title: SIGBWJ), Oct. 1941. This document told the operators that "only repairs of a very minor nature should be attempted in the field". It also instructed them to send all damaged parts to the Chief Signal Officer for replacement and in case of "serious damage, major repairs or faulty operation" to notify the Chief Signal Officer and await instructions. According to SIGBWJ the repairs which the operator could perform without difficulty were as follows: replacing the printer wheel, rewiring a burned out rotor, changing a fuse, replacing a burned out capacitor or resistor, and changing the motor. Included were brief instructions on how to accomplish these minor repairs and a page and a half of instructions on how to lubricate the converter. These first instructions stated that the converter should be lubricated once a month. From July 1941 until September 1942, when SIGKKK was published, these SIGBWJ instructions on minor repair and lubrication were all that existed concerning maintenance. It is interesting that

although SIGBWJ provides detailed instruction of lubrication, NOT ONE WORD WAS WRITTEN CONCERNING THE OPERATOR'S CLEANING THE CONVERTER.

When detailed maintenance instructions in the form of SIGKKK[1] appeared in Sept. 1942, this new document superseded SIGBWJ. SIGKKK did not give simple preventive maintenance instructions for the operator as SIGBWJ had done. Therefore, from Sept. 1942 until June 1945, when "Operating Instructions for Converter M-134-C" (short title: SIGQZF-2) was published, no instructions on preventive maintenance were provided for the operator. SIGQZF-2 contained three pages of information "Maintenance Responsibilities of the Operator," which not only instructed the operator on lubrication (as did SIGBWJ) but included a detailed description (neglected in SIGBWJ) on how to clean the converter.

No definite schedule for lubrication was provided in SIGQZF-2. This was in contrast to the prescription in the superseded SIG3WJ for lubrication once a month. The new policy on lubrication schedule stated in SIGQZF-2 was as follows: "No definite schedule of lubrication can be provided. The frequency of lubrication periods will depend on dust, humidity, and temperature conditions as well as volume of traffic..." When the next edition of SIGQZF (SIGQZF-3)[2] was published on 1 Nov. 1946, it contained approximately the same cleaning and lubrication instructions

1. "Operating and Maintenance Instructions for Converter M-134-C" (short title: SIGKKK), 1 Sept. 1942.
2. "Crypto-Operating Instructions for Converter M-134-C" (short title: SIGQZF-3), 1 Nov. 1946.

for the operator as did SIGQZF-2. Instructions for the operator on minor repair were included in neither SIGQZF-2 or SIGQZF-3.

In Aug. 1946, an AG letter was published which outlined the "Policy on Maintenance of Cryptographic Equipment".[1] (See Tab F.) This policy prescribed that maintenance would be performed under the "Five Echelon System". (For explanation of the "Five Echelon System, see Tab F.) Changes in the "Five Echelon System" were published in a new special regulation which superseded the AG letter (Tab F) on 28 March 1949. This new special regulation is SR 750-445-1, "Maintenance Supplies and Equipment", 28 March 1949 (see Tab G).

F. Service Record Cards

On 2 August 1944 a letter[2] announcing the issuing of a new service record card (short title: SIGGOEM) was sent to all holders. The card was designed for the purpose of keeping a more accurate record of maintenance work done on Converter M-134-C. A special holder was designed for the card, the holder to fit on the left side of the converter cover by drilling six .078 holes (#47 drill) in the cover. When filled these service-record cards were returned to the Signal Security Branch (later expanded to Army Security Agency). For photograph of the service record card in place, see Tab W.

1. Letter, AGAO-S-B-M 311.5 (31 July 46), Subject: "Policy on Maintenance of Cryptographic Equipment," 5 Aug. 1946.
2. SPSIC Letter No. 446, Subject: Service Record Card for Converter M-134-C, To: All holders of Converter M-134-C, Signed for the CSO by Frank E. Stoner, Brigadier General, Chief, Signal Security Branch Service and Russel H. Horton, Major, S.C., Signal Security Branch.

G. Dust Tests

In early 1945 a series of tests were conducted to determine whether leaving the cover off the SIGABA increased maintenance problems by allowing "dust and dirt to settle on the rotors, resulting in unnecessary friction and wear".[1] It was reported[1] by an AACS station (to ASA thru channels) that leaving the cover off the SIGABA increased maintenance problems, and it was suggested by this same station that a hinged cover be designed to facilitate replacing the cover and thereby to encourage operators to keep the SIGIVI enclosed at all possible times.

In order to determine whether a change from the detachable SIGABA cover to a hinged type would "reduce the 'out-of-service' periods", a series of dust tests were conducted. In accordance with a decision[2] of the Executive Committee of Security Division, ASA, a letter[3] was sent to seventy-nine holders of Converter M-134-C requesting them to "Conduct a test substantially as follows:

a. A qualified maintenance mah to thoroughly clean and lubricate two converters as indicated in Section VI of "Operating and Maintenance Instructions for Converter M-134-C (short title: SIGKKK)".
   (1) The first of the two converters to be operated for 30 days with the 100730 cover lid completely removed.

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1. Letter to CG, Army Air Forces, Attn. Communications Security Officer, Office of Air Communications Officer, From: Francis T. Fogaty, Major, Air Corps, Deputy Assistant for Chief of Staff, Intelligence, Stationary Letterhead: Headquarters Army Airways Communications System, 5 Dec. 1944. Folder: Dust Tests, M-134-C, CSGAS-80
2. Memorandum, Action 1. To: CO, Subject: Recommendations on Modification of SIGABA Cover Lid into hinged-type lid. Signed Allsopp.
3. Letter, To: Selected Holders of Converter M-134-C, Signed: For the Chief Signal Officer by Frank E. Stoner, Major General, U.S. Army, Chief, Army Communications Service and Kenneth Kuhn, Lt. Col., S.C., Signal Security Branch, 14 Mar. 1945.

(2) The second converter to be operated for the same period of time; operating personnel to be carefully instructed to keep the cover lid on the converter at all times except when actually setting or changing the rotors.[1]

Of the 79 stations conducting the dust test, 49 reported that it helped to keep the cover on and 30 reported that it did not.

While the tests were being conducted, Maintenance Branch of Army Security Agency designed a hinged cover and installed it on a Converter M-134-C. For a photograph of this hinged cover, see Tab . The results of the dust tests indicated that the resulting improvement would not condone manufacture distribution of a hinged cover. Therefore, the project was dropped.

H. Rehabilitation Program

Currently (May 1949), all SIGABAs that are rehabilitated contain the latest design of parts. All of this rehabilitation work is done by maintenance personnel at Army Security Agency. However, these rehabilitated SIGABAs will probably not be used in quantity due to the fact that, as fast as possible, all Converters M-134-C are to be converted to ASAM 18's.

1. Same as footnote 3, previous page.

CHAPTER XVIII. THE ZERO MACHINE

In early 1942, a special Washington-London circuit was established for the secret communication of President Roosevelt and Prime Minister Churchill. The equipment which provided this communication has become known as the zero machine and the circuit as POTUS-PRIME, meaning President of the U. S. and the Prime Minister. All POTUS-PRIME messages bore the special precedence designation xxxc which was higher than the highest normal precedence designation, Urgent. The arrangements made for the use of the zero equipment were quite complicated but the results were so speedy that the British, who had no access to the equipment, never ceased to be amazed at the very few moments required to report the POTUS-PRIME traffic "RECEIVED".

POTUS-PRIME messages were sent via Western Union trans-Atlantic cable by means of on-line SIGABAs. The SIGABAs of the send circuit from Washington to london were located in Naval Communication's code room in Washington and in the code room of the Naval Attache in London. The SIGABAs of the send circuit from London to Washington were located in the code room of the Military Attache in London and the War Department code room in Washington. By means of this arrangement only Navy code room personnel saw messages from the President to the Prime Minister and only Army code room personnel saw messages from the Prime Minister to the President. Delivery to the Prime Minister and President was accomplished by means of special secret telephone and teletype lines from

the code rooms to their respective offices at No. 10 Downing Street in London and at the White House in Washington.

The messages were transmitted across the Atlantic by the on-line SIGABAs via cable as follows: The on-line SIGABAs in the code room were connected to a special relay box[1] in the Western Union office. As soon as a trans-Atlantic cable circuit was free, the Western Union office would patch in the sending SIGABA. The enciphered signals from the SIGABA went directly to a transmitter distributor in the Western Union office, and from that point directly over the cable so that the signals were received almost immediately on the deciphering SIGABA across the Atlantic as plain typed text. The maximum transmitting speed of the cable circuit was 250 letters per minute. The speed available on the cryptographic keyboard was 325 letters per minute. To compensate for this difference in speed, storage transmitters were provided within the circuit in order to store up 60 letters. It was therefore possible to operate the ABA keyboard for short periods at a speed greater than the cable speed. "Excess" letters were stored. If however, the storage capacity was exceeded, the machines lost synchronism.

In March 1943, the Western Union trans-Atlantic cable was changed to Variplex operation. This change meant that more than one subscriber could send messages at the same time but the number of letters of the same message going over the cable would be slowed down in accordance with

1. This special relay box was designed by Western Union Telegraph Co.

the number of subscribers sending at that moment. When a circuit of the cable was completely free, the sending of a POTUS-PRIME message was almost instantaneous. The delays encountered were caused by more subscribers needing the cable than the capacity of the cable could allow.

During the first few months of use, an imperfection in the zero equipment caused such serious trouble that it was necessary to discontinue its use until an improvement could be developed. The trouble was caused by the fact that the machines in London and Washington were dependent upon perfect synchronism. False signals sometimes occurred which produced false stepping of the deciphering machine, thereby, getting the machines out of phase and giving garbled text. Therefore, a new unit called a "kick eliminator" was introduced in the fall of 1942 in order to eliminate this false stepping of the deciphering machine. The perfection reached by introduction of the "kick eliminator" made the zero equipment the most secure and rapid in the world.

During the interim in which the zero equipment could not be used, the POTUS-PRIME messages were enciphered by normal means, namely, Converter M-134-A, and were transmitted by means of normal teletype circuits. During this period the only difference between POTUS-PRIME messages and normal traffic was that their xxxc precedence gave them preferential handling. The introduction of the "kick eliminator" into the xxxc circuit made possible resumption of using the zero equipment.

TOP SECRET

ABA ORIQM

ACE FYLVT

ADI UATGZ

AFO DINOY

AGU AWSJG

AHY JSGUF

ECA ZKQER

EDE CNATB

EFI RSPHJ

EGO KGNOA

EHU BPCIV

EJY SKOJQ

IDA CXLBU

IFE SWKCE

IGI MVPHD

IHO DJBLT

KJU EDVIW

IKY UYNKE

OFA XEMWR

OGE CLFZO

OHI XHTLF

OJO MPIGR

OKU HZAFX

OLY QUYNP

UGA EMDQH

TOP SECRET

The indicator system used for POTUS-PRIME traffic over the zero circuit was different from the normal SIGABA indicator system. A table listed three-letter combinations followed by five-letter groups. (See sample table on opposite page.) The operator chose two of the three letter groups from the table, for example, IHO and EHU. The indicator transmitted would therefore be IHOEHU which would indicate (see table opposite) that the control rotor setting was DJBLT and the alphabet rotor setting was BPCIV.

APPENDIX

	SIGQZF	SIGQZF-2	SIGQZF-3
Control, cipher, and index rotors	Each machine is provided with 10 large control or cipher rotors to be used in the control and cipher positions of the cipher unit; and 5 small or index rotors.	Each converter is provided with 5 small rotors to be used in the index (front) position and 10 large rotors to be used in the stepping control (middle) and alphabet (rear) position.	Same as SIGQZF-2.
Key List	The rotor assembly changes daily in accordance with Table No. 2 from SIGQZF* of the system employed. The term rotor assembly is intended to cover (1) the combinations of 5 rotors selected as control rotors. (2) The combination of 5 rotors selected as cipher rotors. (3) The index rotors and (4) The permutation or order in which the rotors are to be inserted in the control, cipher, and index positions.	The Key List. - The key list (see sample new-style key list from SIGQZF-2)* contains the arrangement of the stepping control and alphabet rotors for each day of the month and the alignments of the index rotors for each of the several security classifications for every day of the month. The arrangement of the stepping control and alphabet rotors remains the same throughout the cryptographic period for all security classifications. The alignment of the index rotors differ for each security classification.	Same as SIGQZF-2. (See sample key list from SIGQZF-3)*

*The sample key list tables referred to above are found in Volume 3, Chapter XIV, Section B, pages

	SIGQZF	SIGQZF-2	SIGQZF-3
Selection of Control and Cipher Rotors	Figures in the columns marked "CONTROL" and "CIPHER" of the rotor assembly table (see Table I from SIGQZF, p. __) refer to the units digits marked on the control rotors and on the cipher rotors. A set of rotors bearing the numbers 11 to 20 inclusive, for example, will be regarded as being marked 1,2,3,---0. The tens digits will be disregarded when assembling the rotors in accordance with the daily key. "R" in the table indicates that the particular rotor is to be inserted in a reversed position. Example: Jan 1 the rotor assembly table (see Table No. 2 from SIGQZF)* may designate 3-1-0-5-6 for the control rotors and 9-2-7-4R-8 for the cipher rotors. Rotors marked 3,1,0,5 and 6 (disregarding the tens digits) will be inserted in the control rotor position in that order, from left to right, as the operator faces the machine. The remaining 5 rotors, marked 9,2,7,4R and 8 will be inserted in the cipher rotor positions in that order, from left to right, with rotor number 4 reversed.	Figures in the columns marked CONTROL (MIDDLE) and CIPHER (REAR) of Table I (see Table I from SIGQZF-2)* refer to the units digits marked on the control and cipher rotors. A set of rotors bearing the numbers 21 to 30 inclusive, for example, will be regarded as being marked 1,2,3,...0. The tens digits will be disregarded when assembling the rotors in accordance with the daily rotor assembly. "R" in the table indicates that the rotor so designated is to be inserted in the reversed position. Example: On the second day of the month, Table I (see Table I from SIGQZF-2)* designates 5-0-3-7-9 for the control rotors and 1-6R-8-2-4 for the cipher rotors. Rotors marked 5,0,3,7, and 9 (disregarding tens digits) will be inserted in the control position in that order, from left to right as the operator faces the converter. The remaining 5 rotors, marked 1,6,8, 2, and 4 will be inserted in the cipher position in that order, from left to right, with rotor number 6 reversed.	Figures in the column marked ROTOR ARRANGEMENT (FOR ALL CLASSIFICATIONS) specifying which stepping control and alphabet rotors are to be used on a specific day of the month and the positions of these rotors in the converter. Numbers in the table refer to the 2nd digit of the of the rotor number. A set of rotors bearing the numbers 21 to 30, inclusive, for example, will be regarded as being marked 1,2,3...0. "R" in the table indicates that the rotor as designated is to be inserted in the reversed position. The rotors will be inserted in their respective positions in order from left to right as the operator faces the converter. Example: On the 2nd day of the month, the sample extract from a key list designates 2-3R-9R-1-5 for the stepping control rotors and 6-4R-8-7-0 for the alphabet rotors. (See sample table from SIGQZF-3)* Rotors marked 2,3,9,1 and 5 (disregarding tens digits) will be inserted in the control rotor position in that order, from left to right as the operator faces

*The sample key list tables referred to above are found in Volume 3, Chapter XIV, Section B, pages

	SIGQZF	SIGQZF-2	SIGQZF-3
Selection of control and cipher rotors (continued)			the converter, with numbers 3 and 9 reversed. The remaining five rotors marked 6,4,8,7 and 0, will be insertee in the alphabet position in that order from left to right with rotor number 4 reversed.
Index Rotors	The first set of numbers in the rotor assembly table will designate the combination and alignment of the index rotors. Example: On Jan 1 the rotor assembly table (Table 2) lists 58-10-45-22-36. (See Table 2, SIGQZF)* The index rotor bearing the sequence 50 to 59 will be inserted in the first position on the left. The number 58 is alignee on the reference mark, etc. In QZF, the arrangement of the index rotors was changed each day. In QZF-2, only the alignment was changed each day. The alignment (according to QZF-2) was different for each classification. The order of the index rotors (after new-style keylists became effective) was always 10-20-30-40-50. This order was not stated in QZF-2 but always appeared in the keyliste.	The set of numbers under INDEX (FRONT) ALIGNMENT SECRET of Table I (see sample table, SIGQZF-2)* designates the daily alignment of the index rotors to be used when the rotor assembly is checked by the 26-30 check group (see below, 26-30 check). In three separate columns, each headed INDEX (FRONT) ALIGNMENT, Table II (see sample table, SIGQZF-2) gives the daily CONFIDENTIAL and RESTRICTED alignments of the index rotors and refers to Table I for the SECRET alignment. Example: According to Table II, on the 2nd day of the month the index rotors should be alignee at 12-23-32-42-54 for SECRET messages; at 11-29-37-43-58 for CONFIDENTIAL messages; and at 12-23-31-42-59 for RESTRICTED messages.	The sets of numbers under INDEX (FRONT) ALIGNMENT designate the alignment of the index rotors used for enciphering and deciphering messages on a specific day of the month. In three separate columns, each headed INDEX (FRONT) ALIGNMENT, the key list gives the daily alignment of the index rotors for each classification (see sample key list from SIGQZF-3)* The alignment of the index rotors is determined by the classification of the message and the day of the month. Example: According to the key list mentioned above, on the first day of the month the numbers of the index rotors should be aligned from left to right on the white reference mark at 10 23 31 49 50 for SECRET messages; at 12 28 31 44 53 for CONFIDENTIAL messages; and at 17 25 36 43 58 for RESTRICTED messages.

*The sample key list tables referred to above are found in Volume 3, Chapter XIV, Section B, pages

	SIGQZF	SIGQZF-2	SIGQZF-3
26-30 Check	Not included in SIGQZF.	The 26-30 check groups provided in Table I are used to check the correctness of the daily rotor assembly and of the stepping of the control and cipher rotors. The check is accomplished in the following manner: Align the index rotors and assemble the control rotors in accordance with Table I. (See sample Table I from QZF-2)* Throw the zeroize-operate key to "Zeroize" and turn the controller to "R"; then press down the "Blank" and "Repeat" keys simultaneously until the letter "O" on the control and cipher rotors appears at the reference mark. Set the stroke counter at zero and the zeroize-operate key at "Operate" and turn the controller to "E". Now press down the "Repeat" and "A" keys simultaneously and hold until 30 letters are printed. The 26th, 27th, 28th, 29th and 30th letters thus obtainee should agree exactly with the 26-30 check group for the day given in Table I.	The 26-30 check groups provided in the key list are used to check the correctness of the daily rotor arrangement and index alignment and the stepping of the stepping control and alphabet rotors. The 26-30 check is performed as follows: (1) Arrange the stepping control and alphabet rotors and align the index rotors in accordance with the key list and the security classification to be checked. (2) Zeroize the converter. (3) Set the stroke counter at zero. (4) Switch the zeroize-operate key to "Operate" and thus turn the controller to "G". (5) Press down the "Repeat" and "A" keys simultaneously and hold until 30 letters are printed. (6) The 26th, 27th, 28th, 29th, and 30th letters thus obtained should agree exactly with the 26-30 check group given in the key list....

*The sample key list tables referred to above are found in Volume 3, Chapter XIV, Section B, pages

	SIGQZF	SIGQZF-2	SIGQZF-3
Initial Alignment	(According to SIGQZF, the initial alignment of the index rotors remains the same throughout the day and since the index rotors do not step, it is necessary to align them only once at the beginning of the day. For alignment of index rotors, see above: "INDEX ROTORS.") The control and cipher rotors to be used on a given day, having been selected and inserted.. must be set to an initial alignment before enciphering or deciphering a message. Daily initial alignment keys will be found in Table No. 2 of the system employed in the column marked "INITIAL ALIGNMENT." The letters of this keying element are brought into alignment along white reference marks extending across the endplates and separator assembly. Control and cipher rotors are aligned to the same key. Example: On Jan 1 the initial alignment given in Table No. 2 of the sample table is JUDPX (see Table 2 of SIGQZF)* The control rotors are turnee by hand so that the letters JUDPX are aligned horizontally on the reference mark. The cipher rotors are also turned by hand so that the letters JUDPX are aligned horizontally on the reference mark. For use of daily initial alignsee message keying element below.	Daily Alignment - Table II. - This table is used to align all rotors before beginning the encipherment or decipherment of a message. Alignments corresponding to the SECRET, CONFIDENTIAL, and RESTRICTED classifications are given for each day. For method of daily alignment of index rotors for each classification, see "Index Rotors" under SIGQZF-2 above. The control and cipher rotors to be used on a given day, having been selected and inserted in the cipher unit must be set to an initial horizontal alignment before enciphering or deciphering a message. Daily initial alignments for each classification will be found in the columns of Table II marked INITIAL ALIGNMENT (CONTROL AND CIPHER). The letters of this keying element are brought into alignment on the white reference marks of the control and cipher positions. Control rotors and cipher rotors will Invariably be aligned to the same key. Example: On the second day of the month, the initial alignment given in Table II, (see Table II from SIGQZF-2)* for SECRET messages is BSGUT; for CONFIDENTIAL messages, FBNVD; and for RESTRICTED messages, PNPXL. Initial alignment will be determined by the classification of the message. For use of daily initial alignment, see message keying element below.	No daily initial alignment.

*The sample key list tables referred to above are found in Volume 3, Chapter XIV, Section B, pages

	SIGQZF	SIGQZF-2	SIGQZF-3
Message Keying Element	A group of any 5 letters, except Z, selected at random, ... is used as the message keying element. It will be hereinafter termed the internal message indicator... Suppose the 5 letters selected are XARPG. After the control, cipher, and index rotors are assembled and aligned... the 5 letters selectee at random will be enciphered and the cipher resultant printed on the tape. This cipher resultant will hereinafter be termed the external message indicator. The control rotors and the cipher rotors are then turnee by hand and alignee to the internal message indicator (XARPG in this example) by the operator. NEVER align the rotors to the external message indicator (the letters printed on the tape), but always to the internal message indicator.	Same as SIGQZF.	The message rotor alignment is derived and aligned on the stepping control and alphabet rotors as follows: a. Select a group of any 5 letters at random (message indicators) b. Zeroize the converter. c. Leave the controller at "R", and then pressing down the "Blank" and "Repeat" keys simultaneously until the letter "O" on the stepping control and alphabet rotors comes to rest at the reference mark. d. Strike the numeral key, 1, the number of times required to align the 1st stepping control rotor (next to the left end plate) to the 1st letter of the message indicator. e. Align the 2nd stepping control rotor by striking the numeral key 2, the 3rd by striking the numeral key 3, until all five stepping control rotors are alignee to the 5 letters of the message indicator. f. If any rotor is stepped past the correct letter or if the rotors are not alignee in proper sequence, the entire process must be repeated from the zeroize position. g. After the stepping control rotors have been aligned, check the alignment of the alphabet rotors to insure that all five are not aligned to "O."

	SIGQZF	SIGQZF-2	SIGQZF-3
Length of Message	If the cryptographed text... will exceed 100 5-letter groups, the plain text will be divided into 2 or more equal parts and each part will be treated as though it were a separate message.	If the cryptographed text... will exceed 350 5-letter groups, the plain text must be divided into 2 or more equal parts so that no part will exceed 350 cipher-text groups. For each part a new internal message indicator will be selected.	Same as SIGQZF-2.

TAB A

Converter M-134-C

(showing parts listed beneath photograph)

Detailed Description of Converter M-134-C

Converter M-134-C is assembled from subunits such as the keyboard, printer unit, rotor magnet and drive bar assemblies, controller, cipher unit and motor unit, all of which are mounted on one base.

Controller. (See Tab D for interior of controller switch.) The controller (3) may be turned manually to any one of five positions, thus connecting the operating circuits and regulating the spacing of the tape to meet any of the following operating conditions:

a. Controller in "O" position. - Power switch turned off.

b. Controller in "P" position - plain typing.
   (1) Key-lever contracts for numerals and letters are connected through control switch pileups directly to the corresponding print magnets.
   (2) Tape feed pawl opposite twelve-tooth ratchet for regular spacing of tape.

c. Controller in "R" position.
   (1) Zeroizing rotors (zeroize-operate key in "Zeroize" position).
      (a) Tape feed pawl is opposite the two-tooth ratchet, preventing tape feeding.
      (b) No. 1 print suppress magnet is energized for each revolution of the main shaft to block printing when the "Blank" key is depressed.
   (2) Stepping control rotors numbers one to five inclusive (zeroize-operate key in "Operate" position.
      (a) The control rotors numbers one to five inclusive may be individually stepping by operating the numeral keys 1,2, 3,4, or 5, respectively,
      (b) No. 2 print suppress magnet is energized each time the main shaft revolves to block printing.

d. Controller in "E" position - enciphering text.
   (1) The circuits of the "X" and "Z" key-lever contacts are connected in parallel.
   (2) The circuit which was disconnected from the letter "Z" is connected to the "Space."
   (3) Circuits from the alphabet key-lever contacts are routed through the cipher unit from left to right.
   (4) Tape feed pawl is opposite the ten-tooth ratchet to insert an extra space after each five-letter group.

e. Controller in "D" position - deciphering text.
   (1) Circuits from the alphabet key-lever contacts are routed through the cipher unit from right to left.
   (2) Tape feed pawl is opposite the twelve-tooth ratchet for regular spacing.
   (3) Circuit from "Z" position on the left cipher distributor of the cipher unit is switched to print suppress magnet #1.

Keyboard. - See Tab I.

(Continued in Tab B)

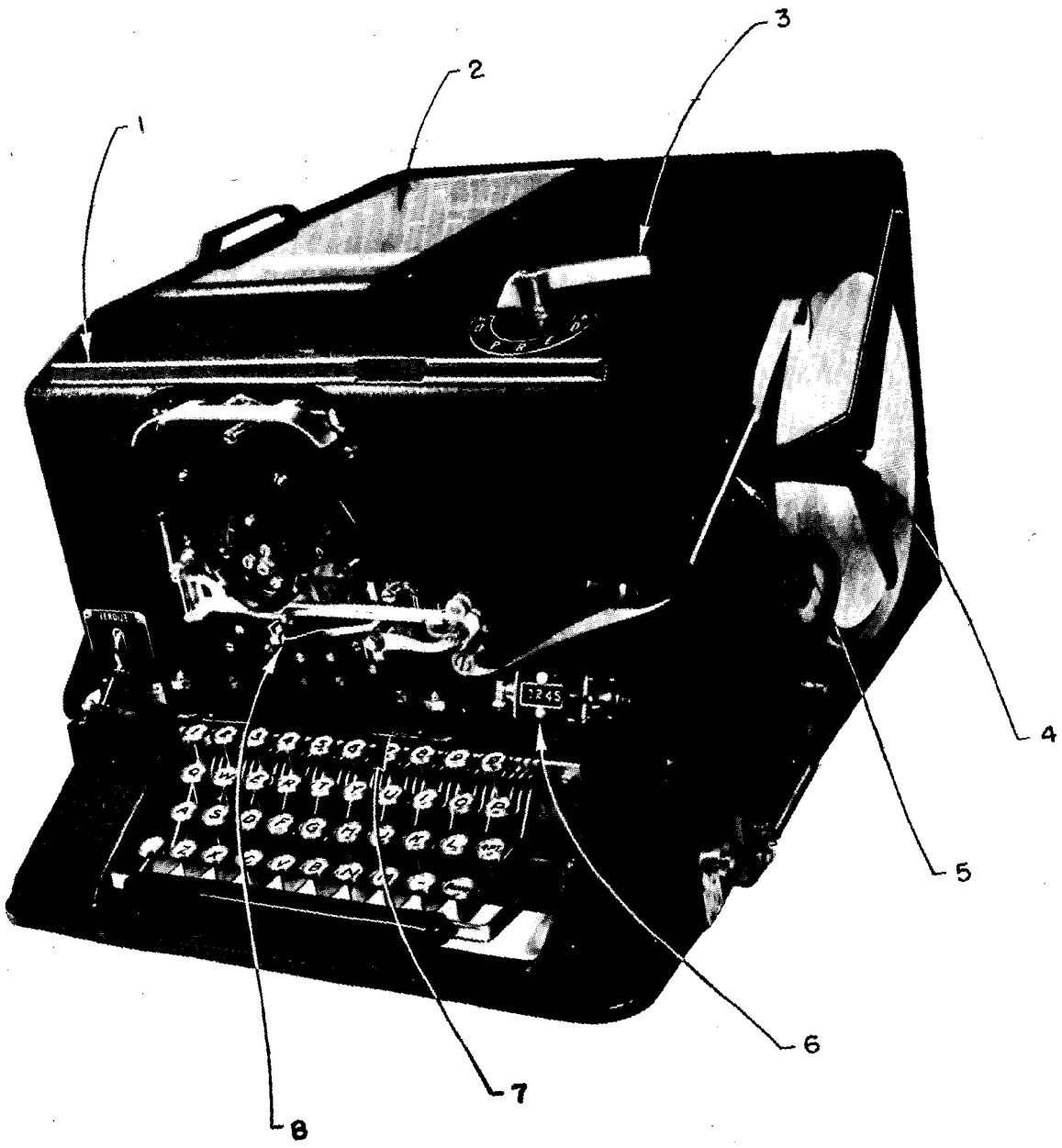


FIG. 1

1. Tape chute
2. Cover lid
3. Controller
4. Tape retaining arm
5. Side tape chute
6. Stroke counter
7. Name plate with register number
8. Print hammer

TAB B

Converter M-134-C

(showing parts listed beneath photograph)

(Continued from Tab A)

Print Suppression. - Under certain conditions, such as spaces between words, and stepping the rotors to zeroize them, it is necessary to suppress printing. When the printing is to be suppressed, one of the two print suppress magnets is energized and the corresponding stop pin is moved into the patch of the print hammer and blocks printing. When the controller is in the "D" position, the circuit from the letter "Z" position on the left cipher distributor is transferred from the "Z" print magnet to print suppress magnet #1 (paragraph 11a(2)).

Motor Unit. - The motor unit consists of the motir, motor fan, motor pinion, mounting plate, and motor plug. Two types of motor units are available as outlined in paragraph 8a, of "Maintenance Instructions for Converter M-134-C" (SIGKKK-2). The correct procedure in substituting motors is outlined in paragraph 133c of the same manual.

"Blank" and "Repeat" Key Levers.

a. When the "Blank" key lever is depressed, a circuit through print suppress magnet #1 is completed. This blocks printing but permits the main shaft to make one revolution.

b. If the "Repeat" and any operative key lever are held depressed simultaneously, the clutch trip magnet lockup circuit will be held open, and the clutch trip magnet will be energized every time the cam "A" closes its print ("A") contact. Repeated operation will result as long as these two key levers are held depressed. The "Repeat" key will not operate if depressed after any other key.

Hand-lever Operation.

a. The hand lever can be used, as a substitute for the motor, to furnish energy to the main shaft. Teeth which are arranged in the hand-lever ratchet mesh with a pinion known as the hand-lever pinion. This pinion is located on the right end of the main shaft. The hand-lever pawl disc with its pawl is fastened to the main shaft at the left end of the pinion in such a way that the hand-lever pawl can engage with the teeth of the pinion. When the pinion is engaged by the pawl, a downward stroke of the hand lever will cause the main shaft to rotate. On the upward stroke the hand-lever pawl rides over the pinion teeth without engaging them.

b. A hand-lever slip ring which can be slid to left or right fits over part of the hand-lever pinion. When the motor is used, this hand-lever slip ring is positioned so that the pawl rides in a channel in its periphery, thus disengaging the hand-lever pawl from the pinion.

(Detailed description continued in Tab D.)

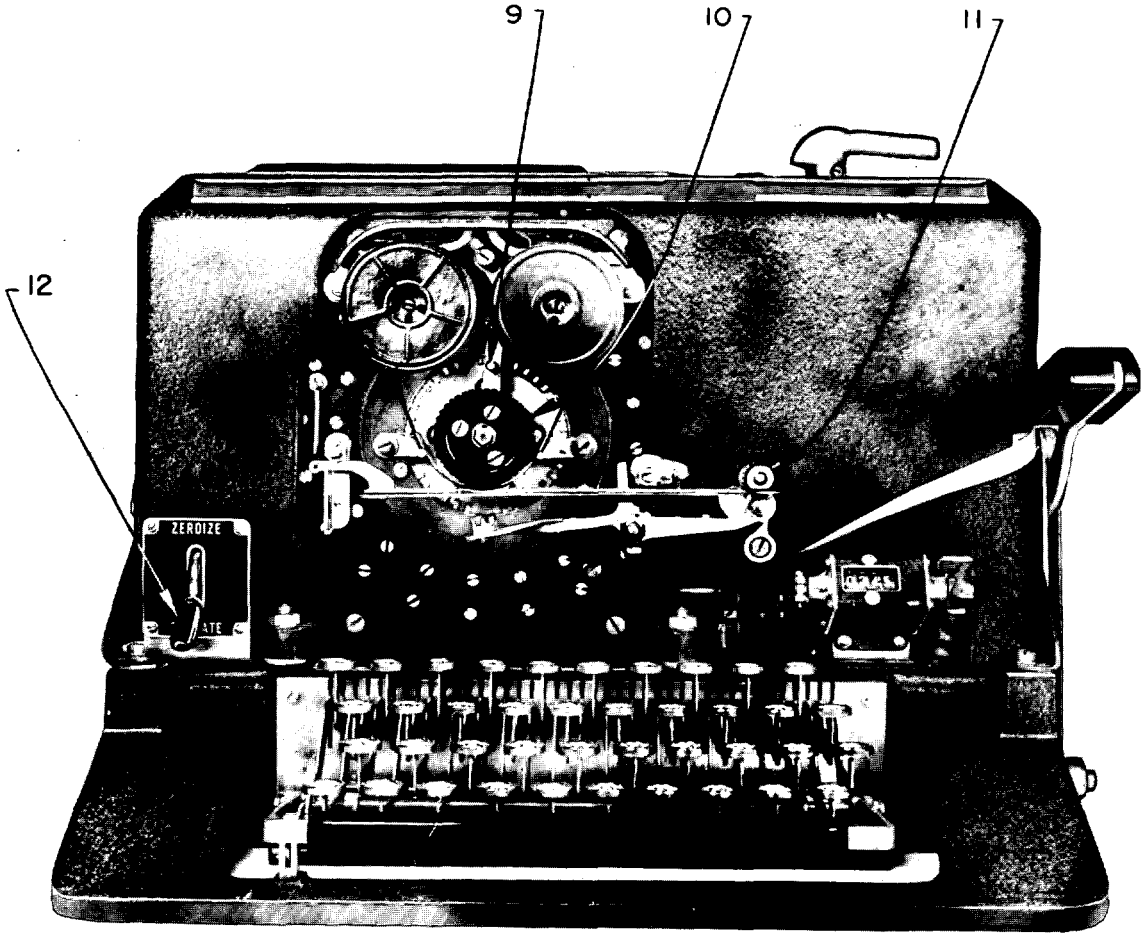


FIG. 2

9. Ribbon shift lever
10. Type wheel
11. Tape feed roller
12. Zeroize-operate key

TAB C

Converter M-134-C

(showing standard cipher unit

(short title: SIGIVI) in place)

For detailed description, see Tabs A, B, D, E, I, J, K, L, M, O.

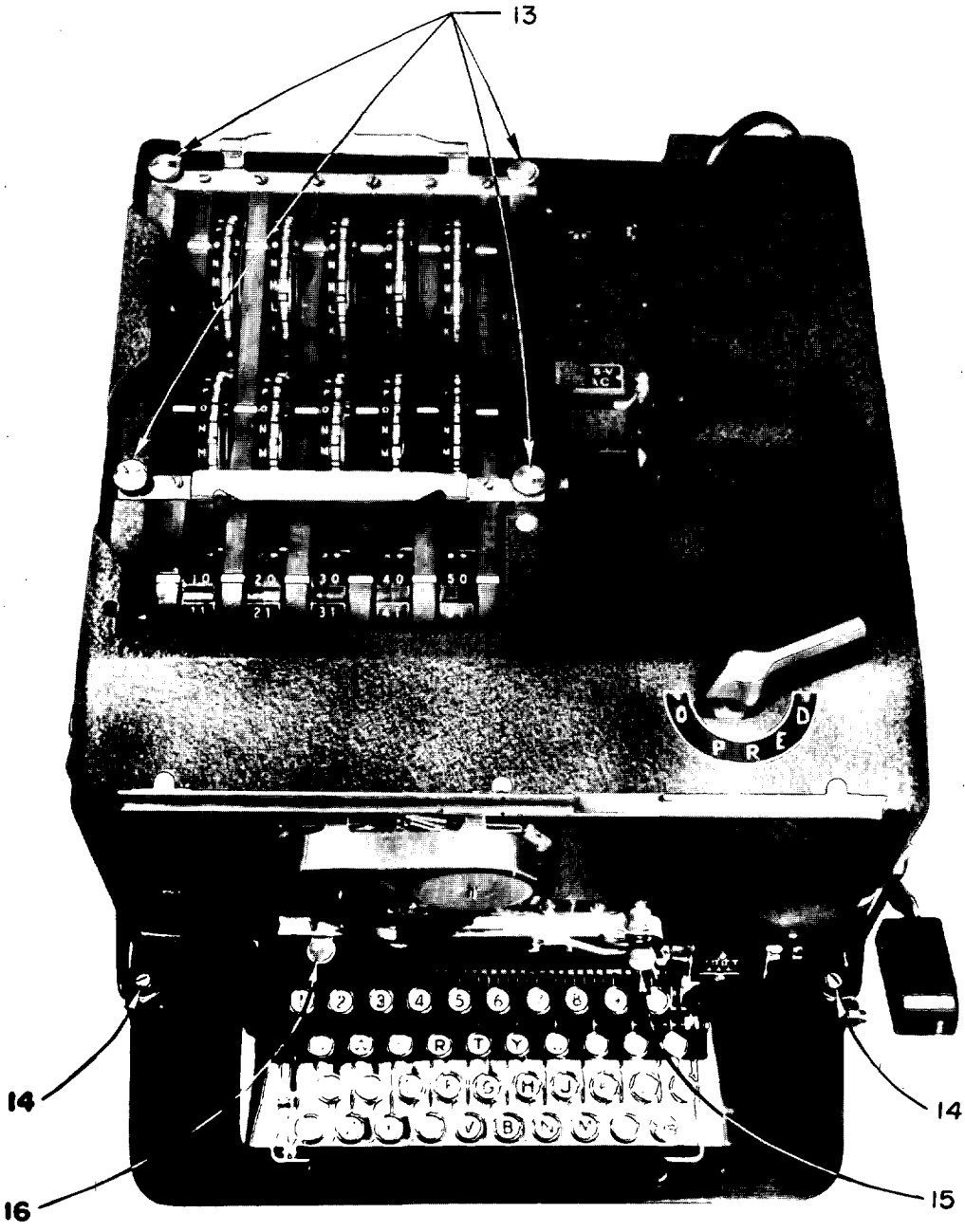


FIG. 3

13. Cipher unit hold-down thumbscrews
14. Cover screws
15. Right tape release
16. Left tape release

TAB D

Converter M-134-C

(showing the three rotor banks of the standard cipher unit (short title: SIGIVI))

(Continued from Tab B)

For explanation of rotor stepping, see Tab E.

Zeroizing the Rotors.

a. With the controller in the "R" position and the zeroize-operate key in the "Zeroize" position, circuits from the stepping contact "B" are routed through each of the ten rotor stepping contact assemblies and each of the rotor magnets.

b. With the foregoing condition set up and the "Blank" and "Repeat" keys held depressed, an impulse from the stepping contact "B" will be applied to all ten rotor magnets (for each revolution of the main shaft). This will cause the rotors to be advanced to their zeroize positions. When the rotors reach their zero positions, the rotor stepping contacts are opened by studs on the rotors, preventing any further stepping.

For description of cipher unit, see Tab M.

(Continued in Tab E)

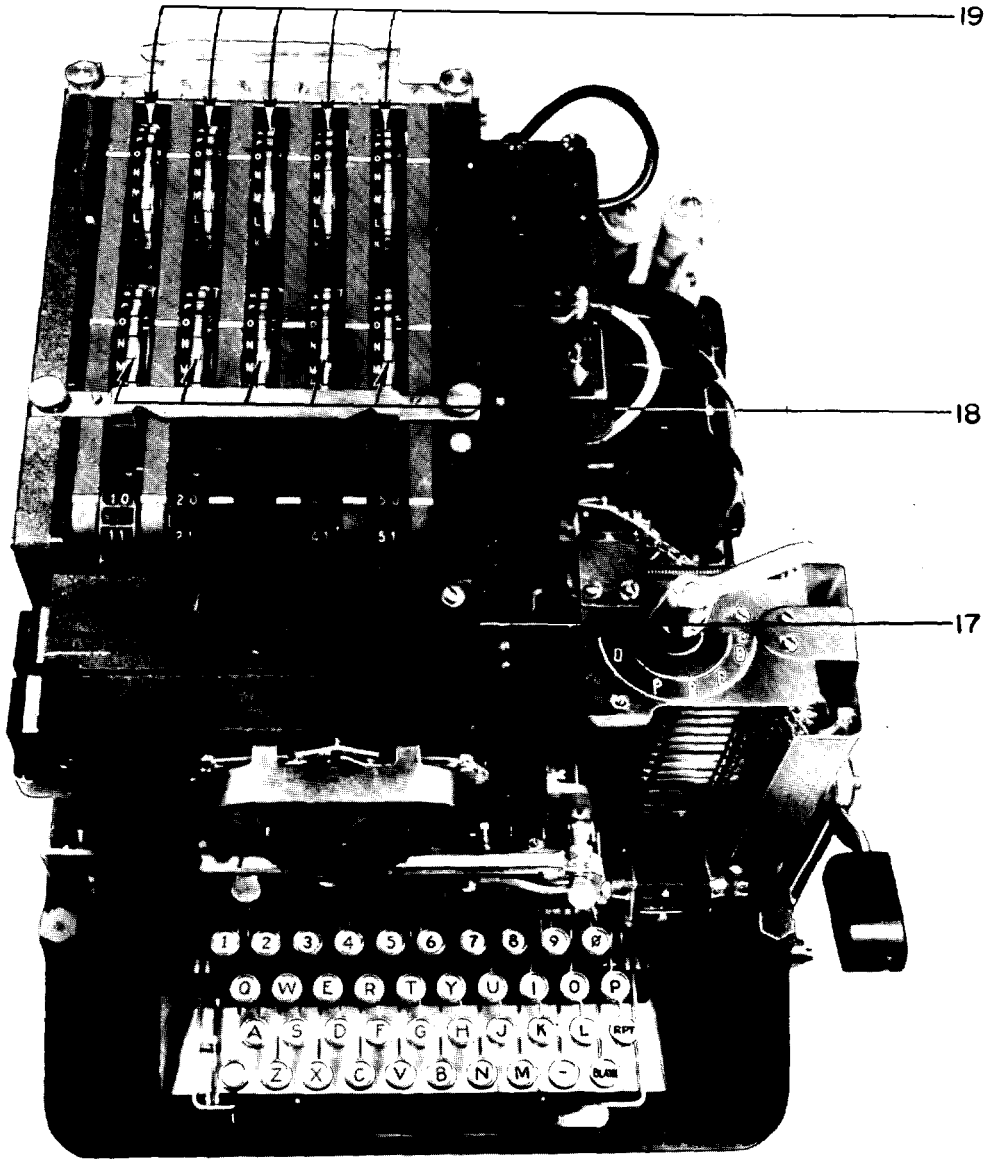


FIG. 4

17. Index rotors
18. Control rotors
19. Cipher rotors

TOP SECRET

TAB E

Converter M-134-C

(cipher unit removed

and

interior of Controller Switch)

TOP SECRET

(Continued from Tab D)

Rotor Magnet and Rotor Drive Bar Assemblies.

a. The rotors in the cipher and control mazes are advanced or stepped ahead by pawls on the rotor drive bar assembly. This assembly is moved back and forth, by the action of the channel cam, once for each revolution of the main shaft The rotors to be advanced are selected by energizing their rotor magnets. When a rotor magnet is energized, the rear portion of its armature moves upward, tripping its associated rotor pawl latch. This releases the corresponding rotor pawl so that its front end moves up to engage a notch on the rotor. While the rotor drive bar asselbly is being moves forward, those rotors that are engaged by their pawls will be advanced one step. When the rotor drive bar assembly returns to the inoperative position, the rotor pawls will be reset on their latches by their reset screws.

b. The positions and wiring of the rotors in the control and index mazes determine which of the rotors in the cipher maze are to be advanced with the operation of a key lever. For each revolution of the main shaft, an impulse from the stepping contact "B" is routed through a minimum of one and a maximum of four of the cipher rotor magnets.

c. Another circuit is routed from the stepping contact "B" to the number three rotor magnet of the control maze, so that it advances its rotor once for each revolution of the main shaft. Every time the letter "O" of this third rotor is aligned with the white reference marks on the cipher unit, a stud on its periphery closes a pair of contacts, completing a circuit to the number four rotor magnet. When the letter "O" of this fourth rotor is aligned with the white reference marks on the cipher unit, a similar stud on its periphery closes a contact. When contacts at the third and fourth positions are closed, a circuit to the number two rotor magnet is completed. That is to say, the third rotor is advanced once for each revolution of the main shaft, the fourth rotor is advanced at least once for every 26 revolutions of the main shaft, and the second rotor is advanced at least once for every 676 revolutions of the main shaft. The first and fifth rotors in the control maze are not advanced during plain, encipher, or decipher operations.

Stepping Individual Rotors in the Control Maze. - With the controlle r in the "R" position and the zeroize-operate key in the "Operate" position, circuits from the upper contacts of the numeral key levers 1 to 5 are connected to their respective print magnets in the regular way. However, a circuit from the stepping contact "B" is routed to print suppress magnet #2. This blocks printing during the stepping operation. The lower contacts of the numeral key levers 1 to 5 complete circuits from the stepping contact "B" to each of the five rotor magnets in the control maze. With each operation of a numeral key lever (1 to 5) the corresponding rotor magnet of the control maze will be energized, permitting its associated rotor to advance one step. The cipher rotors also advance during this operation in an unpredictable manner.

(Detailed description continued in Tab J)

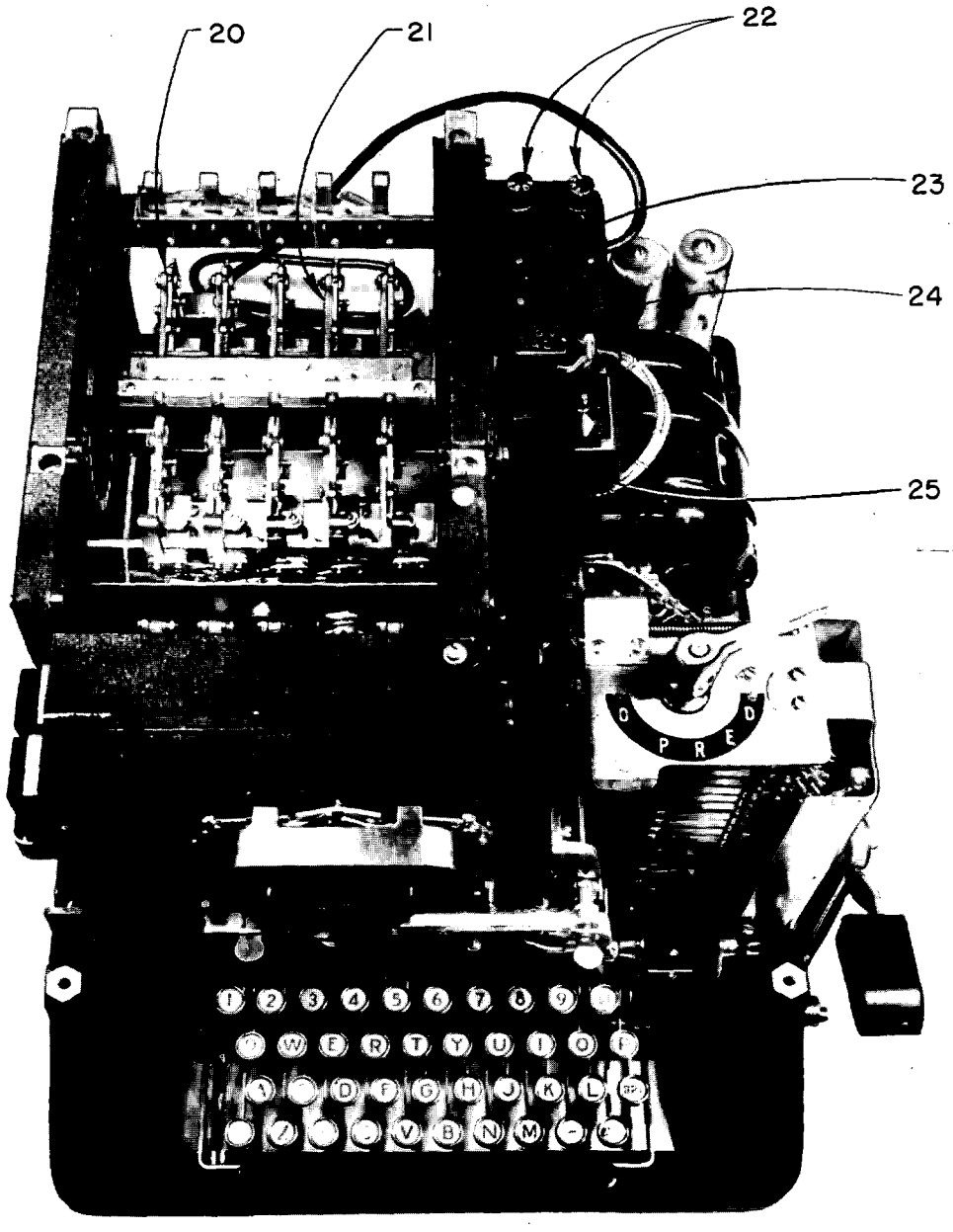


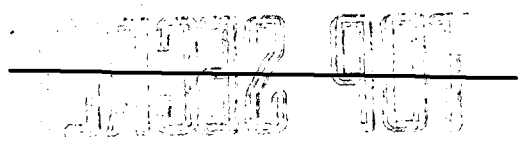
FIG. 5

20. Rotor pawl
21. Rotor drive bar
22. Power fuses
23. Place finder outlet
24. Motor plug
25. Dummy plug

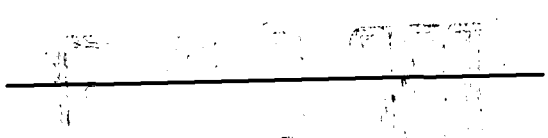
TAB F

Converter M-134-C

(showing parts listed beneath photograph)



For detailed description see Tabs A, B, D, E, I, J, K, L, M, O.



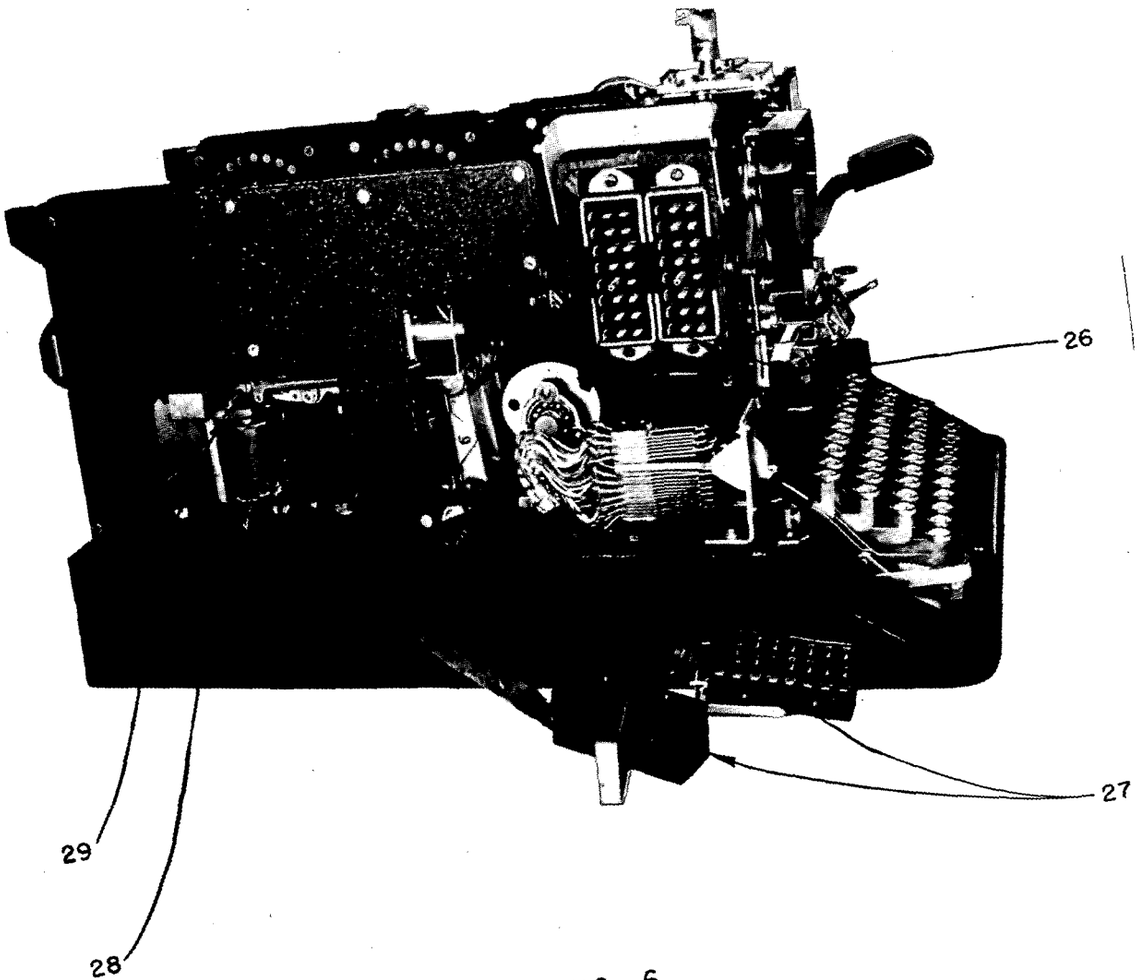


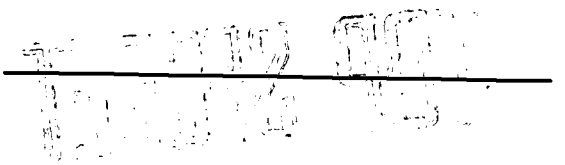
FIG. 6

26. Printer unit contacts
27. Printer unit plugs "C" and "D"
28. Rotor magnet
29. Rotor magnet armature

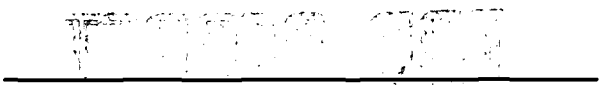
TAB G

Converter M-134-C

(Partly dismantled - see parts listed beneath photograph)



For detailed description see Tabs A, B, D, E, I, J, K, L, M, O.



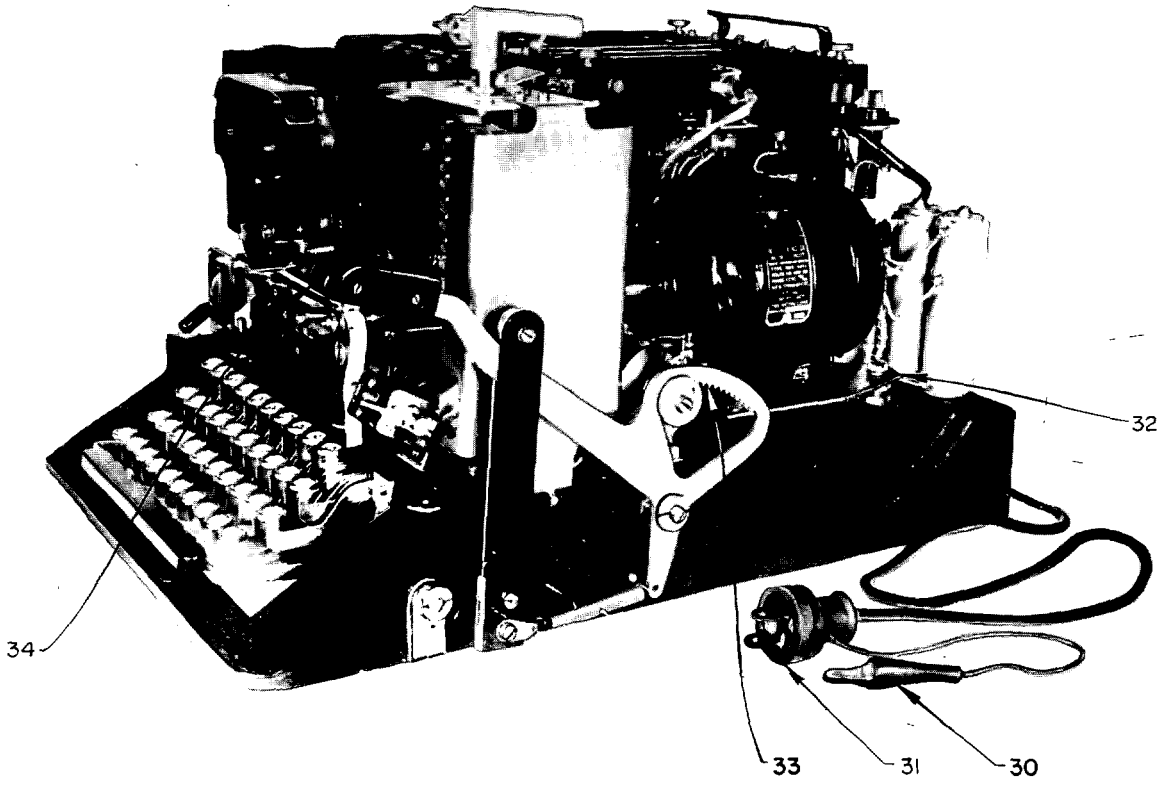


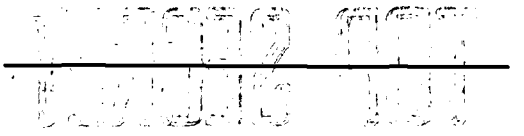
FIG. 7

30. Grounding clip
31. Power plug
32. Motor mounting plate
33. Hand-lever ratchet
34. Hand lever

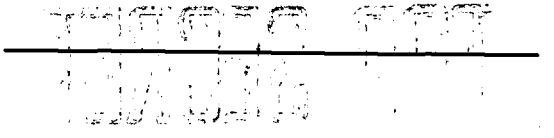
TAB H

Converter M-134-C

(Partly dismantled - see parts listed beneath photograph)



For detailed description see Tabs A, B, D, E, I, J, K, L, M, O.



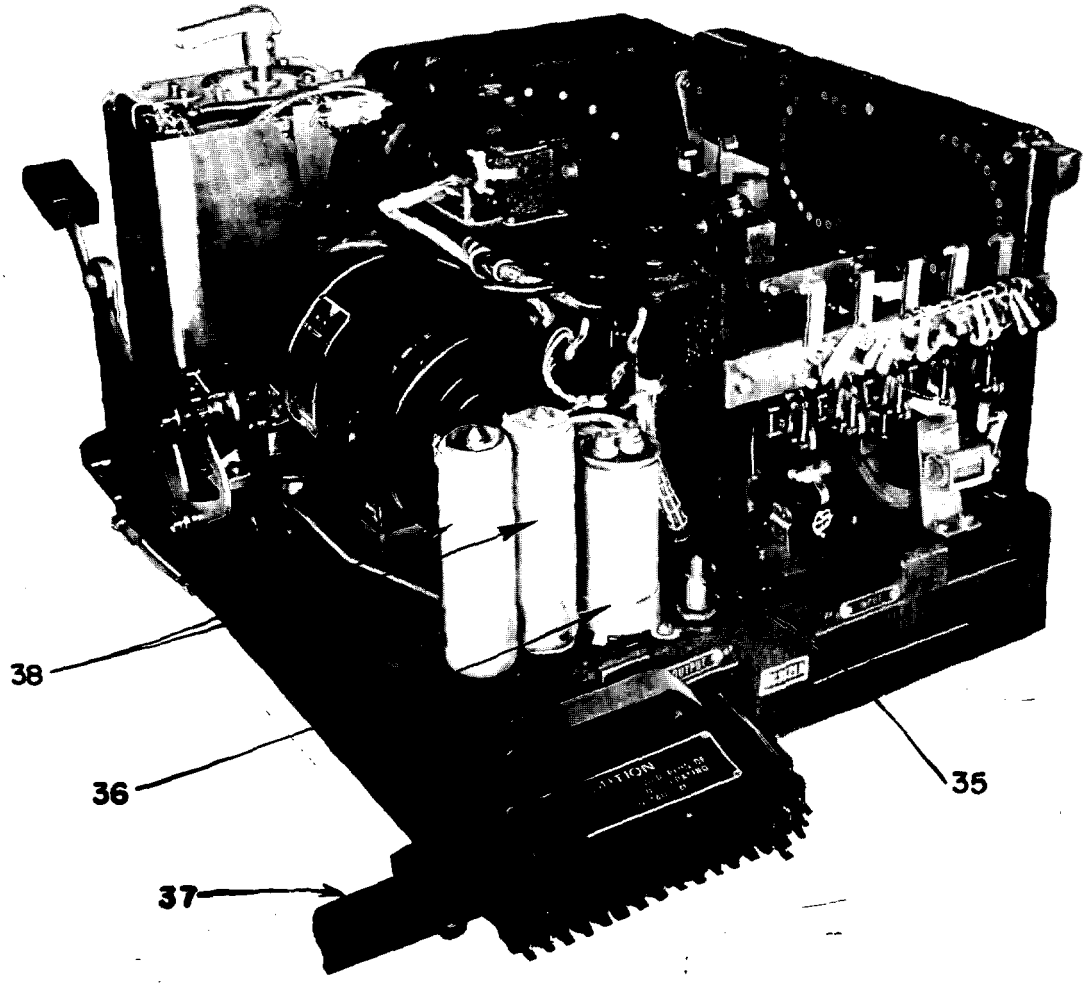


FIG. 8

35. Cover retaining stud bolt
36. Filter condenser
37. Tandem cable with plug
38. Resistors

TAB I

Converter M-134-C

(Underneath View)

(Continued from Tab E)

Keyboard. - (See also Tab A) -

a. The keyboard key levers are pivoted on a cross shaft located on the underside of the base. A projection on each key lever (extending downward) closes a set of contacts whenever a key lever is depressed. These contacts close circuits to the print magnets and to the clutch trip magnet. The clutch trip magnet controls the starting of the main shaft, which supplied power for operating the mechanism.

b. The key levers for the number keys, 1, 2, 3, 4 and 5, close an extra pair of contacts whenever they are depressed. These additional contacts may be used in connection with aligning the initial setting of letters on the rotors in the control maze, but are not used in the present Army operating procedure.

c. A bar called the universal bar extends beneath all the key levers. This bar permits a pair of contacts (called the universal contacts) to close each time a key lever is depressed.

(Continued in Tab J)

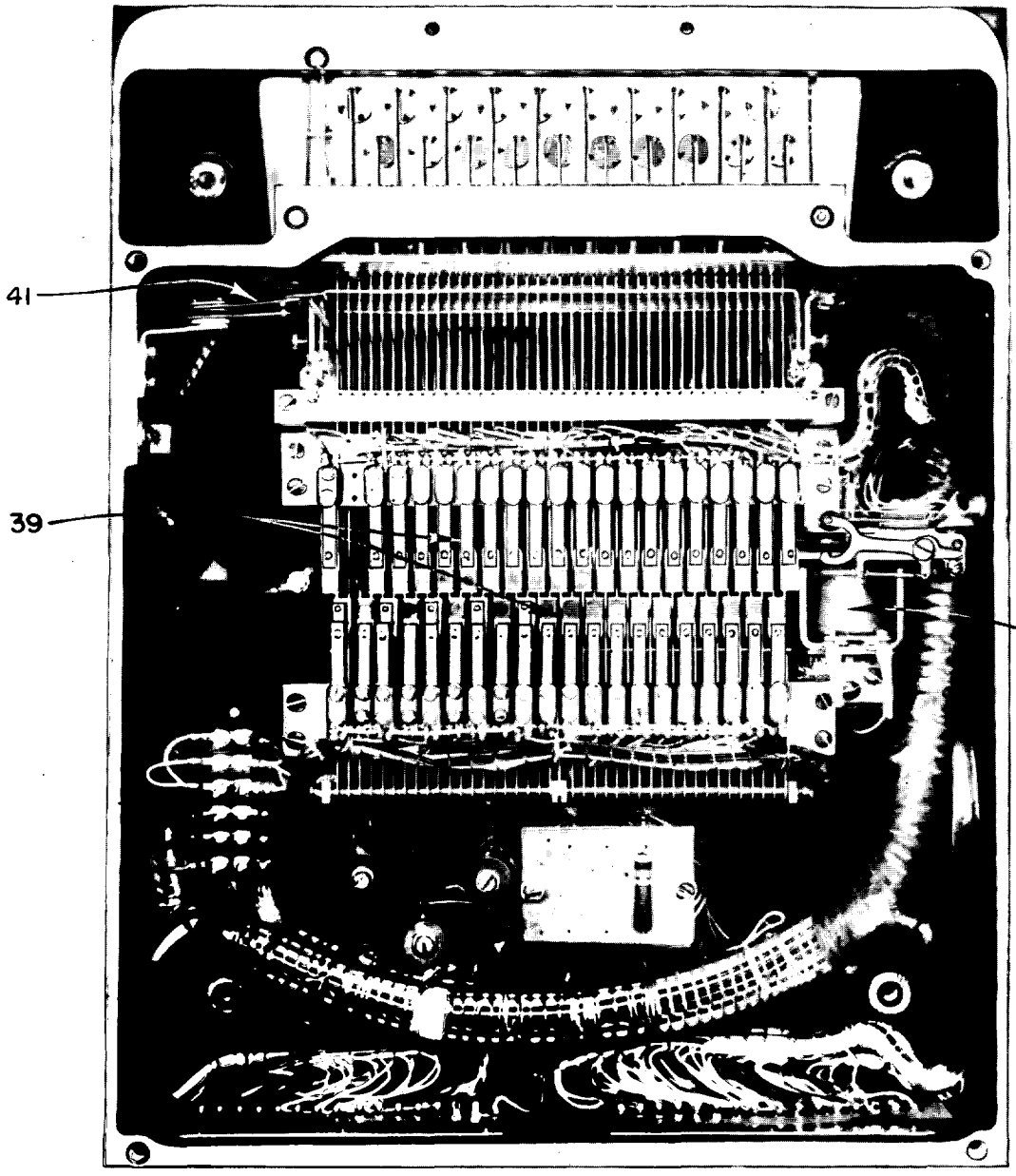


FIG. 9

39. Key-lever contacts
40. Clutch trip magnet
41. Universal contacts

TAB J

Converter M-134-C

(Printer Unit)

Figs. 10, 17, 18, 19

(Continued from Tab I)

Printer Unit.

a. The printer unit (figs. 10 and 17) consists essentially of a print magnet, an armature, a latch and stop pin for each character; a type-wheel shaft with stop arm; type wheel; print hammer; tape feeding mechanism; and two friction clutches.

b. The character to be printed is determined by the selection of a print magnet. When the print magnet armature is attracted, it will move the stop pin latch away from the tooth on its associated stop pin, permitting the stop pin to be pulled by its spring into the path of the stop arm (fig. 17).

c. The type-wheel shaft is driven by the printer drive gear on the main shaft, through the medium of a friction clutch. The type-wheel shaft is stopped in the correct position for the printing of the selected character when the stop arm contacts the selected stop pin.

d. The print hammer follower (fig. 18) is moved up and down by the action of its cam and spring. The forward end of this print hammer follower, in turn, moves the right end of the print hammer arm down, causing the left end to strike the paper tape against the ribbon and type wheel, printing the character.

e. After printing of the character has taken place, the printer reset cam will move the reset yoke and reset collar toward the rear, resetting the stop pin in its latched position (fig. 17).

f. The ribbon mechanism (fig. 19), located above the type wheel, is actuated by the ribbon shift lever which rides on an accentric on the type-wheel shaft at the rear of the type wheel. As the accentric raises and lowers the ribbon shift lever, a tooth on one side of this lever engages one of the ribbon ratchets, winding the ribbon on the associated spool. When the ribbon is unwound from one spool, it can be rewound by moving the ribbon shift lever manually toward that spool.

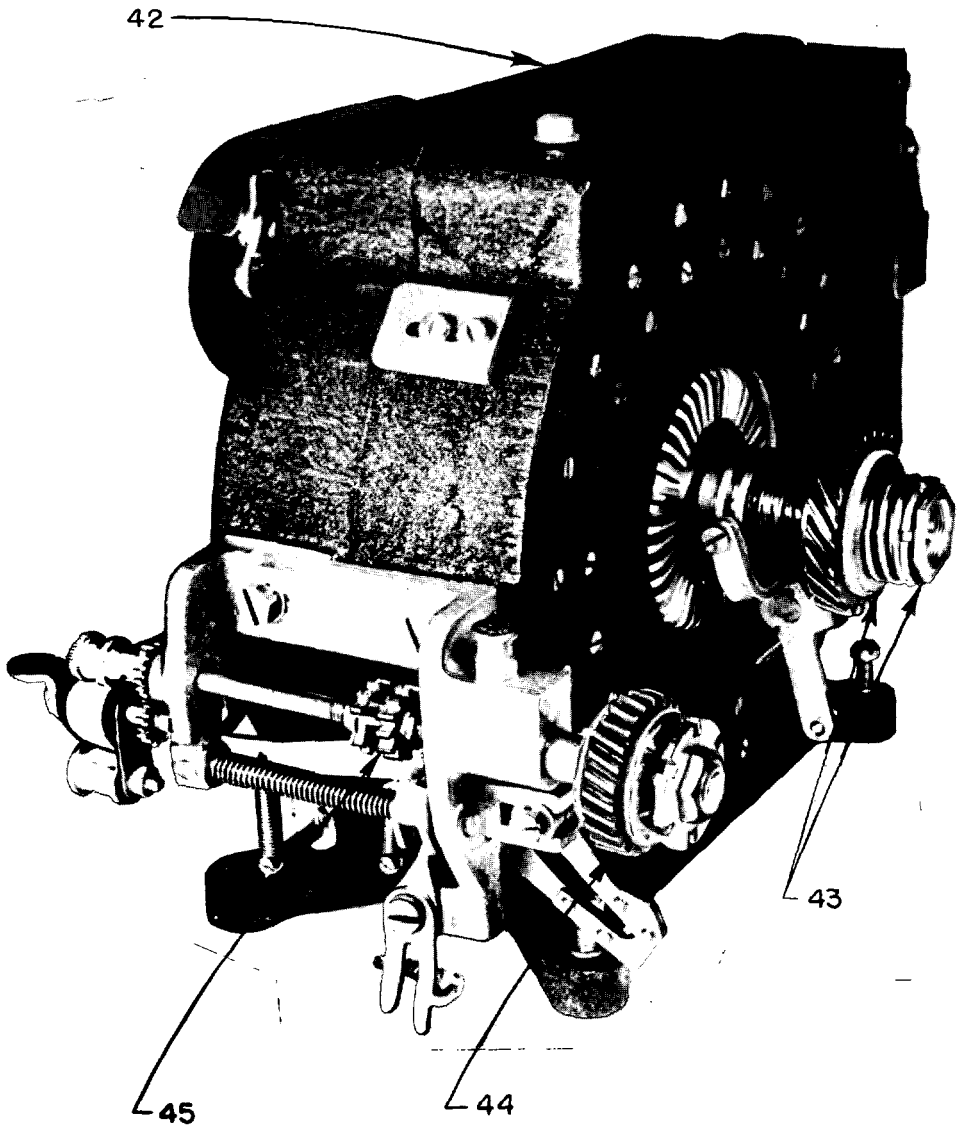


FIG. 10

42. Printer unit
43. Type-wheel shaft friction clutch assembly
44. Tape feed shaft gear
45. Tape feed ratchet assembly

TAB K

Converter M-134-C

(Showing especially Main Shaft)

Figs. 11, 20, 21

TOP SECRET

(Continued from Tab J)

Main Shaft.

a. The main shaft assembly (fig. 20) includes the driving clutch, gear hub, counter cam, tape feed cam, print hammer cam, cam "A," cam "B," printer drive gear, printer reset cam, channel cam, clutch reset lever reset cam, hand-lever pinion, and hand-lever slip ring.

b. The power for operating the mechanism of the converter is supplied by the motor or by the hand lever. The motor pinion meshes with the motor driven gear. This gear is mounted on the gear hub, with the tape feed drive gear and the drive member of the driving clutch (fig. 20). The gear hub revolves continually while the motor is running.

c. In the normal inoperative position, the main shaft assembly (except the gear hub) is held stationary, because the driven member of the driving clutch is held out of mesh with the drive member, by the clutch throwout lever (fig. 20 and 21). When the clutch trip lever latching extension releases the clutch reset lever lower extension, the clutch throwout lever will be moved away from the camming surface of the clutch driven member permitting the clutch to engage and the main shaft to revolve with the gear hub.

d. When any key lever is depressed, the following operations are performed:

(1) The universal contacts close (Tab I, #41).

(2) The key-lever contacts close, completing a circuit through one of the print magnets, and the clutch trip magnet. (Circuits covered in Tab O.)

(3) The clutch trip magnet is energized, and is held energized, through the closing of its locking contacts and the universal contacts, operating the clutch trip lever.

(4) When the clutch trip lever is actuated (figs. 20 and 21), its latching extension will be raised, permitting the clutch reset lever lower extension forward and move the adjusting screw down against the clutch throwout lever. As the clutch reset lever continues to move, the forward end of the clutch throwout lever is lifted out of engagement with the camming surface of the driven clutch member, permitting the main shaft to revolve. Near the end of the revolution of the main shaft, the clutch reset lever reset cam moves the clutch reset lever reset extension and returns the clutch reset lever lower extension to its latched position, permitting the clutch throwout lever to move down to and in the path of the camming surface of the clutch driven member, camming it out of mesh with the drive member.

(Clntinued on opposite page

(5) The nonrepeat latch is provided to prevent more than one operation with each depression of a key lever, regardless of the length of time a key lever is held depressed (fig. 21). Should the key lever be held depressed for a period longer than that required for one revolution of the main shaft, the clutch reset lever lower extension will engage the tooth on the nonrepeat latch, and the clutch throwout lever will be held against the camming surface of the clutch driven member. When the key lever is released, the clutch trip lever will assume its inoperative position, and its latching extension will push the nonrepeat latch down out of engagement with the clutch reset lever lower extension. This will permit the latching extension of the clutch trip lever to engage the lower extension of the clutch reset lever. The clutch reset lever will be held in this position until the clutch trip magnet is energized again by the depression of a key lever.

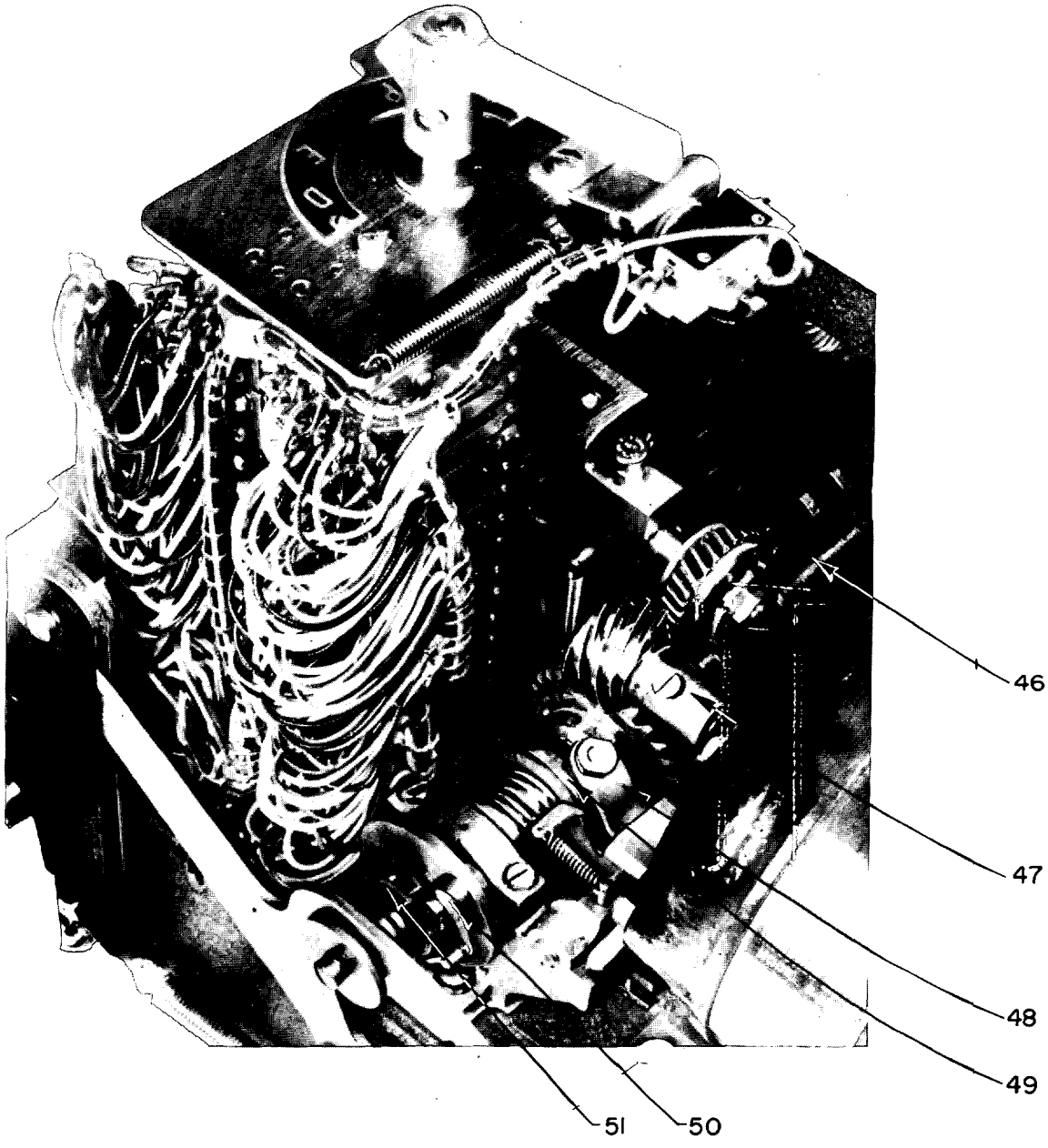


FIG. 11

46. Main shaft
47. Motor pinion
48. Clutch throwout lever
49. Main shaft driving clutch
50. Hand-lever pawl
51. Hand-lever slip ring

TAB L

Converter M-134-C

(Gears and Cams on Main Shaft)

(Continued from Tab K)

Tape Feeding or Spacing.

a. Tape feeding or spacing is accomplished by rotating the tape feed shaft clockwise the equivalent of one or more letter spaces as required. The tape feed shaft is rotated by the tape feed drive gear (on the main shaft gear hub) through the medium of a friction clutch (Tab J, Fig. 18). The tape is fed between two knurled rollers. The pressure roller is attached to the tape chute and is held up against the tape feed roller by a spring. The tape feed roller is attached to the tape feed shaft. A gear is fastened to the rear of each of the rollers. As the tape feed shaft is rotated, the tape feed roller and gear will rotate clockwise and the pressure roller and gear will rotate counterclockwise, causing the tape to be fed through the rollers and tape chute. Spacing of the tape is regulated by a tape feed pawl and a ratchet asselbly. The tape feed pawl is mounted on a shaft, just below the tape feed shaft. The tape feed ratchet assembly is made up of three ratchets and is mounted on the tape feed shaft.

b. The tape feed pawl is operated by the tape feed pawl follower and tape feed cam. With each operation of the main shaft, the tape feed pawl moves away from a ratchet tooth just long enough to permit the tape feed shaft and ratchet to turn until stopped by the next ratchet tooth. Thus the tape will be spaced out in the proper amount.

c. The front to rear position of the tape feed pawl is controlled by the position of the controller so that the tape feed pawl will operate in conjunction with one of the three ratchets. The rear ratchet has twelve teeth; the middle ratchet has two teeth; and the front ratchet has ten teeth which are spaced the same as the twelve-tooth ratchet, with the exception that one tooth is missing after each group of five teeth. Each tooth on the two-tooth ratchet lines up with the first tooth of each five-tooth group on the front ratchet.

d. When the controller is moved to the "P" or "D" position, the tape feed shift arm will move the tape feed shift lever so that the tape feed pawl will be in line with the twelve-tooth ratchet. The spacing of the tape will be regular.

e. When the controller is in the "E" position, the tape feed pawl will be in line with the ten-tooth ratchet and the tape will be advanced an extra space after every five-letter group.

f. The purpose of the two-tooth ratchet is to start the spacing of each five-letter enciphered group on the first letter. When the controller is moved through the "R" to the "E" position for encipherment, the tape feed pawl moves across a tooth on the two-tooth ratchet to a position where one of the teeth is missing on the ten-tooth ratchet. This will then be the proper position to start spacing for a five-letter enciphered group. When the "R" position of the controller is used, the tape feed pawl is opposite the two-tooth ratchet. The teeth of the two-tooth ratchet are long enough to prevent spacing in the "R" position.

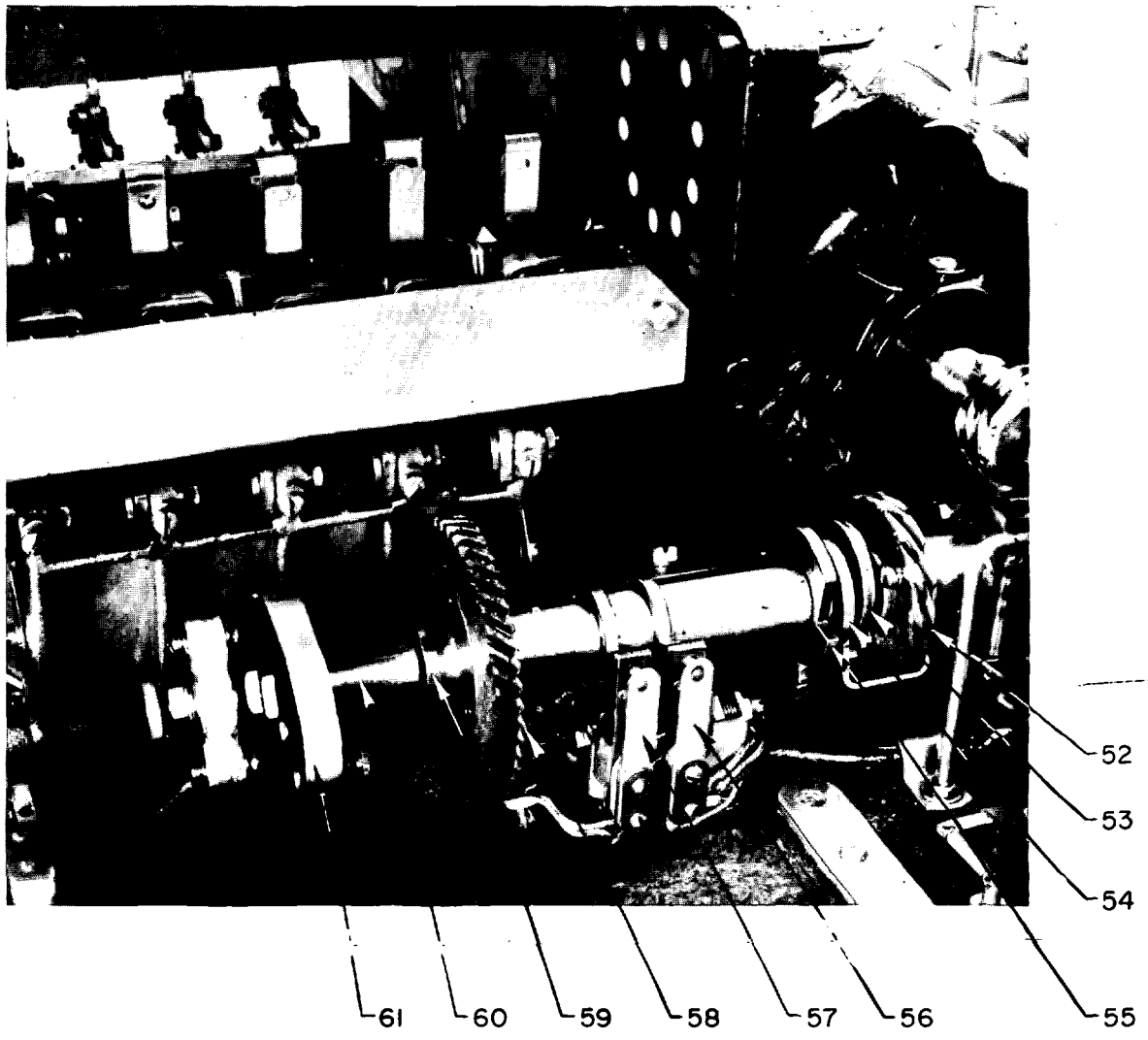


FIG. 12

52. Tape feed drive gear
53. Counter cam
54. Tape feed cam
55. Print hammer cam
56. "B" (stepping, contact
57. "A" (print) contact
58. Printer drive gear
59. Printer reset cam
60. Main shaft
61. Channel cam

TAB M

Converter M-134-C

(Standard Cipher Equipment (short title: SIGIVI) partly dismantled)

(Continued from Tab L)

Cipher Unit.

a. The cipher unit is designed to use five cipher, five control, and five index rotors. The cipher and control rotors may be used interchangeably in the cipher or control maze. The five index rotors can be used only in the index maze.

b. The cipher and control rotors are the larger size with 26 contacts while the index rotors are smaller and have 10 contacts. Each large rotor is made up of a steel ratchet wheel assembled between two bakelite sides. Each index or small rotor is made up of two bakelite sides but does not use the steel ratchet wheel. Each large rotor has 26 connections or "buttons" molded into each of its two sides, and each index rotor has 10 buttons. The connecting buttons on each side of each rotor are wired to the connecting buttons on the other side in a predetermined manner. When positioned in the cipher unit, the connecting buttons on the face of one rotor are connected to those on the adjacent rotors through the contact plungers mounted in the cipher unit separators. The outer connecting buttons on the end rotors are connected by the separators to the left and right end distributors. The right and left end distributors of the cipher maze are connected to the control switch pileups at the control cam; the right end distributor of the control maze is wired to contact "B"; the left end distributors of the control and index mazes are wired together; the right end distributor of the index maze is wired to the zeroize-operate key. When the converter is set for typing plain text, circuits from the key-lever contacts are connected at the control switch pileups of the control column to the corresponding print magnets. When the converter is set for enciphering, the circuits from the key-lever contacts are routed at the control column through the contacts and wiring of the cipher maze in a left-to-right direction. When the converter is set for deciphering, the circuits are similar except that they pass through the cipher maze in a reverse direction (right-to-left). The angular position of one or more of the rotors in the cipher maze are changed by advancing them one step with each operation of a key lever. This is accomplished by means of the rotor magnet assembly and the rotor drive bar assembly.

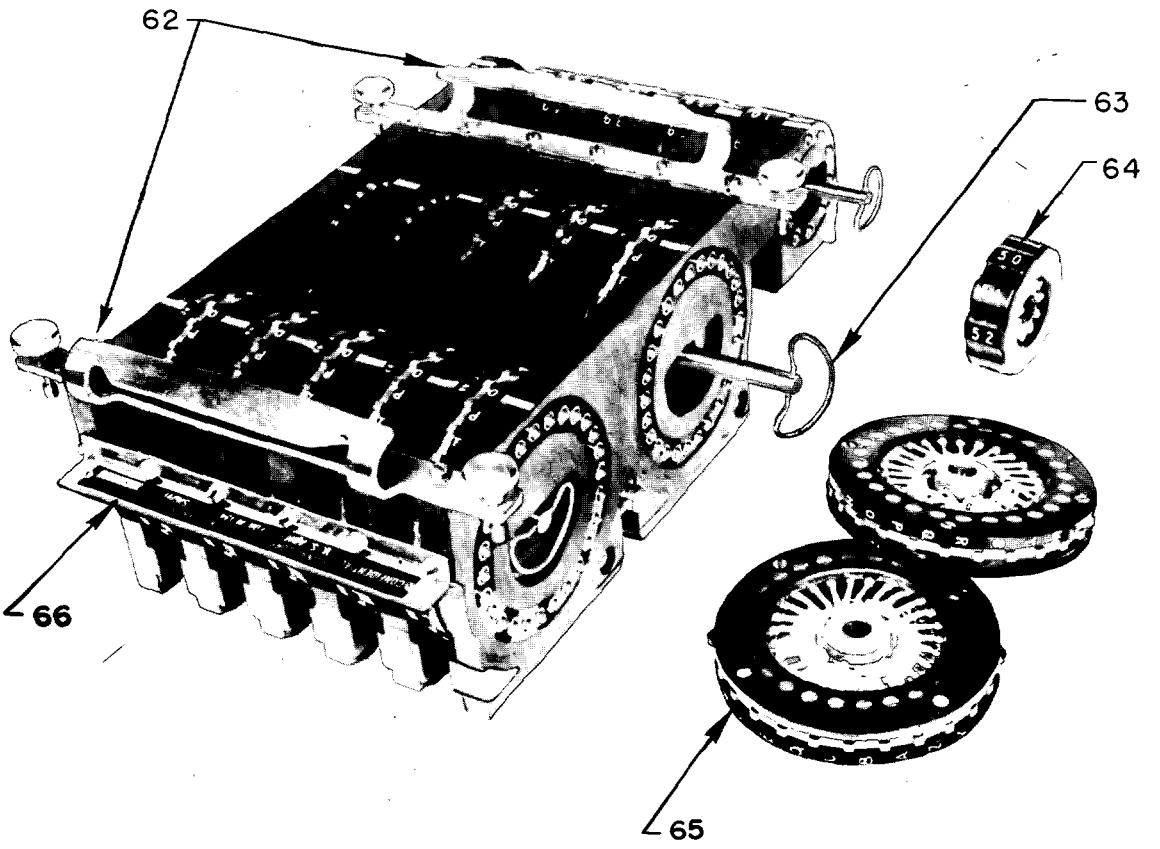


FIG. 13

62. Cipher unit
63. Rotor shaft
64. Index rotor
65. Cipher and control rotors
66. Name plate with register number

TAB N

Converter M-134-C

(Special Cipher Unit (short title: SIGAMUG), partly dismantled)

The special cipher unit (short title: SIGAMUG) can be used in the place of the regular cipher unit (short title: SIGIVI) in order to make Converter M-134-C the equivalent of the Combined Cipher Machine. The stepping of the SIGAMUG rotors is controlled by the contours cut at irregular intervals on the periphery of the rotors. Only five rotors are used in SIGAMUG at one time. The rotors in the Standard cipher unit (short title: SIGIVI) ARE NOT INTERCHANGEABLE with those used in the special cipher unit. More detailed information in reference to the use of SIGAMUG may be obtained from the document "Operating Instructions for Combined Cipher Machines" (short title: SIGDUBN).

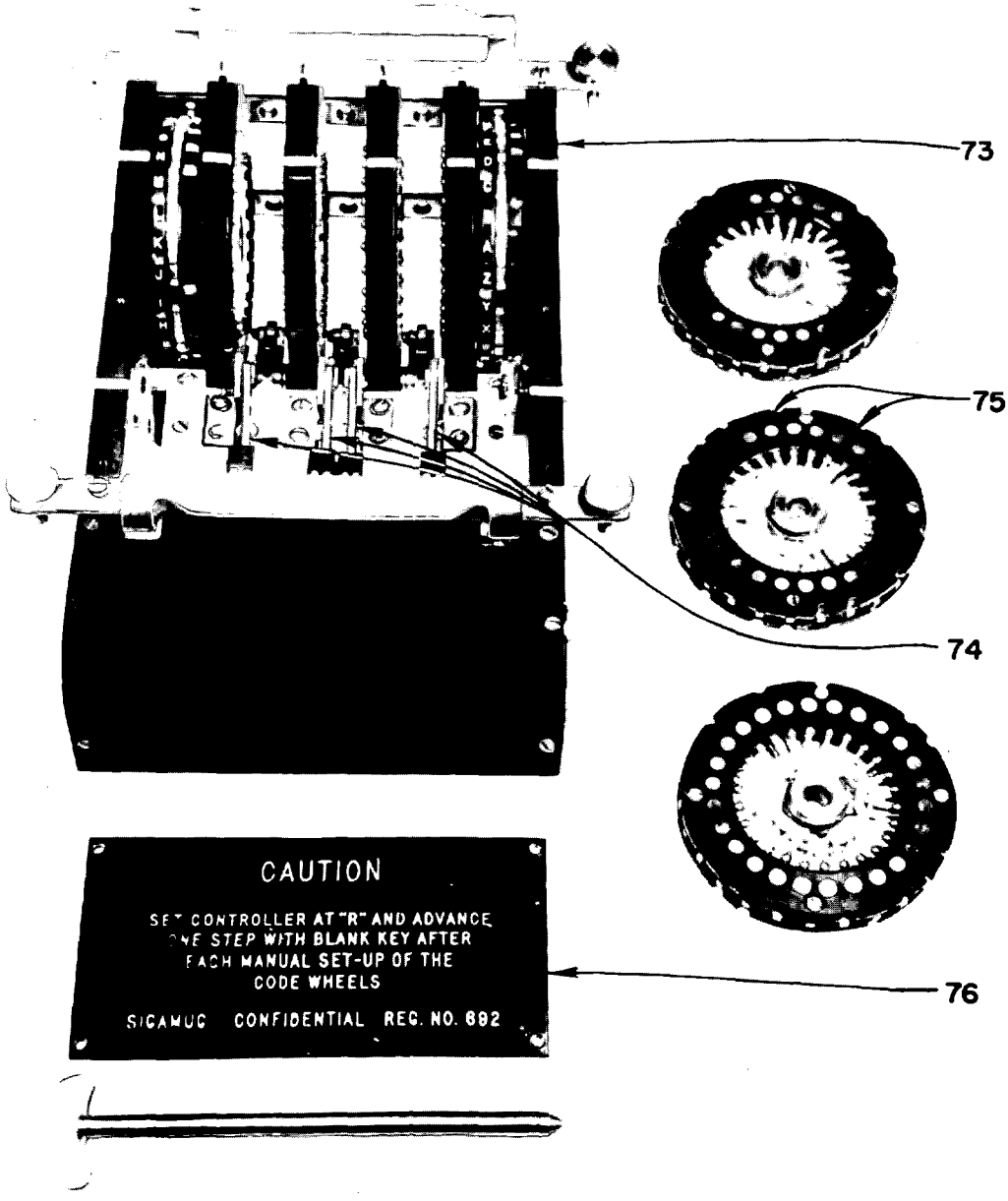


FIG. 16

73. Special cipher unit (short title: SIGAMUG)
74. Contact operating arms
75. Contours cut in periphery of rotors
76. Name plate (removed to permit view of contact operating arms)

TAB O

Detailed Description of Circuits and

Wiring Diagram SC-D-18511A

(Actual Wiring of Converter M-134-C)

CIRCUITS

Description of Circuits.

a. The electrical wiring of the converter may be divided into several different circuits. The two primary circuits are the "printing" and "stepping" circuits. Secondary circuits consist of motor, spark suppressor, and power distribution circuits.

b. To change from a.c. to d.c. operation or vice versa, the only change necessary in the installation of the proper motor (par. 133c, "Maintenance Instructions for Converter M-134-C" (short title: SIGKKK-2)).

c. All changes in the wiring of the power distribution circuits necessitated by a change of power are accomplished by the internal wiring of the motor and dummy plugs.

d. In tracing the circuits described in paragraphs below, the actual wiring circuit, SC-D-18511A, should be used. All circuits have been traced assuming a.c. power.

Print circuit, controller in "P" position. - This paragraph traces the circuit of the letter "A"; the zeroize-operate key must be in the "Operate" position. One side of power at R of terminal block - R wire to fuse - thru fuse - R wire to power switch - thru power switch - Y wire to Y on terminal block - Y wire to R-1 switch - closed contacts of R-1 switch - BR wire to common side of key-lever contacts - letter "A" key-lever contacts - Y wire to #1 of receptacle A-Y wire to letter "A" control switch pileup - thru closed contacts of upper and lower pileups - Y wire to #1 of receptacle B-Y wire to #1 of plug C - thru letter "A" print magnet - #22 of plug C - W wire to operate contacts of zeroize-operate key - made contacts - Y wire to contact A - thru contacts - G wire to contact of clutch trip magnet - O wire to clutch trip magnet - thru magnet - R wire to 300-ohm resistor - R wire to R terminal - strapped to G thru motor plug - G wire to G on terminal block - G wire to power switch - thru power switch - BK wire to fuse - thru fuse - BK wire to BK on terminal block - other side of power.

Print circuit, controller in "E" position.

a. With the controller in the "E" position the selected letter is enciphered. This means that the energized magnet in the printer may not correspond to the key lever operated. This is caused by the printing circuit going through the cipher rotors from distributor B to distributor A.

b. This subparagraph traces the circuit of the letter "A"; the zeroize-operate key must be in the "Operate" position. One side of power at R of terminal block - R wire to fuse - thru fuse - R wire to power switch - thru power switch - Y wire to Y on terminal block - Y wire to R-1 switch - closed contacts of R-1 switch - BR wire to common side of key-lever contacts - letter "A" lever contacts - Y wire to #1 of receptacle A - Y wire to upper control switch pileup of letter "A" - closed contacts of upper pileup - lower pileup - BR wire to distributor B - thru maze - At this point the circuit to distributor A is determined by the wiring of the five cipher rotors. For purposes of tracing the circuit assume it terminates

(Circuits, continued)

on the letter "B" of distributor A - PK wire to upper control switch pileup of letter "B" - lower pileup - made contacts - G wire to #2 of receptacle B - G wire to #1 of plug D - thru print magnet of letter "B" - #22 of plug D - PK wire to #24 of plug C - W wire to operate contacts of zeroize-operate key - made contacts - Y wire to contact A - thru contacts - G wire to contact of clutch trip magnet - O wire to clutch trip magnet - thru magnet - R wire to 300-ohm resistor - R wire to R terminal - strapped to G thru motor plug - G wire to G on terminal block - G wire to power switch-thru power switch - BK wire to fuse - thru fuse - BK wire to BK on terminal block - other side of power.

Print circuit, controller in "D" position.

a. Wirh the controller in the "D" position, the converter will decipher a previously enciphered character. If the proper operating procedure has been followed, all rotors of the cipher maze will be in the same position as when the character was enciphered. To decipher the character, it is only necessary to reverse the circuit through the rotors of the cipher maze.

b. This subparagraph traces the circuit of the letter "B"; the zeroize-operate key must be in the "Operate" position. One side of power at R of terminal block - R wire to fuse - thru fuse - R wire to power switch - thru power switch - Y wire to Y on terminal block - Y wire to R-1 switch - closed contacts of R-1 switch - BR wire to common side of key-lever contacts - letter "B" key-lever contacts - G wire to #2 of receptacle A- G wire to upper control switch pileup of letter "B" - made contacts of upper pileup - PK wire to distributor A - thru wiring of five cipher rotors, terminating at "A" on distributor B (as assumed in paragraph above) - BR wire to lower control switch pileup of letter "A" - closed contacts of lower pileup - Y wire to #1 of receptacle B - Y wire to #1 of plug C - thru letter "A" print magnet - #22 of plug C - W wire to operate contacts of zeroize-operate key - made contacts - Y wire to contact A - thru contacts - G wire to contack of clutch trip magnet - O wire to clutch trip magnet - thru magnet - R wire to 300-ohm resistor - R wire to R terminal - strapped to G thru motor plug - G wire to G on terminal block - G wire to power switch - thru power switch - BK wire to fuse - thru fuse - BK wire to BK on terminal block - other side of power.

Stepping circuit, cipher rotor magnets, controller in "E" or "D" position, zeroize-operate key in "Operate" position.

a. When enciphering, deciphering, or individually stepping the control rotors, a minimum of one and a maximum of four of the cipher rotors advance one step during each revolution of the main shaft.

(Continued on reverse side)

(Circuits, continued)

b. The number of cipher rotor magnets energized is controlled by the number of circuits completed through the control and index rotors. Four contact buttons in the right distributor of the control maze are wired together. These four circuits, after going through the rotors of the control maze, terminate at contact buttons on the left control distributor. As determined by the wiring of the control rotors and the left control distributor it is possible to have a minimum of one and a maximum of four circuits continue on from this point. In the index maze it is also possible to reduce the number of circuits. On the incoming (left) side of the maze there are nine available circuits (#1 is blank). Due to the strapping of the contacts on the out-going (right) side of the maze, only five circuits continue. The actual paths of the circuits would be determined by the wiring of the index rotors.

c. One side of power at R of terminal block - R wire to fuse - thru fuse - R wire to power switch - thru power switch - Y wire to Y on terminal block - Y wire to R-1 switch - Y strap to P switch - internal strap and closed contacts to BK of P switch - BK wire to "B" contacts ("B" contacts close when the main shaft starts to revolve) - R wire to right side of control maze - (for the purpose of tracing the circuit assume all terminate on #3) - #3 on left of control maze - BR wire to #3 of index maze - thru rotors of index maze - (for the purpose of tracing the circuit assume it terminates on #8 at the right side of the index maze) - R wire to operate contacts of zeroize-operate key - 8D to 8S contact - BR wire to contact 8 of rotor magnet assembly outlet - prong 8 of plug - R wire to magnet #8 - thru magnet - common strap - R wire to prong 12 of plug - contact 12 of outlet - R wire to resistor - thru 25 ohms resistance - Y wire to Y terminal - strapped to G thru motor plug - G wire to G on terminal block - G wire to power switch - thru power switch - BK wire to fuse - thru fuse - BK wire to BK on terminal block - other side of power.

Stepping circuit, control rotor magnets, controller in "E" or "D" position, zeroize-operate key in "Operate" position.

a. Magnet #3. One side of power at R of terminal block - R wire to fuse - thru fuse - R wire to power switch - thru power switch - Y wire to Y on terminal block - Y wire to R-1 switch - Y strap to P switch - internal strap and closed contacts to BK of P switch - BK wire to "B" contacts ("B" contacts close when main shaft starts to revolve) - R wire to R-2 switch - closed contacts of R-2 switch - Y wire to swinger contact spring of #3 control rotor stepping contacts - R wire to contact 3 of rotor magnet assembly outlet - prong 3 of plug - BR wire to magnet #3 - thru magnet - common strap - BK wire to prong 11 of plug - contact 11 of outlet - BK wire to resistor - thru 25 ohms resistance - R wire to R terminal - strapped to R and G terminals thru motor plug - G wire to G on terminal block - G wire to power switch - thru power switch - BK wire to fuse - thru fuse - BK wire to BK on terminal block - other side of power.

b. Magnet #4. To energize magnet #4, the outer contact of rotor stepping contact assembly #3 must close. The closing of this contact places magnet #4 in parallel with magnet #3. One side of power at R of

(Circuits, continued)

terminal block to swinger contact spring of #3 control rotor stepping contacts as in a above. Thru made swinger and outer contacts of #3 control rotor stepping contacts - G wire to R-2 switch - closed contacts of R-2 switch - BK wire to swinger contact spring of #4 control rotor stepping contacts - BK wire to contact 4 of rotor magnet outlet - prong 4 of plug - PK wire to magnet #4 - thru magnet - common strap - BK wire to prong 11 of plug - contact 11 of outlet. Circuit continues from this point as in a above to other side of power.

c. Magnet #2. To energize magnet #2, the outer contacts of rotor stepping contact assemblies #3 and #4 must be closed. The closing of these contacts places magnet #2 in parallel with magnets #3 and #4. One side of power at R of terminal block to swinger contact spring of #4 control rotor stepping contacts as in a and b above. Thru made swinger and outer contact of #4 control rotor stepping contacts - O wire to R-2 switch - closed contacts of R-2 switch - S wire to swinger contact spring of #2 control rotor stepping contacts - S wire to contact 2 of rotor magnet outlet - prong 2 of plug - G wire to #2 magnet - thru magnet - common strap - BK wire to prong 11 of plug - contact 11 of outlet. Circuit continues from this point as in a above to other side of power.

Stepping circuit, all rotor magnets, controller in "R" position, zeroize-operate key in "Zeroize" position.

a. Magnet #8 used for illustration of cipher rotor circuit. - One side of power at R of terminal block - R wire to fuse - thru fuse - R wire to power switch - thru power switch - Y wire to Y on terminal b block - Y wire to R-1 switch - Y strap to P switch - internal strap to closed contacts to BK of P switch - BK wire to "B" contacts ("B" contacts close when main shaft starts to revolve) - R wire to zeroize-operate key (ten contacts of the zeroize-operate key are strapped to route circuits to the ten rotor magnets) - thru #8 set of rotor stepping contacts - R wire to #8 set of cipher rotor stepping contacts - thru closed contacts - BR wire to contact 8 of rotor magnet assembly outlet - prong 8 of plug - R wire to magnet #8 - thru magnet - common strap - R wire to prong 12 of plug - contact 12 of outlet - R wire to resistor- thru 25 ohms resistance - Y wire to Y terminal - strapped to G thru motor plug - G wire to G on terminal block - G wire to power switch - thru power switch - BK wire to fuse - thru fuse - BK wire to BK on terminal block - other side of power.

b. Magnet #3 used for illustration of control rotor circuit. - One side of power to the ten strapped contacts of the zeroize-operate key as in a above - thru #3 set of rotor stepping contacts - BR wire to inner contact spring of #3 control rotor stepping contacts - thru closed contacts - R wire to contact 3 of rotor magnet assembly outlet - prong 3 of plug - BR wire to magnet #3 - thru magnet - common strap - BK wire to prong 11 of plug - contact 11 of outlet - BK wire to

(Continued on reverse side)

(Circuits, continued)

resistor - thru 25 ohms resistance - R wire to R terminal - strapped to R and G terminals thru motor plug - G wire to G on terminal block - G wire to power switch - thru switch - BK wire to fuse - thru fuse - BK wire to BK on terminal block- other side of power.

Stepping circuit, control rotor magnets, controller in "R" position, zeroize-operate key in "Operate" position. - Magnet #3 used to illustrate control rotor circuits. One side of power at R of terminal block - R wire to fuse - thru fuse - R wire to power switch - thru power switch Y wire to Y on terminal block - Y wire to R-1 switch - Y strap to P switch - internal strap and closed contacts to BK of P switch - BK wire to "B" contacts ("B" contacts close when main shaft starts to revolve) - R wire to lower contact of number 5 key lever - common strap to lower contact of number 3 key lever (key lever operated) - thru contacts - R wire to contact 3 of rotor magnet assembly outlet - prong 3 of plug - BR wire to magnet #3 - thru magnet - common strap - BK wire to prong 11 of plug - contact 11 of outlet - BK wire to resistor - thru 25 ohms resistance - R wire to R terminal - strapped to R and G terminals thru motor plug - G wire to G on terminal block - G wire to power switch - thru power switch - BK wire to fuse - thru fuse - BK wire to BK on terminal block - other side of power.

Spark suppressor circuits.

a. Spark suppressor circuits are used across the "A" (print) contacts and across the contacts of the control and cipher rotors.

b. The "A" (print) contact suppressor circuit consists of one 1-microfarad condenser and 400 ohms of resistance in series, across the "A" contacts.

c. A spark protection circuit containing one 2-mocrofarad condenser is connected across the series circuit which includes the contacts of the control and index rotors and the windings of the cipher rotor magnets.

Miscellaneous circuits.

a. Clutch trip magnet lockup circuit. - One side of power at R of terminal block - R wire to fuse - thru fuse - R wire to power switch - thru power switch - Y wire to Y on terminal block - strapped to Y on terminal block - Y wire to "Repeat" key contacts - thru closed contacts of "Repeat" key - PK wire to universal contacts - thru made universal contacts - S wire to #27 of receptacle A - to #27 of receptacle B - S wire to locking contact of clutch trip magnet - thru made contacts - O wire to clutch trip magnet - thru magnet - R wire to 300-ohm resistor - R wire to R terminal - strapped to G thru motor plug - G wire to G on terminal block - G wire to power switch - thru power switch - BK wire to fuse - thru fuse - BK wire to BK on terminal block - other side of power.

b. Line filter circuits. - Connected across the incoming power line at the fuses are two 1-microfarad condensers, one from each side of the power line to a common ground.

(Circuits, continued)

c. Power distribution. - Changes in power distribution circuits when using 110-v., a.c. or d.c., or 24-v. emergency power:

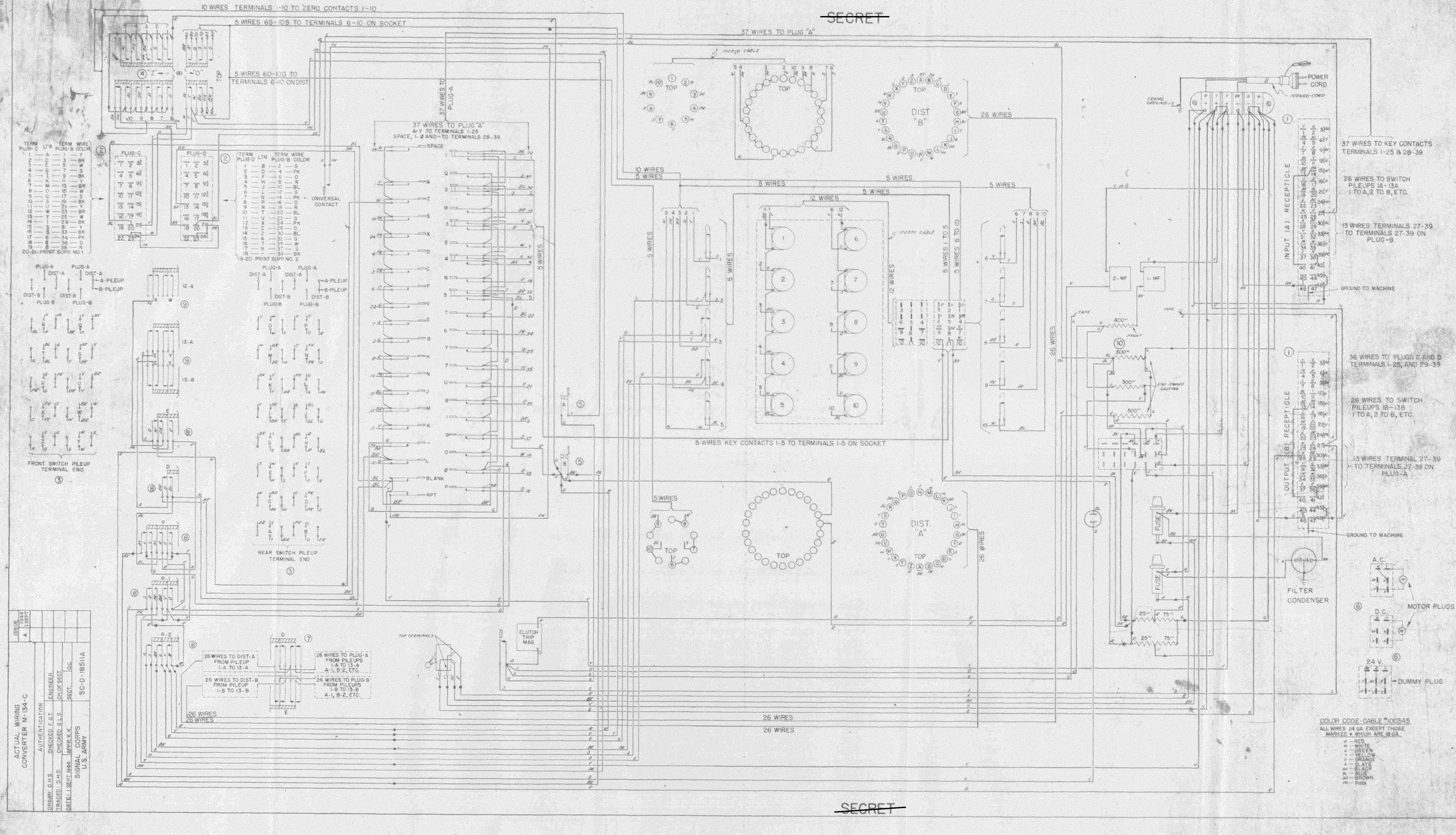
Circuits	110-v a.c.	110-v d.c.
Print Suppress Magnet #2	300 ohms in series	300 ohms in series
Print Circuit	None	300 ohms in series
Stepping Magnet, Control Rotors	25 ohms in series	100 ohms in series
Stepping Magnet, Cipher Rotors	25 ohms in series	100 ohms in series

When operating on 24-v. emergency power supply, all the above resistors are short circuited. In addition a 300-ohm resistor is shunted across the winding of the clutch trip magnet.

d. The circuit changes outlined in c above are accomplished automatically through the internal wiring of the motor and dummy plugs when inserted in their proper location.

REF ID:A523210

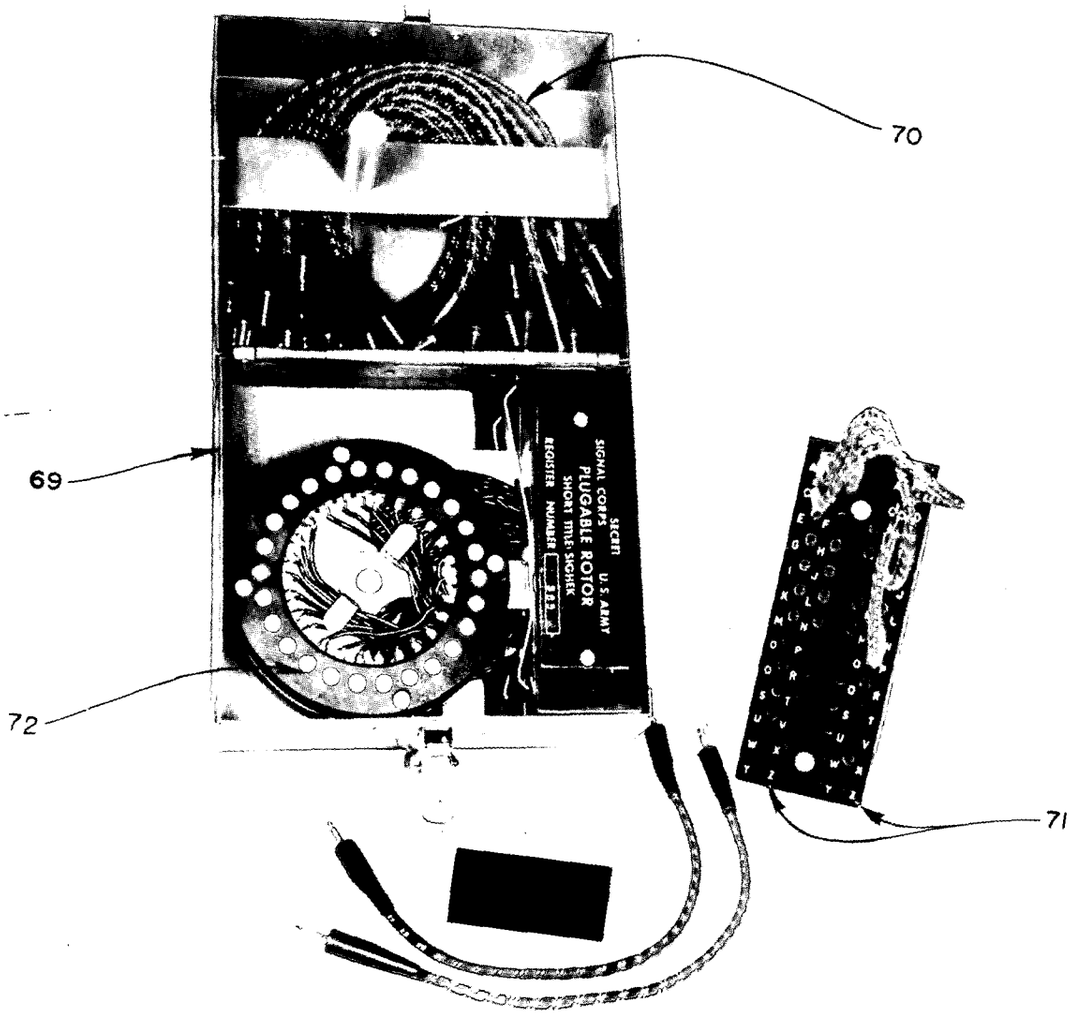
~~SECRET~~



TAB P

Pluggable Rotor

(short title: SIGHEK)



69. Metal container
70. Patch cords
71. Engraved alphabets
72. Pluggable rotor (short title: SIGHEK)

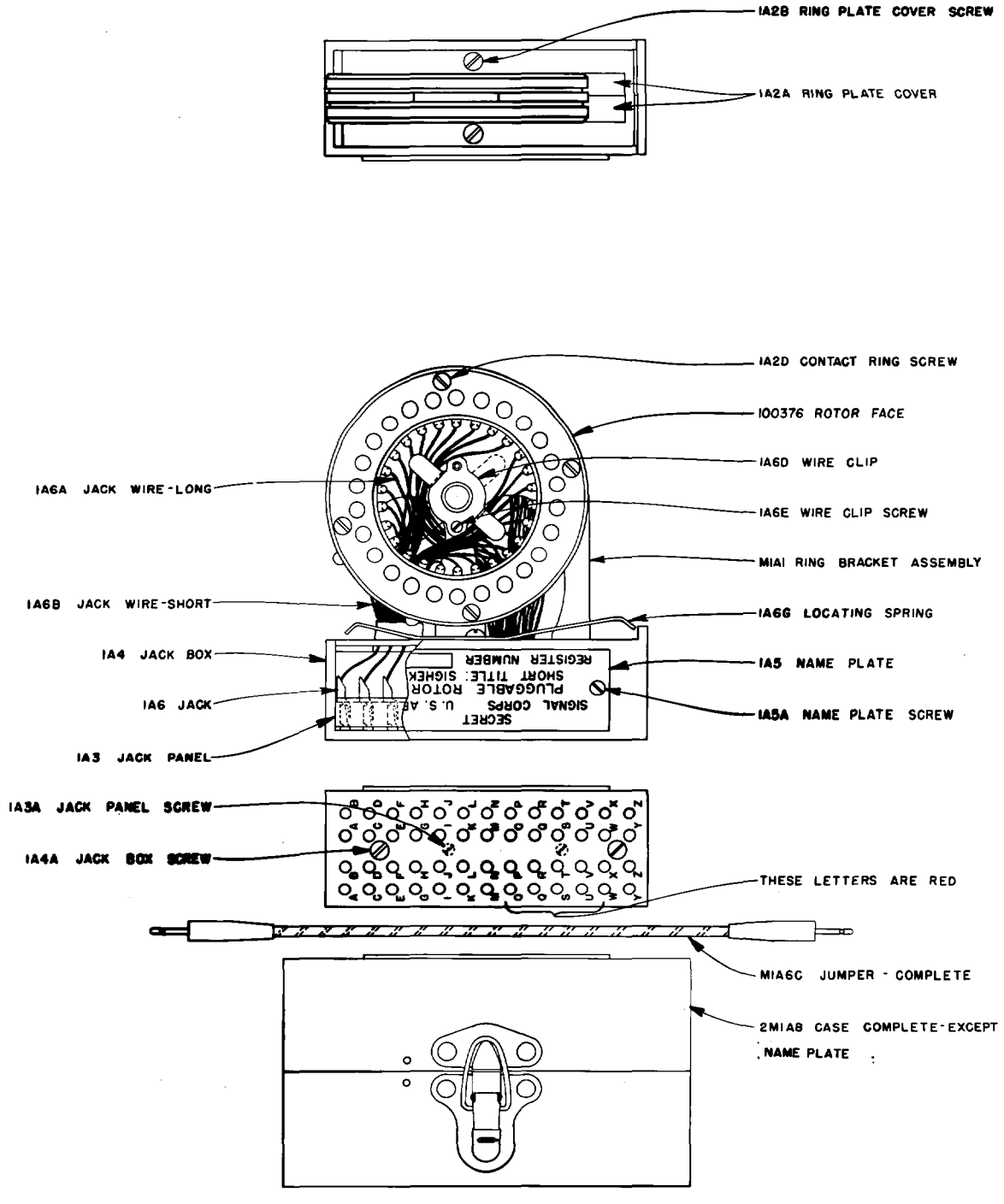


FIG. 81

TAB Q

History of Invention and Development of the Mark II ECM

Submitted by Captain L. F. Safford

of the

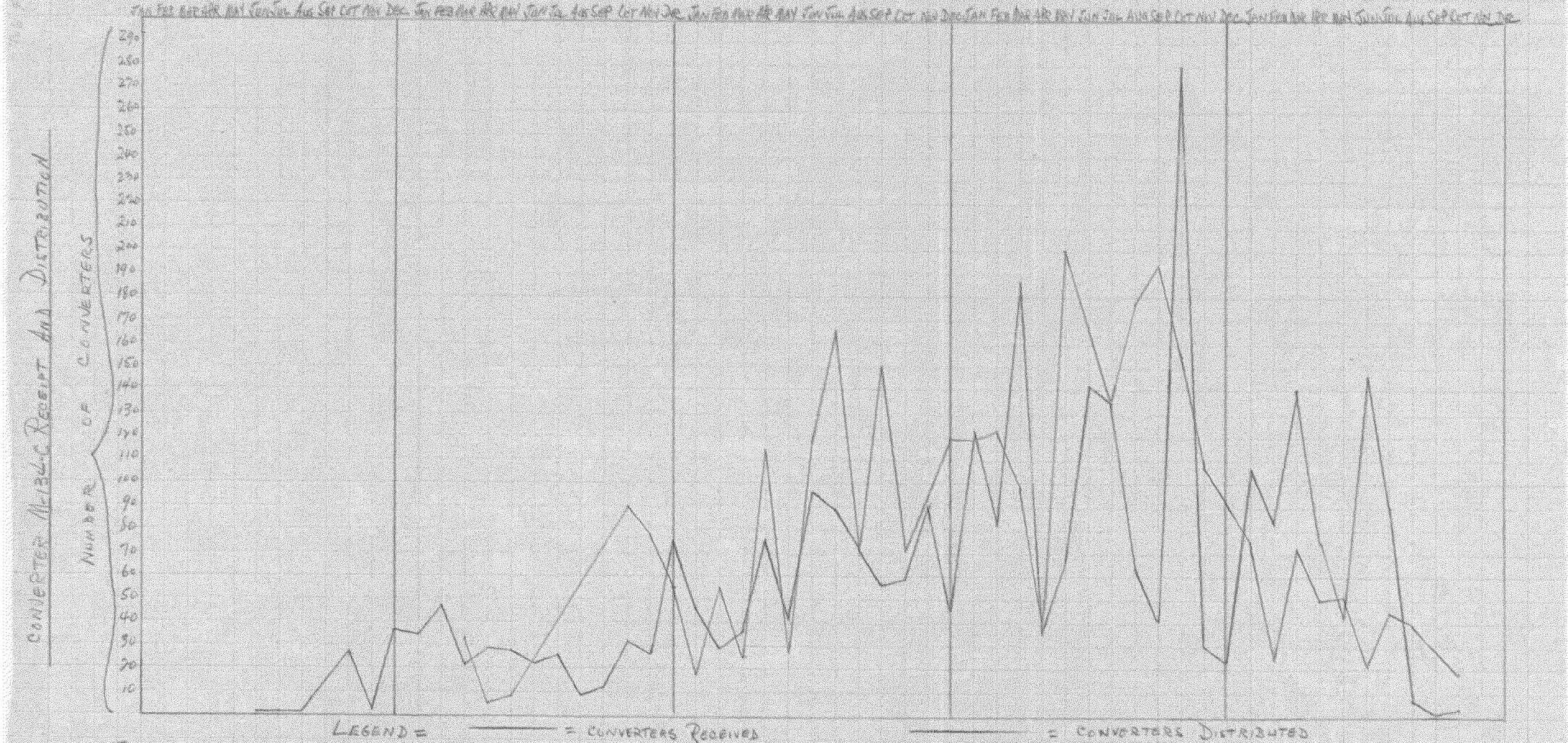
United States Navy

30 October 1943

TAB R

Converter M-134-C

Receipt and Distribution Chart



CUMULATIVE TOTALS:

CONVERTERS REC'D =

CONVERTERS DISTRD =

(OVER)

* The first voucher executed by the Custodian, Arlington Hall Station, assuming responsibility for the converters is dated March 1942. This voucher consolidates all converters delivered by the manufacturer up to this date. It is stated that vouchers covering individual deliveries for the 280 converters were not available.

* The following will be noted:

1942 Feburary Total 187 includes 47 converters of 01 thru 200 series the date of original issue of which could not be immediately determined.

June[illegible]er Total 309 includes 21 converters of 201 thru 300 series, same as above.

November Total 436 includes 22 converters of 301 thru 400 series, same as above.

1943	January	Total	572	includes	14	"	401	"	500	"	"
	February	"	629	"	28	"	501	"	600	"	"
	April	"	743	"	2	"	601	"	700	"	"
	July	"	973	"	3	"	801	"	900	"	"
	August	"	1049	"	3	"	901	"	1000	"	"
	November	"	1258	"	3	"	1101	"	1200	"	"
	December	"	1305	"	1	"	1201	"	1300	"	"
1944	January	"	1429	"	2	"	1301	"	1400	"	"

This total also includes 7 converters (3356 thru 3362) [of total of 3330]

February Total includes converters 3363 thru 3369

1946 The following disposition will be noted:

January 1946 :109 converters immediately turned over the warehouse

April 1946 3 converters distributed

June 1946 1 converter distributed

Total 0113

Plus 3217 as distributed 1941 – 1945

Total 3330 number of converters delivered

It will be further noted that in a good number of instances for the earlier converters, through the first 600, the receipt date was used when it was available and the issue date not. Several dates were determined or approximated by reference to Holder Files; however, all holder files were not checked for non-available issue or receipt dates.

All of this information is taken from the SIGABA Machine Items Record, Security Division, ASA.

The inclusion of converters for which initial distribution dates were not determined in the total figure at the time when the converters of a certain series had been received and it could be assumed had been issued accounts for the fact that the distribution figures for Jan, Feb, Mar 1943 exceed receipt figures.

* Some place along the line 14 converters bearing register nos. 3356 thru 3369 were manufactured. The register nos. run consecutively up to 3316 and then skip to 3356.

TAB S

Official Documents Concerning Physical Safeguarding of Converter M-134-C (See Chapter XV)

1. Army-Navy Joint Policy Concerning Distribution and Disclosure of Cryptographic Design of the ECM-M-134-C.

2. "Policy Concerning Distribution and Disclosure of Cryptographic Design of Converters M-134, M-134-A, M-134-C", SPSIC 461 Codes, 24 August 1942.

3. Same title, AG 413.51 (1 Jul 44) OB-S-B-M, 3 July 1944.

4. Same title, (Change letter), AG 413.51 (26 Jul 44) OB-S-B-M, 28 July 1944.

5. "Policy Concerning Distribution and Disclosure of Cryptographic Design of Converter M-134-C," AG 413.51 (11 Oct 44) OB-S-B-M, 12 October 1944.

6. Same title, AG 413.51 (15 Jun 45) OB-S-B, 17 June 1945.

7. Paragraphs 11, 15, and 17 of "General Instructions for Converter M-134-C" (short title: SIGBRE-1), AG 311.5 (21 Feb 45) OB-S-B, authenticated 7 May 1945; published June 1945.

8. "Instructions for Proper Packing and Handling of SIGABA and All Other Cryptographic Material for Overseas Shipment", AG 311.5 (12 Jul 44)OB-S-SPSIC-M, 12 July 1944.

9. "Proper Safeguarding of SIGABA Equipment", SPSIS 461 Codes, 30 March 1943.

10. "Policy Concerning Transportation of Converter M-134-C in Aircraft", AG 311.5 (28 Nov 44) OB-S-B-M, 1 December 1944.

11. "Policy Concerning the Use of Chest CH-76", AG 428 (14 Feb 45) OB-S-B-M, 17 February 1945.

12. "Policy Concerning the Use of Chest CH-76", AG 428 (31 Mar 45) OB-S-B-M, 3 April 1945.

TOP SECRET

Paragraphs 11, 15 and 17 of "General Instructions for Converter M-134-C" (short title: SIGBRE-1), AG 311.5 (21 Feb 45)OB-S-B, authenticated 7 May 1945; published June 1945

* * * * * *

11. Classification and Safeguarding.

a. Converter M-134-C, exclusive of rotors, is classified CONFIDENTIAL.

b. The cipher unit, exclusive of rotors, is classified CONFIDENTIAL.

c. The index rotors are classified CONFIDENTIAL.

d. The cipher and control rotors, including the pluggable rotor, are classified SECRET.

e. The combined adapter (short title: SIGAMUG), exclusive of rotors, is classified CONFIDENTIAL.

f. Converter M-134-C and associated material will be handled in accordance with the provisions of AR 380-5, 15 March 1944. Information pertaining to Converter M-134-C and associated material will be divulged only to those duly authorized members of the U. S. armed forces and specifically authorized U. S. citizens whose cryptographic duties necessitate a knowledge of such information and who have been cleared in accordance with letter AG 311.5 (12 Mar 45) OB-I-B-M, 21 March 1945, Subject: Clearance of Personnel for Cryptographic Duties.

* * * * * *

15. Access to and Safeguarding of Information Pertaining to Converter M-134-C.

a. Only persons who are authorized in accordance with the policy of the War Department governing clearance of cryptographic personnel (see par. 11) will have access to Converter M-134-C, associated material, or information pertaining thereto.

b. All information concerning any details of Converter M-134-C, including rotors, wiring diagrams, key lists, keying instructions, maintenance instructions, and operating instructions, will be regarded as classified information and will be divulged only in accordance with paragraph 11 above.

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c. The War Department may make Converter M-134-C available to the Allies of the United States provided that it is accompanied by a liaison officer and Communication Group. It will be the duty of the liaison officer to prevent the viewing of the converter or its operation, or the viewing of associated equipment and documents, by anyone other than authorized personnel of U. S. armed forces.

* * * * * *

17. Safeguarding Converter M-134-C in Foreign Countries.

a. Converter M-134-C will not be taken into areas which are liable to imminent capture by the enemy. Converter M-134-C and associated material will not be placed ashore in territories outside the continental limits of the United States except at such places where armed personnel of U. S. forces are stationed in sufficient numbers to insure the continued physical security of the converter, and to effect its immediate and complete destruction in event of imminent capture or subjection to physical compromise. Provided that these minimum physical security safeguards have been adequately effected and are rigidly enforced, the following operational conditions will determine the authority for approving requests for installation and use of Converter M-134-C in such areas:

(1) In cases involving U. S. Army units engaged in tactical operations in foreign territory, requests for authorization for the installation and use of the converter by such units will be referred for approval to the commander of the highest echelon of U. S. armed forces present during such tactical operations.

(2) In cases involving U. S. Army units in liberated and occupied countries under the control of U. S. armed forces, or in U. S. and Allied territories and possessions within the territorial limits of a theater or area of operations, department, or defense command, requests for the issuance of the converter to such units will be forwarded through military channels to be approved by the U. S. commander of the theater, area, department, or defense command concerned.

(3) In cases involving U. S. Army units in neutral nations, in liberated or occupied countries <u>not</u> under the control of U. S. armed forces, or in Allied nations <u>not</u> within the territorial limits of a theater or area of operations, department or defense command, requests for the issuance of the converter to such units will be submitted through military channels to be approved by the War Department.

(4) In all cases, units requesting approval for the use of the Converter under any of the above operating conditions will inform the approving authority as to the volume, nature, and scope of the unit's communication requirements, the number and type of U. S. troops stationed at the proposed installation to insure its continued physical security, and the measures and means to be employed to effect its immediate and complete destruction in an emergency.

(5) In all cases in which approval has been granted by the appropriate authority for use of the converter by U. S. Army units operating under any of the above conditions, commanders of such units will be responsible for informing the approving authority of any change in status of the items cited in subparagraph (4) above which would remove the military necessity for continued use of the converter or which would jeopardize its physical security under such operating conditions.

b. Prior to overseas shipment Converter M-134-C and all associated material should be installed in a CH-76. If a CH-76 is not available, Converter M-134-C and associated material will be handled in accordance with the provisions of paragraphs 25a, 27a, and 30, AR 380-5, 15 March 1944.

c. Unless authorized to the contrary (see par. 12d above), units outside the continental United States will not transport, operate, or otherwise handle Converter M-134-C unless it is installed in Chest CH-76.

TAB T

ETOUSA Rules for Guarding Converter M-134-C

These are the rules which the Army personnel who lost the Converter M-134-C in Colmar, France should have been familiar with.

ARMY REGULATIONS NO. 380-5,
War Department, 15 March, 1944.

Par. 30. Storage of Classified Documents.

b. Storage of registered documents.

(1)Registered documents will be stored in the most secure space available, preferably the equivalent of a three-combination safe. If a three combination safe is not available, then the documents should be kept constantly under armed guard. Field lock safes will be considered the equivalent of three-combination safes for the storage of registered documents for units serving in the field outside of posts and garrisons.

d. Daily inspection.--At every headquarters an inspection will be made each day immediately before the close of business to insure that all classified documents and cryptographic devices have been properly put away.

e. Security in field.--In tactical operations, actual or simulated, the commanding officer of the unit concerned is responsible that all documents are given the maximum security possible under the circumstances. No secret document will be taken into areas liable to imminent capture by the enemy.

Par. 43. Cryptographic security officer.--a. At each headquarters maintaining a message center the commander will appoint a commissioned officer as cryptographic security officer, who ordinarily will be the officer in charge of the message center. He will be the custodian of cryptographic material and will be responsible for all measures necessary to insure cryptographic security and physical security thereof.

Par. 44. Precautions necessary to insure cryptographic security.--In order to insure cryptographic security the following principles must be observed:

a. Cryptographic material will be given the most secure storage available and will never be left unattended except when deposited in a three-combination safe or its equivalent.

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HEADQUARTERS
EUROPEAN THEATER OF OPERATIONS
UNITED STATES ARMY
OFFICE OF THE CHIEF SIGNAL OFFICER

ETSIC-I/lbm/ih

14 March 1944

SUBJECT: Protection of Cryptographic Equipment During Transit in all phases of Operation.

TO : Signal Communication, and Signal Security Officers down to and including Division Headquarters in Army Ground Forces; Wing Headquarters in Army Air Forces; Ports and Depots in Services of Supply.

It is intended that this publication will provide specific information pertaining to physical security practices involved in the Protection of Cryptographic Equipment during Transit with particular respect to the following phases of operation:

A. Static Operation
B. Mobile Operation
C. Assault Operation
D. Landing Operation
E. Echelon Operation

A. Static Operation

Cryptographic material and associated equipment is always highly vulnerable to capture by the enemy or compromise during transit irrespective of geographic location. All responsible personnel operating in a static position must be constantly alert to protect cryptographic equipment from capture by the enemy and loss through careless handling. The following security measures should be observed by all concerned:

Wrapping and Packing:

(1) All Secret and Confidential cryptographic documents and material normally handled by the U.S. Army Postal Service, GHQ Messenger Service, or Officer Courier Service will be securely wrapped with an inner and outer cover. The inner cover will contain the classification clearly stamped with the words, "For Signal Security Officer", in addition to address that appears on outer cover. The outer cover will show no classification and should be addressed to the Commanding General, Commanding Officer, or Signal Officer and in no case will the term cryptographic, code, cipher or equivalent term appear on the outer cover.

(2) A numbered package receipt attached to the outside of the inner cover and an original and duplicate document receipt stating contents, indicating short titles, copy numbers and quantity of each item should be included in each package.

(3) Heavy cryptographic equipment not normally transported by U.S. Postal or Messenger Service will be properly packed or crated to withstand the particular means of transportation. The following protective measures will be observed in preparing the SIGABA for any means of transportation:

a. Securely bolt the SIGABA to base of wood box. (Use 4 packing bolts and wood packing strips).

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b. Clamp top of box to base and waterproof connecting edge with hot tar or wax. The latter will be done only when the machine will be transported by water.

c. Place box in top half of CH-76 Chest and lock combination.

d. Place all rotors, Secret and Confidential written material, codes, ciphers, etc. in lower half of CH-76 Chest and lock combination. (The above items will be sealed with a waterproof material when transported by water.)

e. Mark top and bottom halves of Chest with special identifying marking without indicating contents.

f. Protect combination Chest locks with soft material to act as cushion. These locks become inoperative with little punishment.

g. The Incendiary Safe Destroying Bomb "MI" should be installed in lower and upper halves of CH-76 Chest as indicated in par 4, Change No. 2 (SigXXX-1).

h. Under no circumstance will the SigRINO be transported <u>without an authorized armed officer courier and an armed guard</u>. The SigRINO will <u>never</u> be left unattended while in transit.

(4) <u>Permission to Move Cryptographic Material</u>.
U.S. Army cryptographic material may be transferred from one headquarters to another within the U.K., or with a headquarters out of the U.K. <u>only</u> with the following authorization :

a. By authorization of Theater Signal Officer.

b. By Field Order.

(5) Policy concerning Transportation of SigRINO and SigCUM by <u>Road, Rail, Ship</u> and <u>Plane</u>.

The following security precautions are equally applicable to the transportation of SigRINO and SigCUM, and will be vigilantly observed by all responsible for transporting either device.

All instructions outlined in Section A(3) above apply to the safe keeping of the SigRINO and SigCUM when transported by <u>any</u> means.

<u>Transmission by Road</u>

a. Adequate care should be taken to insure that the above-mentioned equipment is carefully loaded in the vehicle and the tail gate is locked in the upright position.

b. Periodic checks should be made to determine security measures during transit.

c. Under no circumstances will <u>anyone</u> be allowed to ride in the vehicle as a casual passenger.

Transmission by Ship

a. The ship's strong room in ocean going vessels will be used to safeguard the SigRINO and SigCUM.

b. The most secure and accessable location in channel and river boats will be chosen for safeguarding this equipment. An armed guard (cryptographer) will be posted with the devices 24 hours a day.

Transmission by Aircraft

The SigRINO and SigCUM with Motors may be transported by aircraft provided that:

a. Aircraft will not be flown over enemy occupied territory.

b. Aircraft will not be flown over neutral territory.

c. Aircraft will not be flown over water from which, in the event of forced landing or crash, the enemy could capture the devices.

Note: Attention is invited to Par. 25d, AR 380-5 for information and guidance concerning destruction of cryptographic equipment in the event a forced landing is made in enemy occupied or neutral territory.

B. Mobile Operation

(1) Attention is invited to letter, this headquarters, dated 15 June 1944, subject: Code Room Physical Security in all Phases of Operation, for information and guidance concerning construction, equipment, operation and destruction of a mobile code room in all phases of operation.

(2) In the event of a convoy move to a new headquarters, the code room vehicle should be located toward the front of the convoy to insure immediate cryptographic communications for the forward command post.

(3) Armed cryptographic personnel should occupy the vehicle immediately following the code room van or truck.

(4) Armed guards will protect the immediate area surrounding the mobile code room during temporary and overnight convoy halt.

C. Assault Operations

(1) Only those codes and ciphers which are authorized by proper authority to be employed in assault landing will be carried and used in the assault phase.

(2) Care should be taken to protect the assault codes and ciphers with a waterproof material prior to embarkation.

(3) Each cryptographer responsible for transporting and using the assault codes and ciphers will be instructed in the procedure for emergency destruction, and provided with the necessary items to complete that destruction. Matches should be carried in a waterproof container.

(4) The SigABA may be employed on headquarter ships for communication to rear echelon areas.

D. Landing Operations

In order that U.S. Army cryptographic equipment and associated key systems will be adequately safeguarded from capture by the enemy during landing operations, the following security measures governing its protection should be observed by all responsible personnel concerned:

(1) It is important that all cryptographic personnel involved in a landing operation be thoroughly trained in the use and destruction of all cryptographic systems for which they are responsible during the voyage and landing.

(2) Reference is made to section A(3) sub-paragraphs a, b, c, d, e, f, g, h, for detailed information in preparing the SigRINO for transportation by water.

(3) The combinations to both sections of the CH-76 Chest should be known only to this Signal Officer, Cryptographic Security Officer and the ranking sergeant cryptographer.

(4) Those cryptographers who are assigned the task of making emergency destruction of the SigRINO, should be informed of its storage location on board ship.

(5) For reasons of convenience in handling and security, the two sections of the SigRINO will be detached when being transported.

(6) Sufficient authorized cryptographers should accompany the SigRINO to protect it in all circumstances and to transport it on to beach head. Four (4) men should be assigned to carry each section of the Chest. If dock facilities are not available for landing it should be planned to transport the SigRINO to the beach by means of a "Duck" or barge.

(7) In case of extreme danger of capture or the order "Abandon Ship", the SigRINO will be destroyed according to instructions in Par. 6, Change No. 2 (SigKKK-1). If time does not permit this procedure, throw the locked SigRINO's overboard. Any cryptographic material not in the CH-76 Chest will be weighted and thrown overboard.

(8) Policies Governing Landing SigRINO on a Beachhead during Landing Operations

a. The officer directly responsible for landing the SigRINO on foreign territory during landing operations must be certain that armed personnel of the U.S. Forces are stationed on shore in sufficient numbers and in such depth as to insure a firm bridgehead.

b. It must be known that the enemy is incapable of bringing sufficient force to bear to dislodge the beachhead positions by a surprise ground attack or endanger the security of the machine.

c. A firm beachhead or safe landing position are determinants which will necessarily be different depending on the peculiarities of a particular situation.

E. Echelon Operations

(1) The SigABA will be transported down to and including the following Command Posts in Army, Corps and Division.

a.	Army Headquarters-	Rear Echelon Command Post Command Post and Forward Command Post.
b.	Corps Headquarters-	Rear Echelon Command Post and Command Post.
c.	Division Headquarters-	Rear Echelon Command Post.

(2) The safest and most expeditious means of transportation available will be employed in moving the SigABA.

(3) Aircraft will be used to transport the SigABA to the Division Rear Echelon Command Post only under exceptional circumstances, or when all other means of transportation are inadequate to meet the exigency of the situation.

For the Chief Signal Officer:

GEORGE A. HIGHER
Colonel, Signal Corps

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HEADQUARTERS
EUROPEAN THEATER OF OPERATIONS
UNITED STATES ARMY
OFFICE OF THE CHIEF SIGNAL OFFICER
APO 887

15 June, 1944

SUBJECT: Code Room Physical Security in all Phases of Operation.

TO : Signal, Communication, and Signal Security Officers, down to and including Division Headquarters in Army Ground Forces; Wing Headquarters in Army Air Forces; Ports and Depots in Services of Supply.

This document rescinds Headquarters, Services of Supply, ETOUSA, Directives, subjects "Physical Security" dated 19 October, 1943, "Security Practices" dated 15 July, 1943, and Directive this Headquarters, dated 3 March 1944, subject as above.

It is intended that this publication will provide specific information pertaining to physical security factors and practices associated with the Code Room in all phases of operation; particularly for Permanent and Semi-Permanent, Mobile and Hq. Combat Code Room with respect to:

A. Code Room Construction.
B. Code Room Equipment.
C. Code Room Operation.
D. Code Room Destruction.

A. CODE ROOM CONSTRUCTION

The Code Room will be located and constructed to provide complete privacy and protection. The following items should be given strict consideration in construction planning or in choosing a Code Room site under various phases of operations:

1. Permanent and Semi-Permanent Code Room

a. To be constructed to incorporate the following factors:

(1) Building materials (Brick, Concrete, Galvanized Metal or equivalent).

(2) Sufficient interval space to permit freedom of movement of personnel and operation of systems presently authorized the unit with reservations planned for future expansion. (Refer to paragraph 10 of letter, this Headquarters, subject "Security of Teletypewriter Privacy Equipment" dated 17 June, 1944).

(3) One entrance by a single heavy door, locked from inside of the Code Room.

(4) No windows or skylights. If windows are present, they should be made opaque and provided with bars.

(5) Adequate ventilation. If possible, fresh air to be drawn from outside the building rather than from adjoining room or hallway.

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(6) Adequate lighting facilities planned to provide maximum light for operators.

(7) Sufficient number of power outlets (110 volts) for maximum authorized equipment operation.

(8) Blast walls of brick or sandbags located not less than three feet or more than six feet from all external Code Room walls.

(9) A stationary blind wall constructed within the Code Room entrance to screen systems and operating personnel from the inadvertent view of unauthorized persons.

(10) Code Room walls should be made sound-proof. This can effectively be accomplished by hanging heavy cloth drapes on the walls. The code room should be tested for sound-proofness under varied circumstances of operation.

2. Mobile Code Room

a. The Code Room constructed in a van or truck must, of necessity, be so planned as to incorporate special provisions to exercise strict security practices. The following security measures should be embodied in the construction specifications:

(1) Locate systems to allow for minimum movements of personnel.

(2) Provide for securing heavy cryptographic equipment to work tables. If SigRIMO is employed, secure to truck body.

(3) One entrance with door, to be locked from inside or outside and bolted from inside when code room is in use.

(4) No windows or openings to the exterior of vehicle.

(5) Provide for forced draft ventilation through sides or top of vehicle. Inside lights will be diffused through ventilating device.

(6) Incorporate sufficient facilities for proper lighting, adequate electric power, racks and shelves for protective implements.

(7) Prepare adequate camouflage netting for varied conditions of operation.

3. Combat Code Room

a. Establishing a Code Room in the Combat Area will depend primarily upon existing conditions and facilities. However, certain fundamental security practices must be observed:

(1) Choose Code Room site in close proximity to Message Center.

(2) Select the most secure location, room building, etc; consider entrances, exits, windows, source of commercial electric power, and fire hazards.

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(3) Prepare to use a black-out wall tent in lieu of non-existing building facilities.

B. CODE ROOM EQUIPMENT

Certain Code Room equipment supplemental to cryptographic systems and devices must, for efficient operation and security discipline, be a part of the Code Room. The following essential items are considered necessary to maintain a high level of code room efficiency and security:

1. Permanent and Semi-Permanent Code Room

a. A three combination steel safe or equivalent to be located in the code room.

b. File cabinet (preferably steel). An added security precaution should be added by providing a detachable iron or steel rod to pass through the file handles and securely locked to the cabinet.

c. Sub-machine guns and .45 calibre revolvers or pistols with ammunition. All personnel should be thoroughly instructed in the use of these weapons.

d. Destructive equipment including 5 gallon can of gasoline and/or kerosene, thermite bombs and other suitable explosives, axe, heavy hammer, iron rods, two braziers with wire meeting, two pairs of wire cutters (long snip nose) and matches.

e. Adequate reserve of paper, necessary forms and paper tape.

f. Supply of classification stamps, color pencils, pencil sharpener located in the Code Room, wire stapler, tape sticker and tape clips.

g. Secret trash baskets.

h. Sufficient dry cell batteries to produce 24 volt power supply.

2. Mobile Code Room

a. A small three-combination steel safe or equivalent.

b. Destructive equipment mentioned in Section B, Paragraph 1.d. above. This equipment should be made secure in racks and easily accessible for use.

c. Defensive weapons mentioned in Section B., Paragraph 1c, above.

d. Special reserve of paper and paper tape.

e. All supplies mentioned in Section B., Paragraph 1.f., above.

f. An emergency power source for each SIGABA.

g. Two 50 feet CD-415 moisture proof electric cords.

h. Work tables secured to body of vehicle.

i. Sufficient dry cell batteries to produce 24 volt power supply.

3. Combat Code Room

a. The lower half of Chest CB-76 should be adequate safe space.

b. Sub-machine guns, .45 calibre fire arms, and other protective weapons deemed necessary considering the urgency of combat conditions.

c. All destructive equipment listed in Section B., Paragraph 1.d. above.

d. Adequate reserve supply of paper, necessary forms and paper tape.

e. All supplies indicated in Section B., Paragraph 1.f.

f. An emergency power source for each SIGABA.

g. Four 50 feet CD-415 moisture proof electric cords.

h. Two folding field tables.

i. Sufficient dry cell batteries to produce 24 volt power supply.

C. CODE ROOM OPERATIONS

The Signal or Cryptographic Security Officer shall be responsible for the enforcement of current regulations and instructions pertaining to the security of cryptographic personnel, cryptographic documents (including codes and ciphers), cryptographic equipment, cryptographic operations, and all other matters pertaining to the security of communications operated and maintained under the supervision of the Signal or Communications Officer.

1. Permanent and Semi-Permanent Code Room

The following security practices concerning Code Room personnel, regulations, instructions, and operations should be thoroughly understood and observed by all concerned:

a. Authorization to show, issue, describe, or discuss cryptographic systems to United States civilians or military personnel is covered by the provisions of AR 380-5, 15 March, 1944.

(1) Special attention in this connection is directed to Paragraphs 11 and 14, AR 380-5, 15 March, 1944, which apply without respect to the ranks or grades of persons involved, and should be strictly adhered to in all cases.

(2) War Department and/or Joint Army/Navy cryptographic systems, including key list, instructions and devices, will, under no circumstances be shown, issued, described to or discussed with civilians or military personnel of any other nation unless prior specific authorization is obtained from the War Department in each instance.

b. All commissioned and enlisted cryptographic personnel (including cryptographic maintenance personnel) will be investigated according to provisions of ETOUSA letter AG 311.5 AGB, dated 12 January, 1944, subject "Clearance of Personnel for Cryptographic Duties". All personnel will be satisfactorily cleared by this investigation, prior to engaging in duties or training as cryptographers or cryptographic maintenance men.

c. A notice RESTRICTED AREA shall be posted on the entrance to the Code Room. The term "Cipher Room", "Cryptographic Office", etc., should not identify, or be used as a guide indicator to the Code Room.

d. A register posted inside the Code Room showing name, location, date, and time of arrival and departure and nature of visit of all persons, other than normal operators and supervisory personnel, authorized to enter the Code Room on official visits.

e. Secret trash will be burned at least once each 24 hours, (during daylight hours if burned in the open) in the presence of an officer and the ashes carefully sifted.

f. Safe combinations should be changed whenever personnel, who have had access to classified material, leave the organization, or in any case, once a month. Under no circumstances will safe combinations be written as a reminder, or combination data carried on the person.

g. A daily inspection of the Code Room to insure that security regulations are being observed and a check to determine that all documents and registered material are present.

h. Personnel thoroughly acquainted with all systems to be in attendance as long as the Code Room is in operation. If, because of limited traffic, the Code Room does not operate 24 hour shifts, steps should be taken to insure that the Signal Security Officer or personnel designated by him may be reached for immediate duty at all times.

i. All Code Room personnel to be acquainted with the provisions of AR 380-5 and other regulations and directives concerning security as well as the instructions contained in all publications concerning the operation of the systems.

j. The Message Center and Code Room operations should be organized so as to allow the absolute minimum time to pass traffic from the teleprinter and radio rooms to the Code Room and vice versa. This can best be accomplished by centralizing these rooms and utilizing wall slots for passing messages, by introducing a time schedule for passing messages of stipulated numbers of groups. Consider elimination of unnecessary steps, faster method of recording, servicing time, and wall slots for incoming and outgoing normal Code Room traffic.

k. In the event that clear text copy of Secret radio or landline traffic is carried from one building to another, sealed envelopes or specially provided locked pouches should be used. These containers should be receipted for. Similar protection should be afforded code text under some circumstances. The coded version and clear text copies will never be filed or transported together.

2. Mobile Code Room

Special security precautions must necessarily be enforced in operating a mobile Code Room. It must be constantly borne in mind that the mobile type of Code Room may be more vulnerable to insecure practices, consequently to direct attack. It is most important that strict discipline be enforced concerning the following security measures:

a. Guards armed with automatic weapons to be stationed at the Code Room entrance of the vehicle 24 hours a day.

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b. Special system of alarms to Code Room operators indicating bombing, gas, parachute or ground attack.

c. All Code Room and other authorized personnel will display a special Code Room pass to the Guard before entering Code Room.

d. Armed messengers will carry messages to and from Code Room vehicle.

e. Special precautions should be taken to prevent local civilian inhabitants and the enemy from knowing the exact location of the Code Room.

f. If operating in open country, special precautionary measures should be exercised to camouflage the vehicle to the immediate surroundings.

g. Footpaths, wheel tracks and lead-in wires indicate activity! Re-locate the Code Room vehicle periodically when operating in wooded or open country.

h. The instructions contained in Section C.1. Paragraphs a,b,c,d,f, g,h,i, also apply to Mobile Code Room operation and should be strictly complied with by all concerned.

i. Secret trash should not be allowed to collect. An officer will supervise the burning of all secret trash at regular intervals.

j. Due care and protection should be given the vehicle to provide for efficient operation in an emergency move.

k. It is strongly recommended that the driver of the Mobile Code Room vehicle be an authorized trained SIGABA maintenance man and a reserve cryptographer. This person should be available at immediate notice.

3. Combat Code Room

The operating conditions of the Combat Code Room will change periodically depending on the progress of the Campaign. However, the fundamental security principles remain constant, and should be vigilantly observed:

a. Adequate armed guards to be strategically located at the Code Room entrance and immediate area 24 hours a day.

b. The instructions contained in Section C.1. Paragraphs a,b,c,d,g, i, and Section C.2. Paragraphs b,c,d,e,i, are peculiarly applicable to a Combat Code Room and should be given particular consideration.

D. CODE ROOM DESTRUCTION.

It shall be the direct responsibility of any person charged with transmission, supervision or operation of classified material to take all precautions necessary to keep such material from capture by the enemy. The possibility of enemy action by day or night is always imminent, consequently, the allocation of responsibility for code room destruction should be by duty rather than by name. Alternates should be designated in every case.

1. Permanent and Semi-Permanent Code Room

The plan for destroying cryptographic material must be practicable and simple. The local plan of destruction must be understood by all directly concerned. Each person involved in the destruction scheme should be assigned

specific duties as part of a team. It is important that a simulated exercise be entered into at regular intervals by all Code Room personnel. The following measures should be considered in any Code Room destruction plan:

a. The amount of equipment to be destroyed in time of emergency should be the basis for maintaining destructive items mentioned in Section B.1. Paragraph d.

b. Restricted equipment will be destroyed beyond possibility of repair or reclamation of parts.

c. Secret and Confidential equipment will be destroyed beyond recognition. Such destruction may be limited to those portions of a secret or confidential device which show principles or design. Other components will be destroyed to an extent that would prevent further use of reclamation.

d. In all cases, documents or devices not yet in force are considered of greatest importance.

e. The following precedence of destruction should be incorporated in any Code Room destruction plan:

(1) Recognition key lists and memoranda.
(2) Cipher machines and key lists.
(3) Strip alphabets and key lists.
(4) Joint reciphering and recording tables.
(5) Secret communication files and operation orders.
(6) Signal ciphers.
(7) Contact codes and ciphers.
(8) Authentication systems.
(9) Call sign ciphers and key lists.
(10) Other codes and signal publications.

f. Classified material of highest importance should be marked in a clearly distinctive manner, i.e. with red marking in an obvious place. This should be done locally in pursuance of the destruction plan, and will be in addition to the regular classifying stamp or marking. TOP SECRET, SECRET and CONFIDENTIAL documents should be sorted and filed for easy access, and list kept of exact locations where such documents are held elsewhere on the station.

g. The volume of classified material which would require destruction in event of emergencies should be kept to an absolute minimum. Thus, it is important that all routine destruction be completed promptly. All personnel shall be cautioned against tendency of permitting papers to accumulate in files.

h. Bound documents or unbound sheets of paper pressed together will not burn to be unidentifiable or unreadable even in a big fire. It is best to tear covers off book, tear or crumple pages, separating sheets as much as possible. Soak papers with kerosene or gasoline at intervals as they are placed into brazier. Place wire netting over top to prevent paper blowing away. Constantly stir fire and ashes.

i. It is of utmost importance that an adequate number of persons be designated as a team to destroy all electrically operated cryptographic devices. Each member of the team must be thoroughly instructed in his specific task to insure speed and effectiveness.

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j. To effectively destroy SigABA rotors and index rotors, remove from Cipher Unit (SigIVI) and completely remove all wiring by cutting with long snip-nose wire cutters. Replace Cipher Unit and place wires and all rotors on top of Cipher Unit. Do not replace glass cover. Place rotors in such a manner that they lie flat and not on top of one another. Place Incendiary Safe Destroying Bomb, Type "M-1",,on top of the rotors with approximately the same length extending over each end. (Attention is directed to Change No. 2 to SigKKK-1 for detailed instructions on installation and use of Incendiary Safe Destroying Bomb Type "M-1").

k. To effectively destroy the Convertor M-209, place all keying elements in neutral positions by changing all lug settings to zero and moving all key wheel pins to the left position. Render the machine unserviceable to the enemy by stamping with boot heel, striking with rock, hammer, axe, or by firing into it with rifle or pistol.

2. Mobile Code Room

The operators of a Mobile Code Room must be constantly alert and prepared to destroy cryptographic material at a moment's notice. The following security precautions should be seriously considered in any destruction plan for this type Code Room:

a. All destructive equipment mentioned in Section B.1. Paragraph d. These items must be so located within the vehicle as to be immediately accessible.

b. Provision should be made to destroy all cryptographic material inside the Code Room. Avoid use of incinerators in open spaces where personnel might be exposed to enemy fire.

c. Where time does not permit communication with the Commanding Officer, every individual concerned must act on his own initiative. The importance of beginning the destruction scheme sufficiently early cannot be over emphasized. Accurate reports of emergency destruction will be made to higher authority as soon as practicable.

d. The instructions contained in Section D.1. Paragraphs b,c,d,e,f, g,h,i,j,k, also apply to Mobile Code Room procedure.

3. Combat Code Room

a. All destructive equipment mentioned in Section B.1. Paragraph d, must be available for instant use. Each item should be prominently located near the equipment or material it is intended to destroy.

b. The instructions contained in all Paragraphs, Section D.1. and Paragraph b.c, Section D.2. are particularly applicable to an efficient destruction scheme for the Combat Code Room and should be complied with.

For the Chief Signal Officer:

s/ George A. Eicher
GEORGE A. EICHER
Colonel, Signal Corps

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OFFICE OF THE CHIEF SIGNAL OFFICER
HEADQUARTERS COMMUNICATIONS ZONE
EUROPEAN THEATER OF OPERATIONS
UNITED STATES ARMY
APO 887

6 July, 1944.

SUBJECT: Security of SigABA.

TO : Signal Security Officer.

1. This letter rescinds Headquarters, Services of Supply, ETOUSA, Letter, subject same as above, dated 15 July, 1943.

2. In order to maintain adequate security of SigABA and its cryptographic systems now in use, it is necessary that the following security regulations be thoroughly understood and observed:

3. a. SigABA and SigIVI are classified as CONFIDENTIAL and must be safeguarded according to the provisions of Paragraphs 30a and 30b of AR 380-5, dated 15 March, 1944. SigABA must be screened within the room from the view of unauthorized persons and completely covered when cleaning personnel are present.

b. The systems and rotors for use with SigABA are classified as SECRET registered documents. They should be kept in the most secure space available, preferably a three-combination locked safe or its equivalent within the code room. Since the equipment is classified and cannot readily be moved, measures should be taken to provide adequate security for the room in which it is installed, in accordance with letter, subject "Code Room Physical Security in all Phases of Operation", dated 15 June, 1944.

4. Paragraph 11 of AR 380-5 states that "no person is entitled to classified military information solely by virtue of his commission or official position. Such information will be entrusted only to those who require it in the performance of their official duties, and to ensure teamwork and efficient instruction of personnel, proper planning or maintenance of equipment". Specifically this means that no-one except the following is to see or have any knowledge concerning any cryptographic material:

The Unit Signal Officer.
The Code Room Officer.
Supervisory Personnel.
Operating Personnel.
Qualified Maintenance Personnel.

Since the Commanding General or Commanding Officer is responsible for all the activities of his command, according to Army Regulations, he may demand the right to see cryptographic material. Acting only upon such a specific request, the Signal Officer will allow the Commanding General or Commanding Officer to view all cryptographic material in his possession. Such inspection will not be invited, nor will any information be volunteered. The above provisions apply with equal force to all members of the United States Armed Forces regardless of rank or position.

COPY

COPY ~~SECRET~~

5. Your attention is invited to War Department letter AG 313.6 MCB dated 22 January, 1944, and entitled "Destruction of Classified Matter in Emergencies on Land, Sea, and in the Air".

6. All registered classified documents associated with the equipment shall be handled in accordance with the provisions of AR 380-5 dated 15 March 1944, and changes thereto. Attention is specifically invited to Paragraphs 2,4,5,6,9,11,16, 29,30,31,37,38 and Section IV. All personnel required to handle registered documents will be made familiar with the provisions of AR 380-5, dated 15 March 1944.

7. The operator personnel should be properly qualified in accordance with the provisions of Paragraph 42(c) of AR 380-5 and AGO letter dated 12 January 1944, ref. AG 311.5 MCB, subject "Clearance of Personnel for Cryptographic Duties".

8. The Signal Security Officer will be responsible for all security matters connected with this apparatus. He shall be familiar with the correct method of operating the equipment as outlined in the published instructions, and shall enforce the provisions of these documents as well as those of AR 380-5.

9. Inquiries concerning security measures shall be referred to the Chief Signal Officer, Hq. ETOUSA APO 887, ATTENTION: SLD.

For the Chief Signal Officer:

GEORGE A. BECHER
Colonel, Signal Corps

~~SECRET~~

COPY

TAB U

Photographs of the Converter M-134-C lost at Colmar, France. These pictures were taken as the mud-covered converter was being removed from the top-half of a Chest 76 in which it had been submerged in the Greesen River near Seiestart, France. For details, see Chapter XVI, Section C.

~~SECRET~~

APPENDIX NO. 1
TO EXAMINATION OF SIGABA NO. 235

Below are listed photographs showing chest, contents, and condition of contents as they were found by investigators from Office of the Chief Signal Officer, Hq ETOUSA, APO 887, U. S. Army.

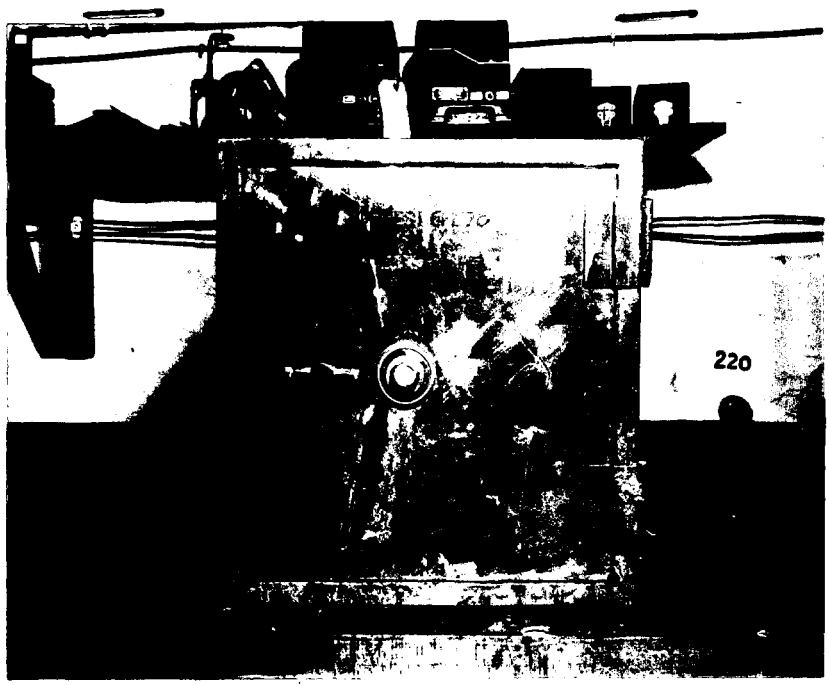

Photo No. 1

This photograph shows the upper half of the Chest CH-76 No. 293 before being opened for investigation by Office of the Chief Signal Officer, Hq ETOUSA, APO 887, U. S. Army.

~~SECRET~~

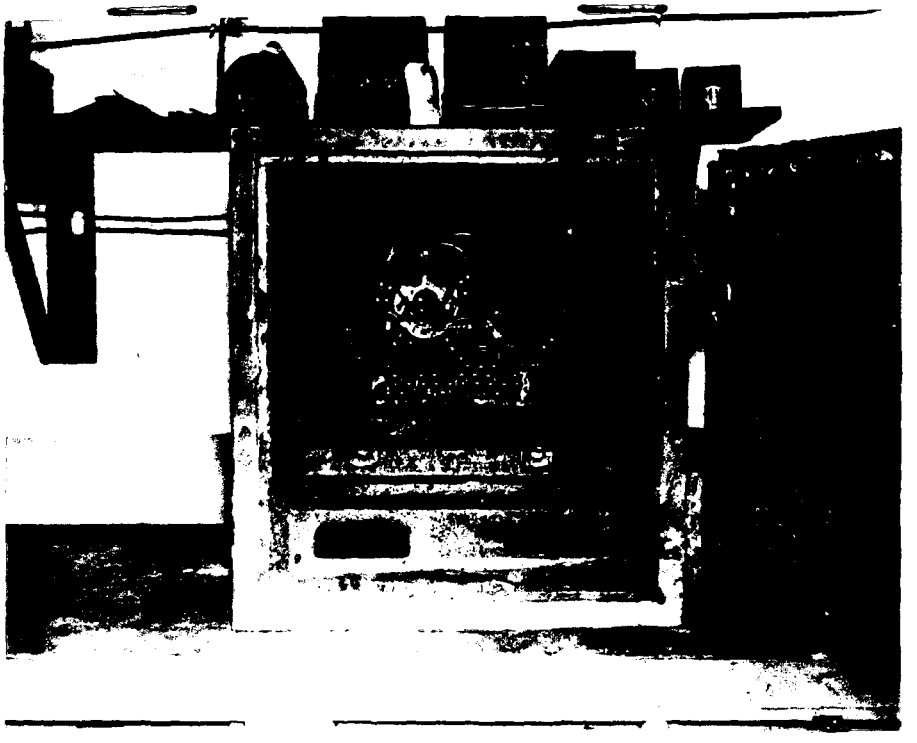

Photo No. 2

The view in the photograph above shows the upper half of the Chest CHr-76 No. 293 immediately after the door had been opened before any attempt had been made to break the mud seals or remove the machine.

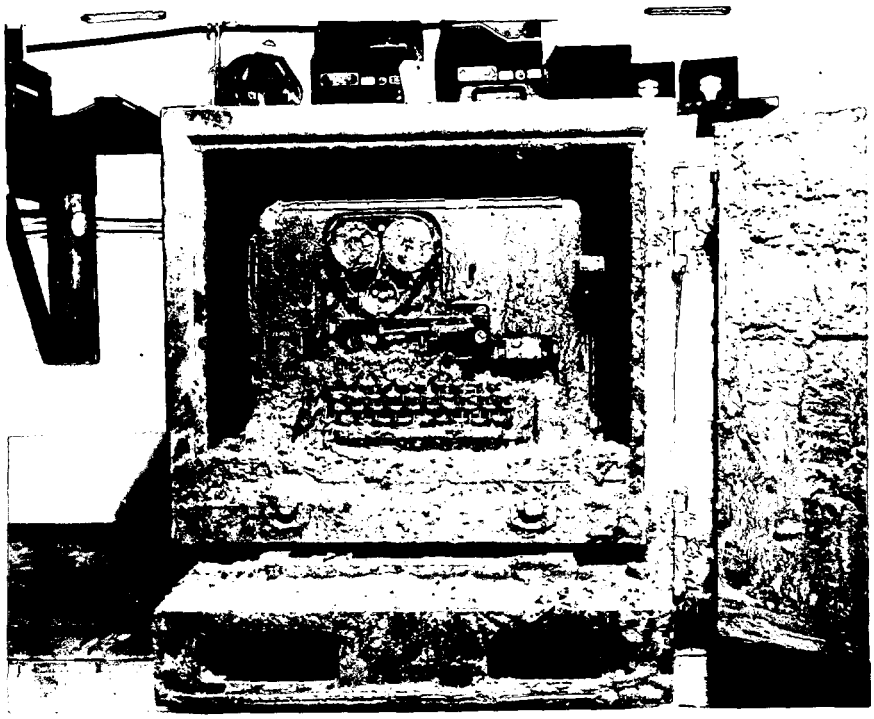

Photo No. 3

This photo was taken after the machine had been partially removed from the chest. This view gives some indication of the condition of the machine and the chest and the amount of mud in the chest.

Photo No. 4

A top view of the machine after it had been almost completely removed from the chest shows the position of the power switch and the position and condition of the SigIVI as it was found by the investigating personnel.

Photo No. 5

The position of the machine in the chest as it was being removed is indicated in the above photograph. The marks on the side of the base board of the SigABA give some indication of the amount the board had swollen during the time it was in the water.

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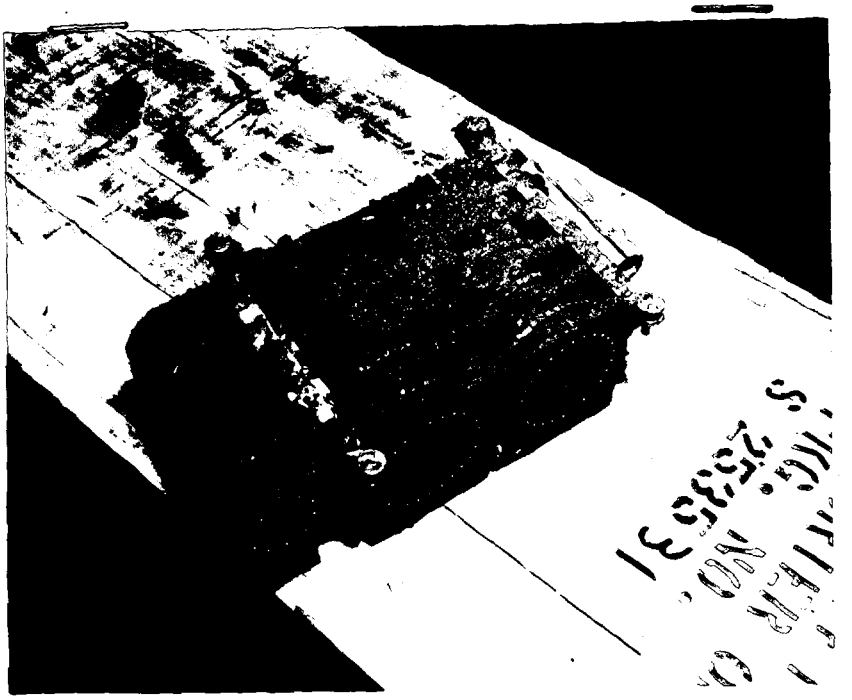

Photo No. 6

The above photograph shows the SigIVI as it was removed from the machine prior to any washing or cleaning.

~~SECRET~~

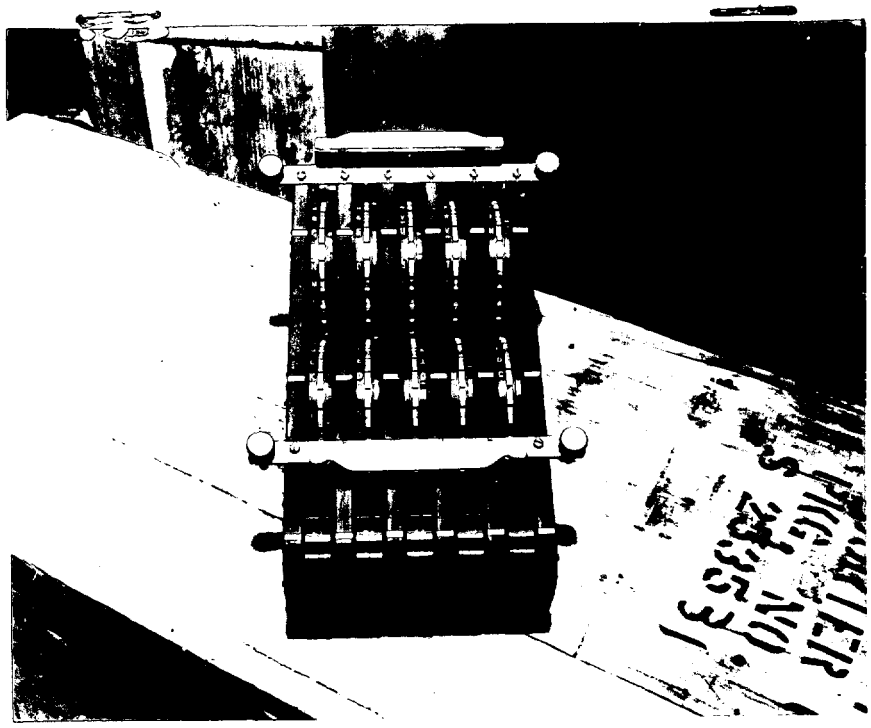

Photo No. 7

The condition of the SigIVI after washing is shown in the photograph above. Upon close inspection the rotor setting can be seen. These are the settings that were on the rotors when the SigIVI was removed from the SigABA.

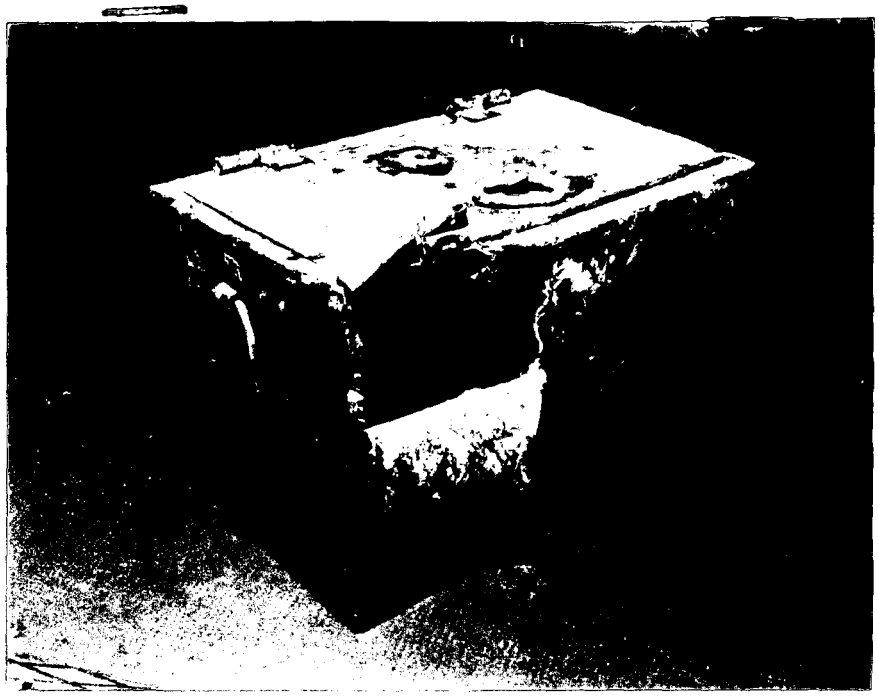

Photo No. 8

The method used in gaining entry into the field safe after it could not be opened with a key is shown above.

Photo No. 9

The contents of the field safe are shown in the photograph above. A close inspection will show the condition of the contents of the safe as they were found by the investigators.

TAB V

Excerpts from

Official Letters concerning Maintenance Training

~~CONFIDENTIAL~~

SPSIS-4B

15 December 1944

Letter No. 518

SUBJECT: Training Personnel for Maintenance of Converter M-134-C.

TO: All Holders of Converter M-134-C.

* * * * * * * * * *

3. The following information is furnished for the guidence of units requesting this office to train personnel assigned to such units.

* * * * * * * * * *

d. Personnel selected for this training must be fully qualified with the subject matter thru previous experience or schooling as indicated below:

(1) Shop Work: A full knowledge of the proper care and use of miscellaneous tools for measuring, gauging and making mechanical adjustments, correct soldering technique as employed in soldering splices and small connections; and in the preparation of cord and plug assemblies. For reference see TM 11-453.

(2) Principles of Electricity: Those basic principles of electricity and magnetism which enable the student to fully understand the use and care of batteries and electrical measuring instruments, the solution of circuits, schematic and actual wiring diagrams, as well as the theory and practical application of AC and DC motors. For reference see TM 1-455.

e. It is suggested that personnel qualified to hold the following Military Occupational Specialties (MOS) or Specification Serial Numbers (SSN), if fully qualified as indicated in subparagraph 3d above, are eligible for such training.

(1) Officer Personnel.

No MOS Assigned	Teletypewriter Equipment Maintenance and Repair Officer. (Officer must have previous experience or schooling which qualifies him in the same manner that an enlisted man is qualified to be a Teletype Mechanic SSN 239.)

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MOS 0145	Radar Maintenance and Repair Officer.
MOS 0260	Telephone and Telegraph Maintenance Officer.
MOS 4415	Signal Equipment Maintenance and Repair Officer.
MOS 9606	Cryptographic Equipment Maintenance and Repair Officer Class 1 Type Equipment.

(2) Enlisted Personnel.

SSN 078	Electrician.
SSN 095	Central Office Repairman.
SSN 097	Installer-Repairman, Telephone and Telegraph.
SSN 115	Automatic Telephone System Maintenance Man.
SSN 232	Switchboard Installer-Repairman, Manual.
SSN 239	Teletype Mechanic.
SSN 384	Installer, Toll Telephone and Telegraph.
SSN 648	Radio Repairman.
SSN 801	Cryptographic Repairman Class 1 Type Equipment.

4. Inclosed is one copy of the pre-entry examination, (SSCE-2) 27 November 1944, to determine elegibility for training. As many copies may be reproduced as are necessary. It is requested that these examinations be given by field units or training centers under the supervision of an officer and that no training aids, manuals, wiring diagrams, etc., be available to the person being examined. It is further requested that the officer supervising the examination certify in writing that the examinees took the examination without receiving any aid from such officer, other individuals, or the items mentioned in the preceding sentence. The completed, ungraded pre-entry examination will be submitted with the training request.

5. Whenever it is determined that an individual is not fully qualified for this assignment on the basis of this examination, or due to lack of previous experience or schooling, arrangements will be made by Military Training Branch, OCSigO, for necessary pre-requisite training upon request.

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AGAO-S-B-M 311.5 (27 Mar 46) EM/gc ID-863 Pentagon

2 April 1946

SUBJECT: Training Personnel for the Maintenance of Converter M-134-C

TO: All Holders of the Converter M-134-C

* * * * * * * * * *

4. The following information is furnished for the guidance of units requesting the Army Security Agency to train personnel assigned to such units.

* * * * * * * * * *

d. Personnel selected for this training must be fully qualified and capable of meeting all prerequisites for enrollment indicated below:

(1) Officers, through civilian background or military experience, must be qualified to perform duties equivalent to that of a Teletype Mechanic (SSN 239).

(2) Enlisted men must have an AGCT score of 110 or higher and be fully qualified as a Teletype Mechanic (SSN 239).

(3) All selected personnel should have a thorough knowledge of the following subjects and the ability to make practical application thereof:

(a) SHOP WORK: Basic knowledge of the proper case and use of miscellaneous tools for measuring, gauging and making mechanical adjustment. Correct soldering technique as employed in soldering splices and small connections, and in the preparation of cord and plug assemblies. For reference see TM 11-453.

(b) PRINCIPLES OF ELECTRICITY: Those basic principles of electricity and magnetism which enable the student to understand fully the proper care and use of batteries, electrical measuring instruments, the solution of circuits, schematic and actual wiring diagrams as well as the theory and practical application of AC and DC motors. For reference see TM 1-455.

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(c) TELETYPE FUNDAMENTALS: A thorough understanding of basic teletype knowledge and the practical application thereof. For reference see TM 11-353.

(d) TELETYPEWRITER EQUIPMENT: Must be fully qualified to install, inspect, maintain and repair the following teletypewriter sets and units of equipment.

M15 Teletypewriter Set
M19 Teletypewriter Set
M14 Keyboard Perforator
M14 Transmitter Distributor
M14 Non-Typing Reperforator Set
M14 Keyboard Typing Reperforator Set
Teletype Printer Sets EE 97 and EE 98
Power Unit PE 75
Power Unit PE 77
Telegraph Switching Central TC-3

(4) Must be capable of passing (with a rating of Satisfactory or better) a pre-entry examination to determine qualifications for enrollment.

(5) Must not be color blind.

(6) Must comply with the requirements of letter AG 311.5 (12 Mar 45)OB-I-B-M, 21 March 1945, subject: "Clearance of Personnel for Cryptographic Duties."

5. Inclosed is one copy of pre-entry examination, (SSCE-2A), 8 March 1946, to determine eligibility for training. As many copies may be reproduced as are necessary. It is desired that these examinations be given by field units or training centers under the supervision of an officer and that no training aids, text manuals, wiring diagrams, etc., be available to the person being examined. It is further desired that the officer supervising the examination certify in writing that the examinee took the examination without receiving any aid from such officer, other individuals or the items mentioned in the preceding sentence. The completed ungraded pre-entry examination, with its attached certification will be submitted with the training request.

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

AGAO-S 353
(2 Sept 48) OSGID M

9 September 1948

SUBJECT: Training of Personnel for the Maintenance of Electro-Mechanical Cryptographic Equipment

TO: Commanders-in-Chief
Far East Command
European Command
Commanding Generals
US Army, Caribbean
US Army, Pacific
US Army, Alaska
Trieste US Troops
Armies, ZI
Military District of Washington
Independent Commands under the Dept of the Army
Chief, Army Field Forces
Chiefs, Technical & Administrative Services

* * * * * * * * * *

3. The following information is furnished for the guidance of commanders who may request the Army Security Agency to train personnel of their commands:

* * * * * * * * * *

b. Personnel selected for this training must be capable of meeting the prerequisites for enrollment indicated below:

(1) Officers, through civilian background or military experience, must be qualified to perform duties equivalent to that of a Teletype Mechanic (SSN 239).

(2) Enlisted men must have an AGCT Score of 110 or higher and be fully qualified as Teletype Mechanic (SSN 239).

(3) All selected personnel should have a knowledge of the following subjects and the ability to make practical application thereof in the degree indicated:

(a) SHOP WORK: Basic knowledge of the proper care and use of miscellaneous tools for measuring, gauging, and in making mechanical adjustments. Correct soldering technique as employed in soldering splices and small connections, and the preparation of cord and plug assemblies. For reference see TM 11-453.

~~CONFIDENTIAL~~

(b) PRINCIPLES OF ELECTRICITY: Those basic principles of electricity and magnetism which enable the student to understand fully the proper care and use of batteries, electrical measuring instruments (Voltmeters, ammeters, ohmmeters), the solution of circuits, schematic and actual wiring diagrams as well as the theory and practical uses of AC and DC meters. For reference see TM 1-455.

(c) TELETYPE FUNDAMENTALS: Familiarity with teletype fundamentals as set forth in TM 11-353.

(d) TELETYPEWRITER EQUIPMENT: Must be fully qualified to install, inspect, maintain and repair the following teletypewriter sets and units of equipment:

COMMERCIAL DESIGNATION	ARMY DESIGNATION
M 15 Teletypewriter Set	Teletypewriter TT-5/FG
M 19 Teletypewriter Set	Teletypewriter TT-7/FG
M 14 Transmitter Distributor	None
M 14 Non-Typing Reperforator Set	Teletypewriter TT-15/FG
M 14 Keyboard Typing Reperforator Set	Teletypewriter TT-16/FG

(4) Must be capable of passing with a rating of satisfactory or better, a pre-entry examination to determine qualification for enrollment.

(5) Must have true color perception.

(6) Must be cleared in accordance with the requirements of letter, AG 311.5 (16 Sep 46) AGAO-S-B-M, 18 September 1946, subject: "Clearance of Personnel for Cryptographic Duties," as amended.

c. The following table presents a summary of course information. The suffixes C1, C2 indicate the type of equipment on which the specialist is qualified to perform maintenance:

SSN OBJECTIVE OF COURSE	COURSE	APPROXIMATE LENGTH
(1) 801-C1	ASAM 2 (Converter M-228) and ASAM 3 (M-228(M). Teletypewriter equipment and special equipment used in conjunction with cryptographic systems employing one time tapes.	15 weeks
(2) 801-C2	ASAM 1 (Converter M-134-C). Included are Converters M-209-( ), and ASAM 5 (MX 783/U.)	10 weeks
(3) 801-C1-C2	ASAM 2 (Converter M-228); ASAM 1 (Converter M-134-C); and ASAM 5 (Converter MX 783/U.) (Combined course).	23 weeks

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4. Inclosed is one copy of pre-entry examination, dated 4 June 1948 which will be administered to applicants in order to determine eligibility for training. As many copies may be reproduced as are necessary. It is desired that these examinations be administered by field units or training centers under the supervision of an officer and that no training aids, text manuals, wiring diagrams, etc., be available to individuals being examined. Officers supervising the examination will certify in writing that the examinee took the examination without assistance. A sample certificate is attached to the inclosed examination. The completed ungraded pre-entry examination, with its attached certificate will be submitted with the training request.

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~~CONFIDENTIAL~~

SPSIS-4B
Letter No. 597

26 May 1945

SUBJECT: Training Personnel for the Maintenance of Converter M-134-C

TO: All Holders of SIGABA

* * * * * * * * * *

3. The following information is furnished for the guidance of units requesting this office to train personnel assigned to such units.

* * * * * * * * * *

d. Personnel selected for this training must be fully qualified and capable of meeting all the prerequisites for enrollment indicated below:

(1) Army General Classification Test Score of 110 or more.

(2) Selected personnel, through previous experience or schooling must be qualified to perform the duties of a Teletype Mechanic (SSN 239) or have a thorough knowledge of the following subjects and the ability to make practical application thereof:

(a) SHOP WORK: Basic knowledge of the proper care and use of miscellaneous tools for measuring, gauging and making mechanical adjustments. Correct soldering technique as employed in soldering splices and small connections, and in the preparation of cord and plug assemblies. For reference see TM 11-453.

(b) PRINCIPLES OF ELECTRICITY: Those basis principles of electricity and magnetism which enable the student to understand fully the proper care and use of batteries, electrical measuring instruments, the solution of circuits, schematic and actual wiring diagrams as well as the theory and practical application of AC and DC motors. For reference see TM 1-455.

(3) Must be capable of passing a pre-entry examination to determine qualifications for enrollment with a rating of satisfactory or better.

(4) Must not be color blind.

~~CONFIDENTIAL~~

(5) Must comply with the requirements of Confidential Letter, War Department, The Adjutant General's Office, Washington, D. C., dated 21 March 1945, file No. AG 311.5 (12 March 1945) OB-I-B-M, Subject: Clearance of Personnel for Cryptographic Duties.

e. It is suggested that such personnel who, through previous experience or schooling, are qualified to be the holder of any one of the following Military Occupational Specialties (MOS) or Specification Serial Numbers (SSN), would be eligible for such training providing they are capable of passing the prescribed pre-entry examination with a rating of satisfactory or better.

(1) Officer Personnel.

No MOS Assigned	Teletypewriter Equipment Maintenance and Repair Officer. (Officer must have previous experience or schooling which qualifies him in the same manner that an enlisted man is qualified to be a Teletype Mechanic SSN 239).
MOS 0145	Radar Maintenance and Repair Officer.
MOS 0260	Telephone and Telegraph Maintenance Officer.
MOS 9606	Cryptographic Equipment Maintenance and Repair Officer Class 1 Type Equipment.

(2) Enlisted Personnel.

SSN 078	Electrician.
SSN 095	Central Office Repairman.
SSN 097	Installer-Repairman, Telephone and Telegraph.
SSN 115	Automatic Telephone System Maintenance Man.
SSN 232	Switchboard Installer-Repairman, Manual.
SSN 239	Teletype Mechanic.
SSN 384	Installer, Toll Telephone and Telegraph.
SSN 648	Radio Repairman.

~~CONFIDENTIAL~~

SPECIAL REGULATIONS
No. 750–445–1

DEPARTMENT OF THE ARMY
WASHINGTON 25, D. C., *28 March 1949*

MAINTENANCE OF SUPPLIES AND EQUIPMENT

CRYPTO-EQUIPMENT ISSUED BY ARMY SECURITY AGENCY

1. General.—All organizations of the Army using any crypto-equipment issued by the Army Security Agency will become familiar with the basic principles of maintenance of such equipment and with the channels of maintenance support and supply as administered under the staff supervision of the Army Security Agency. Training of maintenance personnel will be carried out in accordance with CONFIDENTIAL DA letter (AGAO–S 353 (2 Sep 48) CSGID–M) 9 September 1948, subject: Training of Personnel for the Maintenance of Electro-Mechanical Cryptographic Equipment.

2. Maintenance service.—Maintenance service will be performed in accordance with the system of division of maintenance functions into the three categories of organizational, field, and base maintenance as described below.

a. Organizational maintenance is divided into two echelons as follows:

(1) *First echelon maintenance* is that performed by the operator. The limits of first echelon maintenance are defined in the maintenance manual applicable to the equipment. In general, it includes cleaning, lubrication, and changing of such minor parts as tape, ribbon, fuses, etc.

(2) *Second echelon maintenance* is that performed by specially trained maintenance personnel assigned to the organization. Second echelon maintenance is limited to that maintenance which the skill of the assigned maintenance man and the facilities at his disposal permit. Normally, second echelon maintenance will include all maintenance actions necessary to keep the equipment in operating condition.

*These regulations supersede WD letter (AGAO–S–B–M 311.5 (31 Jul 46)), 5 August 1946, subject: Policy on Maintenance of Cryptographic Equipment.

b. Field maintenance consists of third echelon maintenance which is performed as a service to subordinate organizations by specially trained personnel from a higher headquarters or from appropriate Army Security Agency headquarters. Third echelon maintenance may be performed on a regularly scheduled basis and/or on a request basis and may be considered as a supplement to or substitute for second echelon maintenance.

c. Base maintenance is divided into two echelons, as follows:

(1) *Fourth echelon maintenance* is that performed at an Army Security Agency headquarters as a service to using organizations. Fourth echelon maintenance comprises all major repairs short of a complete overhaul of the equipment. It is characterized by a complete range of spare parts, subassemblies, and assemblies, highly skilled personnel, and machine shop type tools. Oversea organizations will submit requests for this service to the Chief, Army Security Agency, Europe, Pacific, or Hawaii, whichever is applicable. Organizations in the zone of interior will be serviced by the Chief, Army Security Agency, Washington 25, D. C., Attention: CSGAS–85. Oversea organizations outside of the European, Far East, and Pacific Commands may direct requests for maintenance service to the nearest command Army Security Agency headquarters or to the Chief, Army Security Agency, Washington 25, D. C., Attention: CSGAS–85.

(2) *Fifth echelon maintenance* is that performed by the Army Security Agency, Washington 25, D. C., and is characterized by maintenance operations (such as a major overhaul or rehabilitation) requiring skills, parts, supplies, and tools of industrial caliber.

3. Maintenance operations.—Efficient maintenance dictates that the various maintenance operations which must be performed on crypto-equipment be allocated normally within certain organizational levels as outlined in the system described above. However, the level at which any given operation is performed will be influenced by the tactical situation, nature of repairs, time available, skill of maintenance personnel, and availability of tools and parts. When maintenance operations normally performed at a particular level cannot be performed there because of any of these factors, maintenance service will be requested from an organization capable of performing higher echelon maintenance.

4. Maintenance instructions.—Instructions for all echelons of maintenance for the various kinds of crypto-equipment will be found

in the registered documents pertaining to maintenance which are issued by the Army Security Agency to all custodians of the crypto-equipment concerned.

5. Responsibility.—*a.* Commanders will hold officers or other supervisory personnel in charge of operation of crypto-equipment responsible that instructions and procedures for preventive maintenance operations published in maintenance manuals are strictly followed.

b. It is the responsibility of the officer in charge of the operation of crypto-equipment to prevent the abuse of equipment under his control. Evidence of abuse will be investigated and appropriate action taken thereon. Some common abuses are—

(1) Improper, careless, or negligent usage or operation of crypto-equipment.
(2) Lack of lubrication, over-lubrication, or use of unauthorized lubricants.
(3) Lack of inspections.
(4) Deferred maintenance, including lack of proper servicing and adjustments.
(5) The attempting of repairs by unqualified personnel or by the use of improper or inadequate tools and equipment.

6. Requisitioning.—Replacement parts for crypto-equipment may be requisitioned from the appropriate command Army Security Agency headquarters or direct from the Chief, Army Security Agency, Washington 25, D. C., Attention: CSGAS–85. Spare parts lists for equipment supplied by the Army Security Agency are published in the maintenance manuals furnished with the equipment. Specific instructions pertaining to the requisitioning of maintenance spare parts are contained in CSGAS–85 letters published from time to time on the subject of requisitioning maintenance spare parts for crypto-equipment issued by Army Security Agency.

[AG 311.5 (14 Mar 49)]

BY ORDER OF THE SECRETARY OF THE ARMY:

OFFICIAL:
EDWARD F. WITSELL
Major General
The Adjutant General

OMAR N. BRADLEY
Chief of Staff, United States Army

DISTRIBUTION:
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GS USA (5); SS USA (2); Adm Sv (2); Tech Sv (2); except 11 (25); ASA (800); AFF (10); OS Maj Comd (25); Base Comd (10); MDW (10); A (ZI) (10); C & GSC (5); Dep 11 (5).
Air Force:
USAF (10)
For explanation of distribution formula, see SR 310–90–1.

U. S. GOVERNMENT PRINTING OFFICE: 1949 O - 830775

~~CONFIDENTIAL~~

TAB W

Service Record Card (short title: SIGGOEM)

for

Converter M-134-C

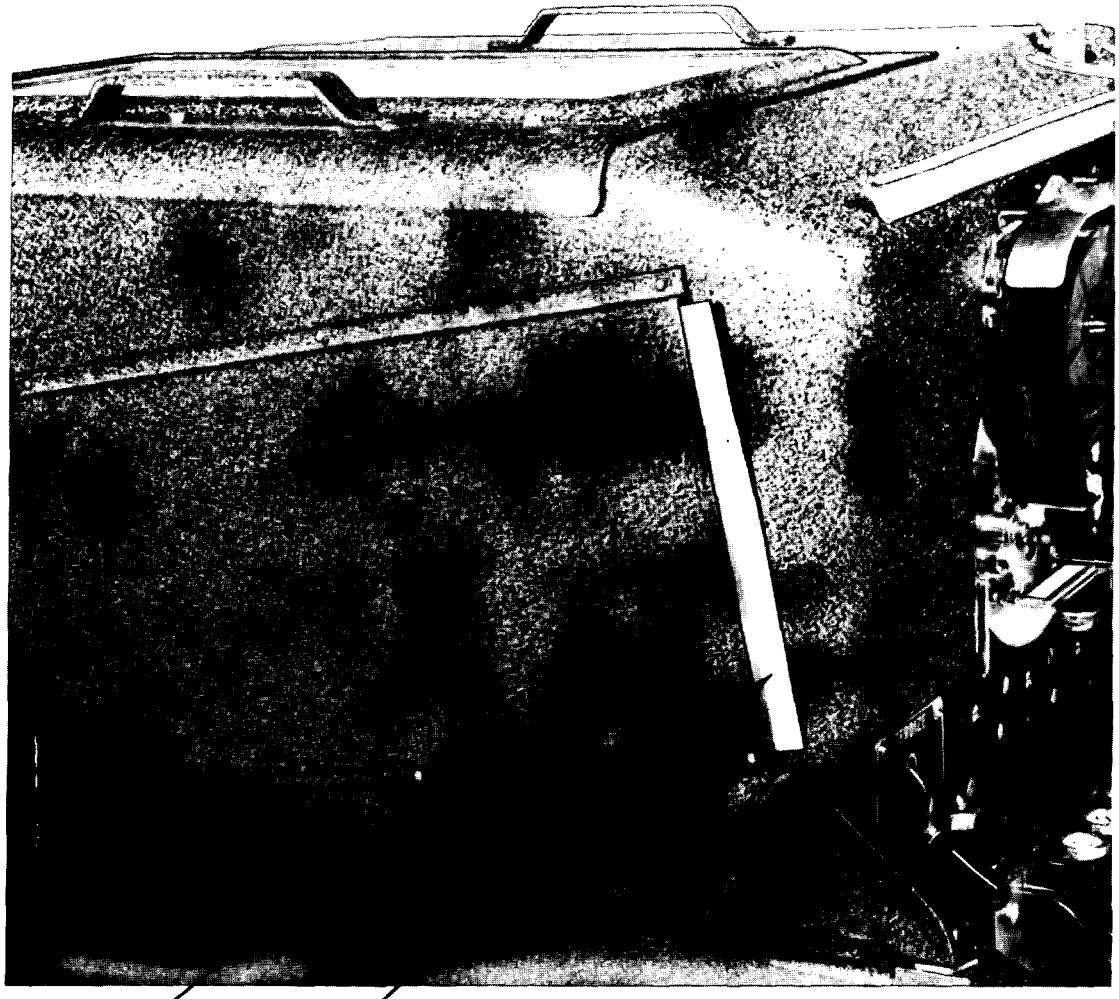


FIG. 14

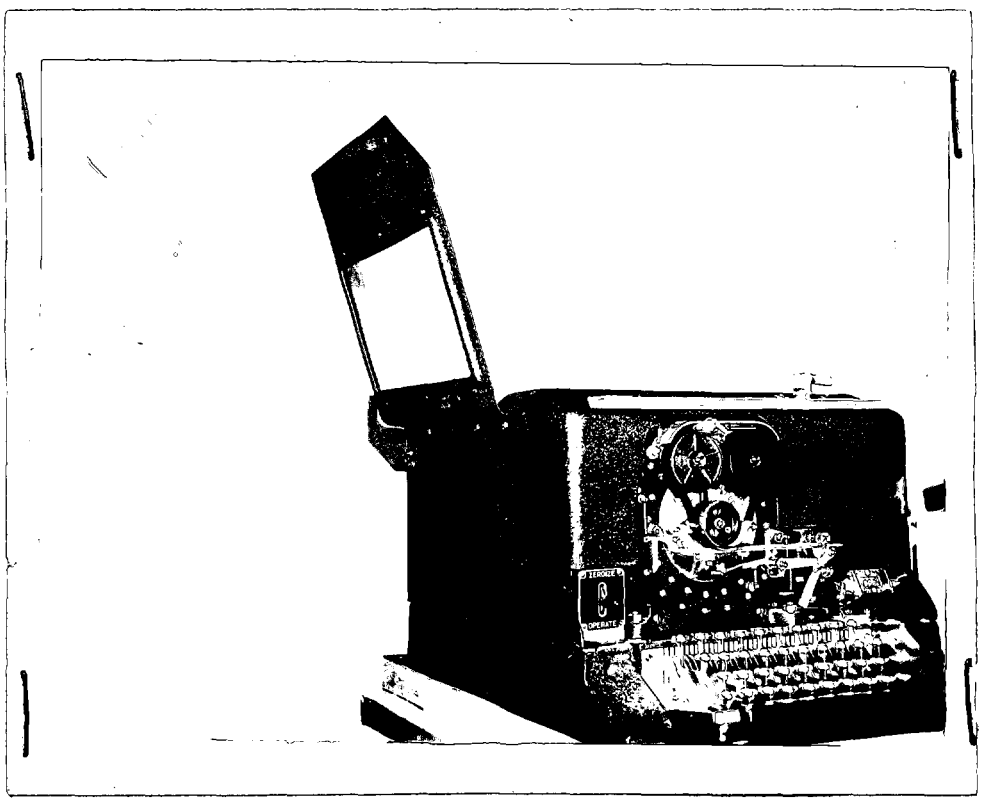
67. Service record card
68. Service record frame

TAB X

Photograph of Converter M-134-C

showing Hinged Cover

For explanation, see Chapter XVII, Section G.


TERROR
B
OPERATE